HYDRAULIC RESEARCH in the UNITED STATES

Waterways Experiment Station, Vicksburg, Mississippi
Memphis Harbor Model—Mississippi River

U. S. DEPARTMENT OF COMMERCE
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National Hydraulic Laboratory
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HYDRAULIC RESEARCH IN THE UNITED STATES

Edited by Florence L. Bain

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"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. The cooperation of these agencies is greatly appreciated. It is our aim to make this as complete a summary as possible of hydraulic research now in progress in the United States, as well as research which has been completed since the last bulletin was issued. Therefore the editor will appreciate receiving names of agencies and information on research projects which have been omitted, so that they may be included in future issues.

Projects are reported under the two general headings, "Current Projects" and "Completed Projects". The first group includes all work now in progress; the second group, work completed since the issuance of Volume XI. Short abstracts of published reports are included in some instances. A list of foreign publications and translations which may be obtained on a loan basis, a list of active committees, and short notes of general interest concerning activities of hydraulic laboratories are also given.

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 last year, and numbers assigned to continuing projects prior to 1947 are now discontinued. Numbers commencing with 271 refer to projects which are reported for the first time in this issue. References to publications which have appeared in earlier editions are not repeated unless such repetition is necessary for an understanding of the project report.

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 (d) 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.

Volumes X and XI of the bulletin are available for general distribution. The supply of earlier issues is exhausted.

KEY TO PROJECTS

(a) Title of project.
(b) Project conducted for.
(c) Investigators.
(d) Correspondent.
(e) Nature of project.
(f) Purpose.
(g) Scope and method.
(h) Present status.
(i) Remarks.

HYDRAULIC RESEARCH IN THE UNITED STATES

CURRENT PROJECTS

THE BALDWIN LOCOMOTIVE WORKS, I. P. Morris Department, Eddystone, Pa.

Inquiries concerning Projects Nos. 271 to 273, incl., should be addressed to Mr. H. J. Davis, Supervisor of Hydraulic Laboratory, I. P. Morris Department, The Baldwin Locomotive Works, Eddystone, Pa.

(271) ADJUSTABLE AND FIXED BLADE PROPELLER TYPE TURBINE MODELS - EFFICIENCY, HORSEPOWER, CAVITATION, AND RUNAWAY SPEED TESTS.

(b) Laboratory project.

(c) R. B. Willi, Supervising Engineer; H. J. Davis, Supervisor of Hydraulic Laboratory.

(e) Experimental research in connection with future design.

(f) To modify existing designs and to obtain new designs with the view of improving overall turbine performance.

(g) Runners of various designs in combination with different turbine settings are being tested in a closed flume, the hydraulic gradient of which may be raised or lowered to simulate the operating conditions of a commercial prototype. All parts of the turbine are precise scale models of the proposed field unit, the runners having a throat diameter of 11 inches. Numerous tests are made to obtain complete efficiency, horsepower, cavitation, and runaway speed data for all ranges of speeds, heads, and plant sigmas. This requires operating the model for the many combinations of gate openings and runner blade angles at various speeds and under variable hydraulic gradients.

(h) Tests are in progress.

(272) FRANCIS TYPE TURBINE MODEL - EFFICIENCY, HORSEPOWER, CAVITATION, AND RUNAWAY SPEED TESTS.

(b) New York Power & Light Corporation - Stewart Bridge Project.

(c) R. B. Willi, Supervising Engineer; H. J. Davis, Supervisor of Hydraulic Laboratory.

(e) Experimental research in connection with design of turbine for New York Power & Light Corporation.

(f) To develop a runner of improved design for application to a set of specific conditions (Stewart Bridge Project).

(g) Drawing board design of runner is often modified after careful analysis of model test results, with the view of obtaining possible improvements in performance. The runner model, 11 inches in diameter, is tested in a closed flume, the hydraulic gradient of which may be raised or lowered to simulate the operating conditions in the field. Tests are made to obtain data on efficiency, horsepower, cavitation, and runaway speed for the range of heads and tailwater elevations analogous to the conditions under which the prototype will have to operate. Several modifications of the runner model are sometimes indicated before the optimum design can be determined.

(h) Model is being constructed. Tests will be in progress in the early part of 1948.

(273) MICROPHONIC PICKUP EXPERIMENTS - DETECTION OF THE OCCURRENCE OF CAVITATION IN HYDRAULIC TURBINE MODELS.

(b) Laboratory project.

(c) R. B. Willi, Supervising Engineer; H. J. Davis, Supervisor of Hydraulic Laboratory.

(e) Experimental research in connection with future design.

(f) To devise a supplementary method of detecting the initial occurrence of cavitation in hydraulic turbine models which will simplify and shorten the tests now required.

(g) These experiments are made with the aid of sensitive microphonic pickups so located as to be actuated by the fluctuating pressure waves induced by the high frequency collapse of vapor pockets in the cavitation regions of the turbine model. Various types of pickups have been tested, two of these showing signs of having the required characteristics. The signals from these pickups are transmitted to an oscillograph screen where the wave forms may be studied, and to an electronic voltmeter which records quantitatively the wave intensity.

(h) Tests are in progress.

POLYTECHNIC INSTITUTE OF BROOKLYN, Brooklyn, N. Y.

Inquiries concerning Projects Nos. 274 to 278, incl., should be addressed to Dr. Chilton A. Wright, Professor of Hydraulic and Sanitary Engineering, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn, N. Y.

(274) STUDY OF LAMINAR AND TURBULENT FLOW OF OIL IN PIPES.

(b) Laboratory project. (c) Paul R. DeCicco.

(e) Experimental apparatus to study visual laminar and turbulent flow of oil in glass and brass pipe.

(f) To complete apparatus to be used by students in study of fluid flow in pipes; to conduct tests for determining the limit of the apparatus.

(g) The friction factors are determined from the flow of turbine oil in a glass and a brass pipe. The flow is measured by a meter and a Pitot tube. The oil is heated from room temperature to 130°F to vary its viscosity. Use of a Pitot tube in a by-pass line will allow determination of results for higher Reynolds numbers. The limit is now 4000.

(h) Tests have been run on 1-1/2-inch glass pipe. A brass pipe will be installed and further tests made. A search is being made for a suitable dye visible through the glass pipe.

(i) Previous theses: "Laminar and turbulent flow of oil." James Pue. MCE, June 1942.

"The study of laminar and turbulent flow of oil." Roy Schoenhaar. BCE, June 1946.

(275) STUDY OF SCOUR AT TOE OF GRAVITY DAM SPILLWAY.

(b) Laboratory project. (c) Herbert Korner.

(e) Thesis investigation of model of existing structure.

(f) To determine the actual scouring effect of water as it leaves the toe of a dam and further the design of a different toe section to reduce the scour.

(g) A model of an existing dam is being built of aluminum in a glass-walled flume 10 inches wide. A variety of bucket ends will be connected to the dam to observe the actual scouring effect on a sand bed following the model dam. Flow variations will show adaptability of design to other than maximum flow.

(h) Model under construction.

(276) VELOCITY DETERMINATION AT END OF PIPE LINES BY JET COORDINATES.

(b) Laboratory project. (c) Salvatore Fasciana.

(e) Experimental student thesis.

(f) To determine the velocity at the end of a pipe line as a means of measuring flow.

(g) The trajectory of the jet at the end of the pipe is to be observed against a grid and checked by photographs. The initial velocity (horizontal) will be computed from the jet coordinates. Flow will be determined by a calibrated weir. California pipe-line method of measurement as given in King's Handbook will be used.

(h) Grid is in place and ready for tests.

(277) PERFORMANCE OF A CENTRIFUGAL PUMP AS AFFECTED BY VISCOSITY.

(b) Laboratory project. (c) Frank C. LoGuidice.

(e) Student thesis to study pump performance and to construct apparatus for laboratory use.

(f) To study the capacity of the pump with liquids of various viscosities.

(g) Water and oils will be pumped into measuring tanks and power of pump determined. Viscosity change in oil is to be obtained by submerged heating unit. Input power to be calibrated and pressure heads measured by mercury level gages.

(h) Construction and adaptation of apparatus now under way.

(i) Thesis: "Effect of viscosity on pump performance." Frank C. LoGuidice. BME, June 1946.

(278) EFFECT OF ROUGHNESS OF FLUME SURFACES ON FLOW.

(b) Laboratory project. (c) M. Shamsuddin.

(e) Experimental graduate thesis and information on flow.

(f) To obtain information on flow in small flumes with artificial roughness.

(g) Small wooden flume 8 inches by 10 inches is to be constructed in laboratory and lined with sand and shellac. Flume to be set on various slopes and water surface elevation measured. Flow to be measured by Venturi meter.

(h) Now planning and constructing apparatus.

CALIFORNIA INSTITUTE OF TECHNOLOGY, Pasadena, Calif.

Inquiries concerning Projects Nos. 6 to 8, incl., and 11 should be addressed to Prof. Robert T. Knapp or Dr. Vito A. Vanoni, California Institute of Technology, Pasadena 4, Calif. Inquiries concerning Projects Nos. 15 to 17, incl., and 279 should be addressed to Prof. Robert T. Knapp, Director, Hydrodynamics Laboratory, California Institute of Technology, Pasadena 4, Calif.

(6) MECHANICS OF SUSPENDED LOAD TRANSPORTATION.

(b) Graduate student research. (c) V. A. Vanoni, Hassan Ismail.

(e) Basic experimental research.

(f) 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.

(h) The study is being continued.

(i) For details of experiments and results, see "Transportation of suspended sediment

by water." Vito A. Vanoni. Trans. A.S.C.E., Vol. III: 67-133. 1946.

(7) TRANSPORTATION OF BED MATERIAL LOAD.

(b) Graduate student research. (c) Vito A. Vanoni.

(e) Basic experimental research.

(f) To determine a general relationship between the rate of sediment movement by a stream and the hydraulic factors.

(g) The work is being carried out in flumes designed especially for sediment transportation studies.

(h) The work is proceeding as availability of personnel permits.

(8) DENSITY CURRENTS.

(b) Graduate student research. (c) R. T. Knapp.

(e) Basic experimental research.

(f) To investigate density currents resulting from suspensions of fine sediments in reservoirs and to establish principles governing their behavior.

(h) A continuing project.

(i) For recent results see "The effect of entrance mixing on the size of density currents in Shaver Lake", by Hugh Stevens Bell. Trans. American Geophysical Union, Vol. 28, No. 5: 780-791. October 1947.

(11) PIPE AND WIRE REVETMENT FOR STREAM CONTROL.

(b) Flood Control Surveys Division, Soil Conservation Service, U. S. Dept. of Agriculture.

(c) J. T. O'Brien, V. A. Vanoni.

(e) Field and laboratory investigation.

(f) To obtain information upon which to base improvements on the design of pipe and wire revetments for streams.

(g) The study will include field observations and investigations as well as laboratory experiments. The field studies will be conducted by observing existing installations of pipe and wire revetment in the intermittent streams of Southern California and the Southwest with a view to determining the action and the effect of the various components of a revetment system. This study will be aided by an analysis of whatever practical data on flows, failures, etc., may be available in the files of the agencies responsible for the installations. The laboratory program will be designed to determine the general behavior of this type of revetment and to evaluate any modifications which are suggested by the field study. Laboratory flumes are available for this study in which flows carrying high concentrations of sediment can be circulated.

(h) The investigation is completed except for report.

(12) INVESTIGATION OF WAVES AND SURGES IN THE APRA HARBOR, GUAM, MI.

(b) Bureau of Yards and Docks, U. S. Navy Dept.

(c) R. T. Knapp, W. O. Wagner, M. Meisels, J. T. O'Brien.

(d) Prof. Robert T. Knapp or W. O. Wagner, California Institute of Technology, Pasadena 4, Calif.

(e) Experimental project to obtain design information.

(f) To obtain information on the wave and current action in Apra Harbor that will serve to guide the development of the harbor by the U. S. Navy.

(g) Two models of the harbor have been built. A small model on the scale of 1:960 was built in an outdoor laboratory on the campus. A model with a scale of 1:360 has been built in a larger basin at Azusa, Calif. The larger basin is housed in an airplane hangar 140 feet by 160 feet. Both model basins are equipped with wave and surge machines to reproduce conditions observed in the field. Wave heights in the model are measured with special electric depth gages which record on an oscillograph, thus enabling wave amplitude surveys to be made of the entire model in a relatively short time.

(h) The work is nearing completion.

(i) The work is similar in nature to an investigation made by the Institute, during the war, of the Naval Harbor at Terminal Island. Many of the techniques being used now were developed in this study, which is covered in a report by Prof. Robert T. Knapp and Dr. Vito A. Vanoni entitled "Wave and surge studies for the Navy Base", Terminal Island, Calif., January 1945.

(15) STUDIES OF CAVITATION PHENOMENA.

(b) Bureau of Ordnance, U. S. Navy Dept. (c) R. T. Knapp, A. Hollander.

(e) Basic experimental research.

(f) To investigate the basic nature of cavitation phenomena.

(g) 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. With this information, 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 70 fps is available. Motion pictures have been taken at rates as high as 20,000 per second, and equipment is being developed for materially increasing this rate. A new tunnel has been constructed with the same size working section, but with a maximum speed of 100 fps. The new tunnel is unique in that provision is made to absorb air bubbles that are coming out of solution during cavitation before they are circulated so that the flow entering the working section will always be free from air. The tunnel also makes it possible to control the air content and to study its effect on cavitation.

(h) The project is progressing actively.

(i) For results on this program see "Laboratory investigations of the mechanism of cavitation", by Robert T. Knapp and A. Hollander. For description of the water tunnel used in the studies see "The Hydrodynamics Laboratory of the California Institute of Technology",by Robert T. Knapp, Joseph Levy, J. P. O'Neill, and F. Barton Brown. These papers were presented to the annual meeting of the American Society of Mechanical Engineers at Atlantic City, December 1947. Some of the photographic techniques used are contained in the publication by Hugh Stevens Bell entitled "Photographic techniques in experimental hydraulics", Proc. of the Third Hydraulics Conference, Bulletin 31, University of Iowa Studies in Engineering, pp 59-78, 1947.

(16) HYDRODYNAMIC FORCES ON SUBMERGED BODIES.

(b) Bureau of Ordnance, U. S. Navy Dept.

(c) R. T. Knapp, J. Levy, G. B. Robison, Haskell Shapiro, J. P. O'Neill, F. Barton Brown, J. Kaye.

(e) Basic laboratory research.

(f) To develop basic concepts and information that will permit the prediction of the dynamic behavior of bodies moving in a fluid.

(g) 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. Three major pieces of apparatus are available for this type of study. The first is a 14-inch diameter high speed water tunnel with a maximum velocity of 100 fps, and

the second is a free surface water tunnel with a working section of 20 inches by 20 inches in cross-section and with a maximum velocity of about 30 fps. This apparatus is particularly suitable for determining the effect of a free surface on the dynamic forces on a submerged body. Both of these tunnels also have controlled pressure which makes it possible to study cavitation and its effect on forces. The third apparatus is 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. The pressure of the air over the water can be controlled and its effect on the behavior of bodies during water entry studied.

(h) The project is proceeding actively.

(i) For a description of the apparatus used see "The Hydrodynamics Laboratory of the California Institute of Technology", by Robert T. Knapp, Joseph Levy, J. P. O'Neill, and F. Barton Brown, presented at the annual meeting of the American Society of Mechanical Engineers at Atlantic City, December 1947.

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

(b) Bureau of Ordnance, U. S. Navy Dept. (c) R. T. Knapp, E. G. Baird.

(e) Basic experimental research.

(f) 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.

(g) 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.

(h) The project is progressing actively.

(i) The results of the work to date are given in report N-54 of the Hydrodynamics Laboratory entitled "Progress report of the analogy between surface shock waves and liquids and shocks in compressible gases", by H. A. Einstein and Earl G. Baird.

(279) FLOW IN ROTATING CHANNELS.

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

(c) R. T. Knapp and A. Hollander.

(e) Basic research.

(f) To study the basic laws governing flow in rotating channels with a view to applying the results to the design of hydraulic machinery.

(g) Special apparatus that is cheap to operate and versatile in nature is being constructed with which to make detailed observations of the flow in rotating channels of different types over a wide range of operating conditions. One of the principal features of the apparatus is that it permits the determination of characteristics of individual components of hydraulic machinery (pumps and turbines). These characteristics will then be used to predict the behavior of a complete machine made up of two or more individual components. The flow pattern will be determined by means of observations with Pitot tubes and photography. The range of operation will cover cavitating and non-cavitating conditions.

(h) The principal apparatus has been designed and is now being constructed.

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

Inquiries concerning Projects Nos. 19 to 24, incl., should be addressed to Prof. F. J. Veihmeyer, College of Agriculture, Division of Irrigation, Davis, Calif.

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

(b) California Agricultural Experiment Station.

(c) L. D. Doneen, R. M. Hagan, A. H. Hendrickson, F. J. Veihmeyer.

(e) Experiment Station project.

(f) The work under this project is now designed to determine the ability of plants to survive and extract water under water-logged conditions.

(g) The tank equipment described in previous reports is still being used. The investigations have been enlarged, however, to study the diffusion of gases through soils under various soil-moisture conditions.

(h) Project is in active status.

(20) MOVEMENT OF WATER THROUGH SOILS.

(b) California Agricultural Experiment Station.

(c) L. D. Doneen, R. M. Hagan, A. H. Hendrickson, C. N. Johnston, F. J. Veihmeyer.

(e) Experiment Station project. Part of project on principles of soil moisture in relation to irrigation.

(f) The movement of water through soils is studied under various conditions and the ability of the soil to supply water to plants through capillary movement.

(g) Field and laboratory equipment is being used for these studies.

(h) Investigations are in active status.

(i) "Soil density as a factor in determining the permanent wilting percentage." F. J. Veihmeyer and A. H. Hendrickson. Soil Science 62(6): 451-456. December 1946.

(21) STUDY OF HYDRAULICS OF SPRINKLING SYSTEMS.

(b) California Agricultural Experiment Station.

(c) J. B. Brown, C. N. Johnston.

(e) Experiment Station project. This is part of a larger project on the improvement of farm irrigation systems.

(f) Determination of the characteristics of jets and the distribution of water from sprinklers.

(g) Facilities in hydraulic laboratory are being used for the study of reaction of jets.

(h) Project is in active status.

(i) "Irrigation sprinkler characteristics." C. N. Johnston. Agr. Engin. 28(4): 160-163. April 1947.

(22) STUDY OF THERMODYNAMICS OF SOIL MOISTURE.

(b) California Agricultural Experiment Station.

(c) R. M. Hagan, A. H. Hendrickson, C. N. Johnston, F. J. Veihmeyer.

(e) Experiment Station project.

(f) Studies are being made of methods of measuring soil-moisture and the ability of

soil to supply water to plants.

(g) To determine the availability of water to plants.

(h) Project is in active status.

(i) "Emergence and rate of emergence of sugar beet seed as influenced by seed preparation, soil moisture, and temperature." L. D. Leach, Roy Bainer, and L. D. Doneen. Proc. Amer. Soc. Sugar Beet Tech., 4th General Meeting: 107-116. 1946.

"Unnecessary irrigation as an added expense in the production of prunes." A. H. Hendrickson and F. J. Veihmeyer. Amer. Soc. Hort. Sci. 48: 43-47. 1946.

"Seed-bed preparation and cultivation for sugar beets." L. D. Doneen. California Agr. Exp. Sta. Bul. 701. July 1947.

(23) HYDRAULICS OF IRRIGATION SUPPLIES IN CALIFORNIA.

(b) California Agricultural Experiment Station.

(c) M. R. Huberty, C. N. Johnston, A. F. Pillsbury, V. H. Scott, F. J. Veihmeyer.

(e) Experiment Station project.

(f) The effects of denudation of watersheds upon the water regimen of typical grazing areas in California are being studied.

(g) Experimental plots and small watersheds have been equipped with measuring devices. These experiments are being conducted under various conditions of soil, topography, and vegetation in Northern and Central California. Additional experimental plots and watersheds have been established during the year.

(h) Project is in active status.

(i) "A resume of the results of the measurements of runoff, erosion, and soil moisture from vegetated and denuded plots in Shasta, Tehama, Lake, and Mendocino Counties, California", prepared by F. J. Veihmeyer, member of the Committee on Range Land Utilization, University of California. January 1, 1947. Mimeographed report, 11 pages, available upon request.

See also Project No. 27, "Hydrological Effects of Range Management Practices", University of California, Division of Irrigation and Soils, Los Angeles, Calif., page 9.

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

(b) California Agricultural Experiment Station.

(c) J. B. Brown, C. N. Johnston. (e) Experiment Station project.

(f) To develop and improve the design of water-measuring devices and to provide inexpensive means of determining rates of flow.

(g) Facilities of a well-equipped hydraulic laboratory are being used.

(h) Project is in active status.

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

(b) California Agricultural Experiment Station.

(c) L. D. Doneen, M. R. Huberty, A. F. Pillsbury, F. J. Veihmeyer.

(d) Prof. M. R. Huberty, University of California, Los Angeles 24, Calif.; or Prof. F. J. Veihmeyer, College of Agriculture, Davis, Calif.

(e) Experiment Station project.

(f) To study factors affecting soil infiltration rates with particular reference to the quality of irrigation water.

(g) Numerous investigations in the field and laboratory are being conducted.

(h) Project is in active status.

(i) "Quality of Kern County irrigation water." L. D. Doneen and J. D. Axtell. Calif. Agr. Exten. Service, U.S.D.A., and Kern County, Calif., cooperating. May 1947. 7 pages, multilith.

"Progress report on water penetration studies in Kern County." J. D. Axtell, M. A. Lindsay, and L. D. Doneen. Calif. Agr. Exten. Service, U.S.D.A., and Kern County, Calif., cooperating. July 1947. 11 pages, multilith.

See also Project No. 28, "Physical and Chemical Factors Affecting Soil Permeability", University of California, Division of Irrigation and Soils, Los Angeles, Calif., page 10.

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

Inquiries concerning Projects Nos. 26 to 28, incl., should be addressed to Prof. M. R. Huberty, University of California, Los Angeles 24, Calif.

(26) DRAINAGE INVESTIGATIONS IN COACHELLA VALLEY, CALIFORNIA.

(b) Present work cooperative between Coachella Valley County Water District, Coachella, Calif.; Regional Salinity Laboratory, U. S. Dept. of Agriculture, Riverside, Calif.; U. S. Bureau of Reclamation, Region III, Boulder City, Nev.; and University of California, College of Agriculture, Los Angeles, Calif.

(c) J. H. Snyder (for the District), H. E. Hayward (for the Regional Salinity Laboratory), C. L. Sweet (for the Bureau of Reclamation), M. R. Huberty and A. F. Pillsbury (for the University).

(e) Experiments on which to base future design.

(f) Drainage problems are anticipated to develop with the advent of Colorado River water for irrigation in the Valley. Purpose of investigation is to establish nature of and changes in the shallow ground water regime; to establish the horizontal and vertical permeability of the various strata within about 100 feet of the surface; and to establish the most feasible drainage methods with essential design information on each.

(g) On a grid network over the trough of the valley, a network of piezometers (observation wells) is being established. At each location, piezometers will be placed to tap each of the various independent acting aquifers found, the nature of the strata will be logged, and piezometric surfaces will be periodically measured.

(h) Two drainage wells have been installed and studied. A continuing project.

(i) "Installing ground-water piezometers by jetting for drainage investigations." A. F. Pillsbury and J. E. Christiansen. Agr. Engin., Vol. 28, No. 9: 409-410. September 1947.

(27) HYDROLOGICAL EFFECTS OF RANGE MANAGEMENT PRACTICES.

(b) Laboratory project, but coordinated with similar work by the Station under F. J. Veihmeyer at Davis, Calif.

(c) A. F. Pillsbury. (e) Experimental work.

(f) To evaluate the effects of brush burning for the purpose of promoting range forage on the infiltration and runoff of precipitation and on soil erosion in brush and brush grassland areas of Southern California.

(g) Plots and small watersheds are established on typical upland range land with two types of soil and two types of cover (chaparral and chamise) wherein runoff and erosion are measured. Plots and watersheds are established in pans to permit comparison of no-burning and burning, and as to the time any such effect persists. Comparative measurements of infiltration are made on burned over and unburned areas.

(h) A continuing project.

(i) Some data from these studies were reported in "Hydrologic aspects of burning brush and woodland grass ranges in California." Frank Adams, Paul A. Ewing, and Martin R. Huberty. Calif. Dept. of Natural Resources, Sacramento, Calif, 1947: 1-84.

See also Project No. 23, "Hydraulics of Irrigation Supplies in California", University of California, Division of Irrigation, Davis, Calif., page 8.

(28) PHYSICAL AND CHEMICAL FACTORS AFFECTING SOIL PERMEABILITY.

(b) Laboratory project. (c) M. R. Huberty, A. F. Pillsbury.

(e) General research project, but with practical applications in the fields of irrigation, drainage, and conservation stressed.

(f) To obtain factual data for the improvement of irrigation, drainage, and reclamation practices, and for the improvement of the efficiency of irrigation water conveyance and distribution.

(g) The work covers the general field of factors affecting permeability of soils and the forces involved, to some extent as regards saturated flow but mainly as regards unsaturated flow.

(h) A continuing project.

(i) "Factors influencing infiltration rates into Yolo loam." A. F. Pillsbury. Soil Science, 64: 171-181.

See also Project No. 25, "Physical and Chemical Factors Affecting Soil Infiltration Rates", University of California, College of Agriculture, Division of Irrigation, Davis, Calif., page 8.

(29) FARM IRRIGATION STRUCTURES.

(b) Laboratory project. (c) A. F. Pillsbury.

(d) Prof. A. F. Pillsbury, University of California, Los Angeles 24, Calif.

(e) Experiment Station project.

(f) Improvement in the design and operating performance of farm pipe lines, control structures, and sprinkler systems.

(g) Laboratory investigation of factors affecting failure of plain concrete irrigation pipe lines, being primarily a study of the factors affecting expansion coefficients of the pipe, field testing of various devices for automatically controlling flow in concrete irrigation pipe lines; field and laboratory tests of the operating characteristics of sprinklers as regards distribution patterns and hydraulic efficiency; and field tests of the hydraulic characteristics of multiple sprinkler units.

(h) A continuing project.

UNIVERSITY OF CALIFORNIA, Department of Engineering, Fluid Mechanics Laboratory, Berkeley, Calif.

Inquiries concerning Projects Nos. 31, 32, 35 to 46, incl., and 280 to 284, incl., should be addressed to the Chairman, Department of Engineering, University of California, Berkeley 4, Calif.

(31) STUDIES IN FLOW THROUGH POROUS MEDIA.

(b) Laboratory investigation.

(c) K. S. Pister. (e) Graduate thesis.

(f) Measurement of the critical gradient which would exist at the toe of an earth fill dam or levee.

(g) Water is forced vertically upward through a pipe packed with various sands of known porosities. Critical escape gradient is noted when quicksand condition exists.

(h) Two theses completed. Testing in progress.

(32) INTERSECTING STREAMS IN USED CONDUITS.

(b) Laboratory investigation. (c) H. W. Iversen and others.

(e) Experimental and theoretical; graduate thesee.

(f) To determine the energy lose at the junction of pipes of various sizes, junction angles, and discharge ratios.

(g) Various welded junctions of 6-, 4-, and 2-inch pipes have been prepared and are being tested in a etandard arrangement to note energy losses as a function of the flow rates in each pipe. A special 2-inch plastic pipe junction has been prepared to obtain energy losses and to provide visual observation of the mixing process.

(h) Testing in progress. Theoretical and experimental work partially completed. Two theses completed.

(35) OSCILLATORY WAVES.

(b) Laboratory project. (c) R. L. Wiegel.

(e) Graduate thesie.

(f) To obtain experimental information on the details of oscillatory waves in shallow water.

(g) 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. Changee in wave characteristics when the waves pass over various types of bottom diecontinuities are studied.

(h) Work in progreee.

(i) "Oscillatory waves." J. W. Boucher. M.S. thesis, 1947.

(36) MODEL LAWS FOR HYDRAULIC STRUCTURES.

(b) Laboratory research. (c) A. J. Chan.

(e) Graduate thesie.

(f) To obtain experimental data for the design of models of hydraulic structuree.

(g) The effect of scale, absolute size and width, roughness, and other factors will be investigated in the laboratory channels which are available.

(h) Work in progrees.

(37) FLOW THROUGH LEVEES BY ELECTRIC ANALOGY.

(b) Laboratory project. (c) D. A. Bartley.

(e) Special study.

(f) To obtain experimental data for design purposee.

(g) Flow nete for typical levee sections will be prepared in the electric analogy tank.

(h) Work in progreee.

(38) STRUCTURES EXPOSED TO WAVE ACTION.

(b) Laboratory research. (c) J. H. Jones.

(e) Graduate thesis.

(f) To obtain experimental data for the design and location of such shore-protection works as groins, jetties, and bulkheads.

(g) Models of structures will be installed in the model basin and subjected to wave action. Variations will be made in groin spacing, wave characteristics, and sediment characteristics.

(h) Work in progress.

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

(b) Laboratory project. (c) J. A. Putnam, F. G. Miller.

(e) Experimental and theoretical research; Ph.D. and M.S. theses.

(f) 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.

(g) 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.

(h) Two M.S. theses completed; one Ph.D. and one M.S. thesis in progress.

(40) FLOW OF SOLID-GAS MIXTURE IN PIPES.

(b) Laboratory project. (c) L. Farbar.

(e) Experimental investigation to obtain design data.

(f) To determine pressure drop accompanying flow of air, containing large concentrations of ultra-fine solid particles (e.g., catalyst) through pipes, and to investigate problems of metering such mixtures.

(g) Recirculation of air and catalyst through piping containing one vertical run and two horizontal runs of different diameters. Catalyst to be metered gravimetrically as fed, air to be metered by standard nozzle.

(h) Apparatus designed and under construction.

(i) Some tentative empirical data under operating conditions available at local oil refineries.

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

(b) Laboratory project. (c) J. A. Putnam.

(e) Theoretical and experimental investigations; graduate theses.

(f) To determine the transition conditions under which the gas and/or liquid phases are flowing in viscous and/or turbulent motion or in slug flow for isothermal flow in horizontal and vertical pipes.

(g) 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.

(h) Some theoretical work is nearly completed. Apparatus is being reconstructed with a view to determining the above-stated objectives. Five graduate theses completed.

(42) UNSTEADY FLOW IN CONNECTING PIPES.

(b) Laboratory project. (c) R. G. Folsom.

(e) Theoretical and experimental investigation for general information.

(f) To develop calculation methods and charts for the solution of amplitude changes and phase shifts between the water elevations in two reservoirs connected by a long pipe.

(g) From theoretical considerations, a series of charts with dimensionless coordinates will be developed to give the amplitude and phase of the water surface elevation in a small gage well with respect to a large reservoir. Experimental data will be obtained from laboratory equipment and a study made of differences with respect to the theoretical values.

(h) Theoretical and experimental work in progress.

(43) A PITOT TUBE STANDARD FOR FLOW MEASUREMENT.

(b) In cooperation with Turbine Pump Manufacturers' Association.

(c) R. G. Folsom. (e) Design and experimental investigations.

(f) To develop a satisfactory Pitot tube and standard code for use in field testing of pumps.

(g) To design, construct, and calibrate a suitable Pitot tube and use it under a variety of conditions.

(h) Work in progress.

(i) A paper has been prepared, "Use of the pipe factor in quantity rate measurements", by R. G. Folsom and H. W. Iversen.

(44) THE SMALL WATER TUNNEL.

(b) Laboratory project. (c) R. G. Folsom, K. J. Bermel.

(e) Design and construction of experimental facilities.

(f) To provide laboratory facilities for studies on cavitation, ship propellers, current meters, etc.

(g) The design will include a measuring section of about 24 inches in diameter.

(h) Work in progress.

(45) PUMP TESTING LABORATORY.

(b) Laboratory project. (c) R. G. Folsom.

(e) Research in the general field of pumping liquids.

(f) To improve design methods and performance of pumps.

(g) Theoretical and experimental investigations.

(h) Work in progress.

(i) "Jet pumps with liquid drives." R. G. Folsom. Presented at Buffalo Regional Meeting of American Institute of Chemical Engineers, October 1, 1947.

The fundamental equations defining jet pump performance are presented. A summary is made of available theoretical and experimental data for jet pumps using a liquid drive jet to pump the same liquid, a different liquid, a mixture of solid particles with a liquid, or a gas. A new coordinate system is developed to present performance curves for liquid jet pumps which makes possible a prediction of the pump-operating point with any pipe line.

This summary points out the weak points in present knowledge about jet pump action. The mechanism of entrainment of the low-speed fluid stream by the high-speed jet when solid boundaries and pressure gradients are present and the action in the diffuser when liquid and gas are present require further

study. The demonstrated success of the treatment of the liquid self-entrainment pump indicates possible methods for future investigations of other types of jet pumps.

"Performance of liquid jets and jet pumps." R. G. Folsom and C. K. Ferguson. Presented at meeting of A.S.M.E. Process Industries and Hydraulic Divisions, at Los Angeles, November 4, 1947.

The jet pump is a simple device using the energy of a fluid from a high pressure source to pump another fluid. When both fluids are water or other liquid of low viscosity, the complete performance characteristics of the jet pump can be represented on a single graph. Performance curves for a typical jet pump are presented and examples for use for calculation of specific pipe problems are included. Possible application of jet pumps and free jets to blending or mixing operations in a large tank are discussed.

(46) STUDY OF VELOCITY AND TEMPERATURE FLUCTUATIONS IN FULLY DEVELOPED AXISYMMETRIC TURBULENT FLOW OF A LIQUID.

(b) Laboratory project. (c) L. M. Grossman.

(e) Graduate thesis. Experimental and theoretical investigation.

(f) To measure velocity components and temperatures in the turbulent flow of a liquid in a tube in order to explain the mechanism of transport phenomena in fully developed axisymmetric turbulence.

(g) Velocity fluctuations are determined by measuring the potentials induced in an electrolytic liquid cutting an A-C magnetic field, and temperatures by means of a sensitive thermocouple. Spatial correlation coefficients will be found, as well as the turbulence spectrum for liquid flow in a pipe, the object being the clarification of a nonisotropic turbulence theory for the axisymmetric case.

(h) Work in progress.

(47) GRAVITY WAVES AND RELATED PHENOMENON.

(b) Bureau of Ships, U. S. Navy Dept. (c) J. W. Johnson.

(d) Bureau of Ships, U. S. Navy Dept., Washington 25, D. C.

(e) A theoretical, laboratory, and field investigation on the generation and forecasting of waves, surf conditions, measurements of waves, etc.

(f) To develop methods of forecasting wind waves and swell, surf conditions, and beach changes; measurement of wave characteristics; and make laboratory and field investigations to provide experimental checks and other information.

(g) The wave channel, model basin, and other facilities are used in the laboratory investigations. The field party obtains information along the entire Pacific Coast and cooperates with Naval vessels in obtaining information at sea.

(h) Work in progress.

(i) Approximately 270 technical, laboratory, and progress reports have been submitted to the Navy since starting this work in June 1944. The following papers have been published during the past year:

"Wartime research on waves and surf." M. P. O'Brien and J. W. Johnson. The Military Engineer. June 1947.

A summary of the various phases of an extensive investigation on waves and surf is given. The work included means of forecasting waves, development of methods for making hydrographic surveys through the surf zone, development of instruments for measuring wave characteristics, and conducting laboratory and field observations on various phenomena. Many of these developments have wide peace-time application.

"The refraction of surface waves by currents." J. W. Johnson. Trans. American Geophysical Union, Vol. 20, No. 6: 867-874. December 1947.

When ocean waves, moving through still deep water, encounter a current, moving at an angle with the wave direction, the waves undergo a change in length,

steepness, and direction of travel. A theoretical development is given for these factors in terms of initial wave length and direction, and the magnitude of the current. Discussion is given of the action of a coastal current in affording protection against short period waves.

"Sub-surface pressures due to oscillatory waves." R. G. Folsom. Trans. American Geophysical Union, Vol. 28, No. 6: 875-881. December 1947.

Measurements of pressure variations with time at or near the ocean bottom provide a convenient means for determination of wave heights and periods. The wave characteristics are obtained from the pressure measurements through application of theoretical relationships associated with oscillatory waves. Laboratory experiments made to investigate the reliability of the theoretically determined correction factors indicate that the theoretical values result in wave heights about 10 percent lower than the corresponding measured values. A brief analysis of irregular waves is included.

(280) SEDIMENT TRANSPORT.

(b) Laboratory project. (c) H. A. Einstein, E. A. El-Samni.

(e) Theoretical and experimental investigation for general information.

(f) To determine hydraulic forces acting on particles at the surface of the bed.

(g) Measurement of the forces in a circulating flume and comparison with the theory.

(h) Work in progress.

(281) SCOUR BELOW DAMS.

(b) Laboratory project. (c) J. W. Johnson and E. A. El-Samni.

(f) To obtain data for determining the relationship between the dimensions of the scour hole below a dam, sediment characteristics, and the flow conditions.

(g) A high-velocity stream is established by permitting flow to pass under a gate in a glass-walled flume. Various materials are placed at the end of the apron and the dimensions of the scour hole are observed. Aprons of various slopes and various backwater conditions are tested.

(h) Work in progress.

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

(b) Sponsored by American Petroleum Institute.

(c) J. A. Putnam, R. W. Ravenscroft, A. D. K. Laird.

(e) Theoretical and experimental investigations; graduate theses.

(f) To determine the effect of rate of flow on relative permeability over a wide range of pressure gradient when all other variables are controlled. Macroscopic behavior to be investigated from microscopic point of view.

(g) Mixtures of water 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) Theoretical studies under way. Apparatus under construction.

(283) DIFFRACTION OF SURFACE WAVES.

(b) Laboratory project. (c) F. L. Blue, Jr.

(e) Graduate thesis.

(f) To obtain experimental data on the diffraction of waves at gaps in breakwaters.

(g) Experiments are conducted in a 6 ft by 12 ft tank equipped with a wave machine

and wave-measuring equipment. The changes in heights and direction of travel of waves in the lee of breakwaters will be investigated and compared with theory.

(h) Work in progress.

(284) MIXING OF TWO JETS IN A REGION OF PRESSURE GRADIENT.

(b) Laboratory project. (c) R. G. Folsom, C. K. Ferguson.

(e) Experimental investigation.

(f) To determine the boundary conditions suitable for assumptions for a theoretical investigation of the phenomenon.

(g) With air as the working fluid, approximately two-dimentional experiments will be made in a 5-inch by 40-inch channel. Pressure and velocity distributions will be measured.

(h) Test equipment is being fabricated.

UNIVERSITY OF CALIFORNIA, Department of Engineering, Los Angeles 24, Calif.

(48) FOG INVESTIGATION - FOG NOZZLE STUDIES.

(b) U. S. Forest Service. (c) E. H. Taylor, G. Young.

(d) Prof. L. M. K. Boelter, Dept. of Engineering, University of California, Los Angeles 24, Calif.

(e) Experimental project.

(f) To obtain specific information on the performance and behavior of certain commercially obtainable spray nozzles used in fire fighting.

(g) The immediate objective of this program is to provide data relative to the amount of water delivered at a number of predetermined pressures from a series of about one hundred test units. Information regarding the distribution of water within the spray is also obtained. This is done qualitatively by means of photographs and quantitatively by means of a specially designed sampling trap.

(h) Unpublished report completed and filed with the Arcadia Fire Control Equipment Development Center, U. S. Forest Service, Arcadia, Calif. Information regarding this report may be obtained through that office. The data are at present being re-analyzed for the purpose of publication.

THE UNIVERSITY OF SOUTHERN CALIFORNIA, Research Foundation for Cross-Connection Control, Los Angeles, Calif.

(49) RESEARCH FOUNDATION FOR CROSS-CONNECTION CONTROL.

(b) Laboratory project by University of Southern California.

(c) R. E. Vivian, K. C. Reynolds, and staff.

(d) Dr. Robert E. Vivian, Director, Research Foundation for Cross-Connection Control, The University of Southern California, University Park, Los Angeles 7, Calif.

(e) General experimental research.

(f) To supplement and evaluate existing information on mechanical backflow prevention devices operating under constant line pressure, to perform laboratory acceptance tests on all types of backflow prevention devices and water-using equipment, and related matters.

(g) Field investigation covering operation and maintenance of all types of backflow prevention devices installed in the United States. Development of standard technique for the testing of double check valve installations; establishment of standardized laboratory and field test procedures and minimum specification requirements for backflow prevention equipment; field and laboratory research on material corrosion and deterioration; supplemental research on vacuum conditions, pipe sizing, and corrosion; industrial and domestic water pollution problems in relation to cross-connection control and back-siphonage prevention; head losses in backflow prevention equipment; maintenance of minimum pressures in distribution systems, in relation to back-siphonage prevention and cross-connection control.

(h) Two years have been devoted to field and laboratory research. The laboratory has been approved as an official testing laboratory by the Los Angeles Department of Building and Safety and by the Western Plumbing Officials Association.

Paper No. 1. "Summary of field investigation and recommendations." May 23, 1947.

Paper No. 2. "Report to those interested in cross-connection control." September 17, 1947.

Paper No. 3. "Application and testing procedure." September 17, 1947.

Paper No. 4. "Definition of terms and general specifications for backflow prevention devices." September 17, 1947.

Papers will be prepared in the near future on field test procedure, installation and maintenance of backflow prevention devices, and other related subjects.

CARNEGIE INSTITUTE OF TECHNOLOGY, Department of Civil Engineering, Pittsburgh, Pa.

Inquiries concerning Projects Nos. 285 and 286 should be addressed to Prof. F. T. Mavis, Head, Dept. of Civil Engineering, Carnegie Institute of Technology, Pittsburgh 13, Pa.

(285) DISCHARGE FROM GEOMETRICALLY SIMILAR WEIR TANKS.

(b) Laboratory project. (c) F. T. Mavis, E. H. Miller.

(e) Graduate project.

(f) To determine the relationship of the calibration curves for geometrically similar triangular weir tanks for use in hydraulic laboratory design.

(g) Tests were conducted on weir tanks in which the dimensions were systematically varied and calibration curves compared for the same range of heads on the weir.

(h) In progress.

(286) EFFECTS OF END SILLS ON THE HYDRAULIC JUMP IN A RECTANGULAR CHANNEL.

(b) Laboratory project. (c) F. T. Mavis, L. M. Laushey.

(e) Graduate thesis.

(f) To determine the effect of an end sill in the formation of a hydraulic jump.

(g) Tailwater depths required to form a jump with various sills on the apron are found by experiment and compared with depths required without a sill.

(h) In progress.

CASE INSTITUTE OF TECHNOLOGY, Warner Hydraulic Laboratory, Cleveland, O.

(400) HYDRAULIC MODEL STUDIES FOR THE SPILLWAY AND OUTLET WORKS OF MOUNT MORRIS DAM ON THE GENESEE RIVER AT MOUNT MORRIS, N. Y.

(b) Great Lakes Division of the Corps of Engineers, Buffalo District, Buffalo, N. Y. Work is being conducted in the Warner Hydraulic Laboratory, Case Institute of Technology, Cleveland, O.

For a complete report on this project, refer to Project No. 400, listed under Department of the Army, Corps of Engineers, Buffalo District, page 87.

COLORADO A & M COLLEGE, Fort Collins, Colo.

(52) HYDRAULIC SAND SEPARATOR.

(b) Laboratory project. (c) N. A. Christensen, Eugene Serr.

(d) Dr. N. A. Christensen, Colorado A & M College, Fort Collins, Colo.

(e) The project is a combined theoretical and experimental study which, if successful, will give data valuable in the design of hydraulic models.

(f) It is the object of this project to devise a method of classifying sand on a basis of fall velocity in water. If a method of doing this can be devised, it will then be possible to analyze sand samples into classes according to fall velocity, and finally to make up new samples scaled to any desired fall velocity.

(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.

(h) In progress.

(53) SAND TRAPS AND SLUICEWAYS.

(b) U. S. Soil Conservation Service, Colorado Agricultural Experiment Station, Colorado A & M College.

(c) R. L. Parshall.

(d) George D. Clyde, Chief, Division of Irrigation, Soil Conservation Service, College Hill, Box D, Logan, Utah; or R. L. Parshall, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(e) Experimental project for design purposes.

(f) To improve the efficienoy of present developed designs of sand traps using vortex tubes, riffles, and deflectors, alone or in combination. To perfect the design for sluiceways having a relatively flat grade which will efficiently transport the bed load material from sand traps to a point of disposal.

(g) Previous work with vortex tubes demonstrated their effectiveness when the length is less than sixteen feet. With length exceeding sixteen feet, effectiveness decreases. To provide designs for wide canals, lateral movement of bed load to vortex tubes by means of riffles and deflectors is being employed experimentally.

Models of moderate scaled dimensions will be constructed for observation and operated in either or both of the hydraulic laboratories at Fort Collins and Bellvue. Such models may be those of sand traps or sluiceways, separately or in conjunction. Depth, velocity, and discharge measurements will be observed

by appropriate methods. Bed load samples may be introduced and the recovery from the trap measured, volumetrically, to determine the efficiency of the device. The model sluiceway, when operated as an accessory, will be adjusted to such a minimum grade as to effectively carry away the trapped sample bed load. The sample introduced in such tests will vary from fine to coarse, and observations will also be made with anthracite coal as an approximate scaled medium of bed load.

(h) The investigations on the vortex tube with riffles and deflectors are practically complete. The problem of design of the traps for canals wider than sixteen feet has been solved, and it has now been shown that this principle can be used in canals up to 100 feet wide. The problem of developing the vortical flow in sluiceways is the next to be attacked. Preliminary investigations will begin on this problem in the very near future.

(54) MEASURING DEVICE AND INTEGRATING INSTRUMENT.

(b) U. S. Soil Conservation Service, Colorado Agricultural Experiment Station.

(c) R. L. Parshall, C. H. Rohwer.

(d) George D. Clyde, Chief, Division of Irrigation, Soil Conservation Service, College Hill, Box D, Logan, Utah; or Ralph L. Parshall, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(e) Experimental project for design purposes.

(f) To perfect a practical, efficient, and dependable combination measuring device and recording instrument, of simple design and construction, whereby farm delivery of irrigation water may be accurately measured and the total volume in acre-feet be totalized over any period of time. The instrument shall also be capable of indicating the rate of flow in cubic feet per second.

(g) To adapt the principle of measuring the rate of discharge underlying the adjustable tube orifice or develop the law of flow through a short tube, bell entrance, as the basis for designing and constructing the integrating instrument to be used exclusively in connection with the selected type of measuring device. This measuring device will be constructed as a full-sized structure, either of wood or concrete, and tests conducted either at Fort Collins or Bellvue laboratory, where the law of discharge will be determined. The tests on the measurement device will be rather limited because of previous work. The measurements to be made will be those ordinarily observed in conducting tests on hydraulic apparatus, such as depths, velocities, rate of discharge, and temperatures. Special apparatus will be built in the laboratory shop and tested to verify the limitations of the recording instrument. These observations made on the integrator may introduce such factors as time by an ordinary stop watch, temperature of water, ordinary thermometer, dye color in water stream, potassium permanganate, to ascertain the direction of flow and interference due to eddies and cross currents. Pyralin cylindrical chambers probably will be necessary to investigate the rotating action of the turbine that actuates the integrating mechanism of the instrument.

(h) Active.

(55) SNOW COURSE MEASUREMENTS AND FORECAST ANALYSIS.

(b) U. S. Soil Conservation Service, U. S. Bureau of Reclamation, State Engineer of Wyoming, State Engineer of New Mexico.

(c) H. Stockwell.

(d) Homer Stockwell, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(e) Systematic measurements of depths and water content of snow at high elevations in the mountain areas of Colorado for the purpose of forecasting the summer runoff of the main rivers of the state, in the interest of irrigation, power, domestic supplies, and other uses.

(f) To supply information as to the probable water supply for the coming irrigation season.

(g) Measurement of depth of the water content of snow along many permanently established snow courses is made systematically throughout the winter months. Data on other attending conditions affecting runoff are also gathered. These measurements are compared with similar data obtained in previous years, to establish a basis of forecasting probable spring and summer runoff.

(h) This is a continuous project with no plans for termination.

(i) See also Project No. 387, "Hydrology of Snow and Streamflow in Relation to Irrigation", Soil Conservation Service, Division of Irrigation, Logan, Utah, page 76.

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

(b) U. S. Soil Conservation Service, Colorado Agricultural Experiment Station, Colorado A & M College.

(c) C. H. Rohwer, W. E. Code.

(d) George D. Clyde, Chief, Division of Irrigation, Soil Conservation Service, College Hill, Box D, Logan, Utah; or Carl H. Rohwer, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(e) Experimental project for preparing designs of irrigation pumping plants.

(f) To determine the losses due to friction in strainers, suction pipe inlets, foot valves, gate valves, and check valves as a basis for choosing the proper type of these valves and assigning the correct losses for these fittings when designing an irrigation pumping plant. To prepare a report covering the results of these investigations and those previously made, so that information will be available to all who require it.

(g) Install different sizes of the valves to be tested in the Bellvue laboratory and measure the friction losses for various discharges in the range required for pumping plants by means of hook-gage readings. Measure the discharge through the valves with a standard weir. Compute the results and plot them on logarithmic paper. Re-run tests that are shown to be in error by the plot. Take pictures of the valves and the settings. Prepare sketches of the fittings, showing dimensions. When the tests have been completed, assemble the data, compute the results, and prepare a report.

(h) Laboratory work has been completed, and the data assembled are being analyzed. A report will be prepared for publication as a bulletin of the Colorado Agricultural Experiment Station. This should be available in the latter half of 1948.

(57) PHOTOGRAPHIC METHODS OF MAKING SNOW SURVEYS.

(b) Laboratory project. (c) Maxwell Parshall.

(d) Maxwell Parshall, Colorado A & M College, Fort Collins, Colo.

(e) An experimental project for general information.

(f) To design a more simple, quick, and economical method of snow surveying.

(g) A telephoto is made of a portion of a high mountain watershed. The percentage of area covered with snow is compared to the water content of the snow as determined contemporaneously in the vicinity by the standard method of snow surveying. The possibility of a correlation between the two factors is being investigated.

(h) Data are still being obtained. The project will be continued over a period of years to determine its reliability. However, a comparison of this method of snow surveying with the standard methods now being used, over the last seven years, indicates that the photographic method yields data suitable for forecasting equal in accuracy and value to that obtained from the standard methods. These data are being assembled and will be included in a report to be issued during 1948.

(287) PERFORMANCE TESTS OF WELL SCREENS.

(b) Cooperative project, Colorado Agricultural Experiment Station, U. S. Soil

Conservation Service, and various well-screen manufacturers.

(c) C. H. Rohwer, M. L. Albertson.

(d) George D. Clyde, Chief, Division of Irrigation, Soil Conservation Service, College Hill, Box D, Logan, Utah; or Carl H. Rohwer, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(e) Experimental project to supply information for design, use, and installation of well screens.

(f) (1) To measure the 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) To determine the size of opening in well screens, diameter of screen, thickness of gravel envelope, and size and gradation 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) To prepare a report covering the results of these investigations so that the necessary information will be available to well-screen manufacturers, well drillers, and farmers.

(g) (1) For determination of loss of head through screens in water -- install different sizes and types of screens with the sizes of openings desired in the channel at the Bellvue laboratory so that the depth of water surrounding the screen will be constant; install suction pipe similar to those used in irrigation wells inside screen; provide gages and connections for measuring level of water inside and outside of screen; measure the discharge through screen by means of accurately calibrated weir of proper size; and determine temperature of water for each test.

(2) For determination of loss of head through screens in sand or gravel -- conduct similar experiments with the screens installed in gravel of the desired size or gradation of sizes by surrounding screen with perforated casing five feet in diameter, or other suitable size, in which the chosen gravel will be placed; maintain a constant depth of water surrounding the large casing; and measure the head on the openings in the screen by means of piezometers.

(3) For making a study of combination of screen and gravel envelope for most effective control of flow of sand into well with smallest loss of head, install 36-inch screen, or other suitable size, inside of 5-foot perforated casing and around well-screen to be tested. Fill annular space between 36-inch screen and screen being tested with desired type of gravel envelope and annular space between 36-inch screen and 5-foot casing with fine sand. Determine loss of head as in (2).

(h) The equipment is being constructed and laboratory work will begin early in 1948.

(288) FLOW EXPANSIONS.

(b) Laboratory project. (c) J. E. Cermak, M. L. Albertson.

(d) Maurice L. Albertson, Associate Professor of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

(e) Experimental project for design and general information, being conducted as a series of student theses.

(f) To determine generalized curves for the energy loss and velocity distribution in various types of flow expansions.

(g) The initial phase of research is with pipes in which the energy loss and velocity distribution is measured in a truncated-cone type of pipe expansion for various angles of flare, various ratios of upstream and downstream pipe diameter, and various values of Reynolds number. The approach velocity profile is being varied from one extreme of parabolic to the other extreme of uniform. Further investigations of pipe expansions include studying the effect of rounding the transition, and the insertion of guide vanes to induce a spiral-type of flow. The second phase of research involves similar studies of flow through expansions in open channels.

(h) Equipment is being assembled and laboratory work will begin early in 1948.

COLUMBIA UNIVERSITY, Fluid Mechanics Laboratory, Department of Civil Engineering, New York, N. Y.

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

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

(b) Laboratory project.

(c) N. V. Feodoroff, Research Associate, under direction of Prof. Bakhmeteff, assisted by Mr. Agrawal.

(e) General theoretical and experimental research.

(f) To establish rational generalized expressions for permeability of porous beds consisting of grains of uniform or mixed size.

(g) 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.

(h) This project is being systematically worked upon.

(61) ELECTROMAGNETIC VELOMETER.

(b) Laboratory project.

(c) Dr. Oleg Yadoff, formerly of the Sorbonne, Paris, at present Research Associate, Civil Engineering, Columbia University.

(e) General theoretical and experimental research.

(f) 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.

(g) The approach is based on the method of applying the principle of electromagnetic induction, as suggested and developed by Dr. A. Kolin, Research Associate, who conducted the project from 1943 to 1945 under the general supervision of Prof. Bakhmeteff. The scope of research on this project has been extended to explore other different techniques, which would allow measurement of relatively low velocities near solid boundaries, as well as to record manifestation of turbulence.

(h) Work on this project is being revived.

(62) HYDRAULICS OF STRUCTURES.

(b) Laboratory project. Previously referred to as "Hydraulics of Short Flumes".

(c) N. V. Feodoroff.

(e) General theoretical and experimental research, and partly as subject matter for Master's thesis.

(g) The scope of this project has been expanded to embrace a wider set of problems relating to open surface flow. Research on the following special problems will start within the next few months: (1) Boundary layer regimen in intake reaches of open channels; (2) flow patterns over beds curved in the vertical plane; (3) flow patterns and energy annihilation at the foot of spillways, with double separation surfaces; and (4) effect of tailwater on flow regimen over spillways.

(h) Apparatus is in the course of construction, and details and personnel will be reported in the next issue of this Bulletin.

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

(b) Laboratory project.

(f) 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.

(h) Apparatus is in course of construction. Research work is planned to start within the next few months. Details and personnel will be reported in the next issue of this Bulletin.

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

(b) Laboratory project. (e) M.S. thesis in Civil Engineering.

(f) To establish rational forms for bell mouth entrances, and to investigate the boundary layer regimen in the outlet conduits.

(h) Apparatus is in course of construction. Research work is planned to start within the next few months. Details and personnel will be reported in the next issue of this Bulletin.

GEORGIA SCHOOL OF TECHNOLOGY, Civil Engineering Department, Atlanta, Ga.

Inquiries concerning Projects Nos. 291 to 295, incl., should be addressed to Prof. C. E. Kindsvater, Civil Engineering Dept., Georgia School of Technology, Atlanta, Ga.

(291) FLOW OF WATER OVER HIGHWAY EMBANKMENTS.

(b) Cooperative project, Georgia State Highway Department and Georgia School of Technology.

(c) R. A. Chapman, Jr., C. A. Marmelstein, Jr., C. E. Kindsvater.

(e) Experimental study with regard to highway embankments; theoretical study with regard to analogous broad-crested weirs.

(f) To study the scour and flow characteristics of a standard embankment section; to develop, if feasible, means of alleviating scour; to develop a general method of estimating the flow over a wide range of heads, including very high degrees of submergence.

(g) A 1:6 scale model is located in a 3-foot wide flume. Hook gages, point gage, and a micro-manometer are being used for head and profile measurements, a Pitot tube for velocity measurements, gravimetrically-calibrated weir for discharge measurements. Particular attention is being given to regions of unstable flow, beginning of submergence, velocity distributions, etc.

(h) Tests approximately 25 percent complete.

(292) SIMPLIFIED PITOT TUBES FOR HYDRAULIC LABORATORY APPLICATIONS.

(b) Laboratory project. (c) C. E. Kindsvater and student assistants.

(e) Experimental, for general application; part of a continuing program for improved instrumentation.

(f) To develop construction and application techniques for inexpensive but accurate Pitot, Pitot-static, and static tubes of small size.

(g) Tubes, 3/16-inch in outside diameter, of simplified design, have been developed for small-pipe application. Tip design based on results of NACA research

(Technical Note No. 546). Pipe connection gland developed from standard fittings. Preliminary tests indicate satisfactory results. Tubes of larger size are being constructed.

(h) Continuing study.

(i) "Simplified designs facilitate Pitot tube application to small pipes." Carl E. Kindsvater. Civil Engineering, November 1947, p 48.

See Project No. 293, "Friction Coefficients for Spiral-Weld Steel Pipe", immediately following.

(293) FRICTION COEFFICIENTS FOR SPIRAL-WELD STEEL PIPE.

(b) Laboratory project. (c) C. E. Kindsvater, G. J. Horocek.

(e) Experimental, for general information.

(f) To determine friction loss coefficients for a particular variety of galvanized, spiral-weld steel pipe with formed lap.

(g) Tests are presently limited to 6-inch ID size and velocities up to 15 fps. Pressures being measured by means of special static tubes. (See Project No. 292, "Simplified Pitot Tubes for Hydraulic Laboratory Applications", page 23.) Results are corrected to account for loss due to tubes themselves. Discharges are determined by weighing. Analysis is expected to yield information on absolute roughness for application to all sizes of this variety of pipe.

(h) Near completion. Analysis of data under way.

(i) When this variety of pipe was selected for laboratory piping system, dependable information on friction coefficients was not available.

(294) STANDARD FLANGED PIPE FITTINGS AS FLOW METERS.

(b) Laboratory project. (c) C. E. Kindsvater and student assistants.

(e) Experimental, for general information.

(f) To calibrate and correlate calibrations of several similar elbows and reducers used as bend meters, nozzles, and Venturi meters.

(g) A number of standard-radius and long-radius 6-inch diameter elbows, a 6-inch by 3-inch contracting elbow, two standard 6-inch by 3-inch smooth reducing nipples, and two special smooth reducers of longer length have been equipped with bronze wall taps. Tests are under way to calibrate the elbows as bend meters and various combinations of the reducers as nozzles and Venturi meters. Taps have been located in positions considered to be most desirable from the standpoint of practical application. All meters are designed to be self-contained, requiring no additional piezometer flanges, etc.

(h) Continuing study. Preliminary results indicate satisfactory consistency between calibrations of similar elbows. Taps located in reducers upstream from flange connections are insensitive to cavitation in Venturi throat.

(295) LOSSES IN EXTRUDED LUCITE TUBING.

(b) Laboratory project.

(c) C. E. Kindsvater, G. W. Burke, Jr., and student assistants.

(e) Experimental and theoretical, for general information.

(f) To determine coefficients of loss due to friction, sudden expansion, and sudden enlargement in 2-inch and 3-inch polished Lucite tubing.

(g) Flange-connected lengths of tubing are equipped with wall piezometers for pressure-loss measurements. Discharges are measured with calibrated Pitot tube. Velocities ranging up to 20 fps will be investigated, and the results will be correlated with existing information on extremely smooth pipe.

(h) Preliminary calibrations complete. Tests on 3-inch tubing under way.

ILLINOIS INSTITUTE OF TECHNOLOGY, Technology Center, Chicago 16, Ill.
(A consolidation of Armour Institute of Technology and Lewis Institute.)

(1) FLOW IN ARTIFICIALLY ROUGHENED PIPES.

(b) Laboratory project with support from Research Corporation and others.

(c) V. L. Streeter, O. E. Teichmann.

(d) Prof. V. L. Streeter, Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

(e) Fundamental investigation.

(f) To study relationship between friction factor, "f", and geometrical type roughness at fully developed turbulence using artificially roughened pipes.

(g) The pressure drop and velocity profile are determined for water flowing through pipes with a spiral groove of square profile (0.050-inch by 0.050-inch in a 4-inch pipe, 10 turns per inch) cut on the inside surface of the pipe. At least three geometrically similar roughnesses and various shapes of geometrically defined and reproducible roughnesses will be investigated.

(h) Apparatus is set up, and measurements on 4-inch pipe have started.

UNIVERSITY OF ILLINOIS, College of Engineering, Urbana, Ill.

Inquiries concerning Projects Nos. 64 and 297 should be addressed to Prof. F. B. Seely, Head, Department of Theoretical and Applied Mechanics, 214 Talbot Laboratory, University of Illinois, Urbana, Ill.

(64) THE BACKWATER PROFILE FOR STEADY FLOW IN OPEN CHANNELS.

(b) In cooperation with the Water Resources Branch of the U. S. Geological Survey.

(c) W. D. Mitchell and Prof. W. M. Lansford.

(e) Experimental study to obtain general information.

(f) To obtain information on backwater profiles under various conditions of roughness and for various channel cross-sections.

(g) A channel approximately 163 feet long is being used to study the effect of variations in roughness and in shape of cross-section on the backwater problem. Including the work done by Mitchell and Barron (See Vol. XI, p 100), about 40 profiles, type M-1, have been observed. Length of observed profiles averages about 500 feet. Discharges vary from about 1 cfs to 40 cfs. Cross-section varied from rectangular to a section simulating a wide flood plain. Bed slope 0.003 for all observations.

(h) Experiments completed; analysis of results being studied.

(437) THE BACKWATER PROFILE FOR STEADY FLOW IN UNIFORM CHANNELS, AND ITS SIGNIFICANCE IN THE STAGE-FALL-DISCHARGE RELATION.

For a complete report, refer to Project No. 437, listed under Geological Survey, page 124.

(297) FLOW THROUGH ANNULAR PIPES.

(b) Laboratory project and thesis.

(c) E. K. Frazier, W. M. Owen, Prof. W. M. Lansford.

(e) Theoretical and experimental.

(f) To obtain information on the flow through various size annular pipes.

(g) Experimental work will be studied and coordinated with an analytical analysis in an endeavor to solve the problem.

(h) Work is in progress.

(296) INVESTIGATION OF STORM DRAINS FOR EXPRESS HIGHWAYS.

(b) Illinois Division of Highways and U.S. Public Roads Administration.

(c) J. J. Doland and J. C. Guillou, Special Research Associate.

(d) Prof. James J. Doland, 317 Engineering Hall, University of Illinois, Urbana, Ill.

(e) Experimental project for general information.

(f) To determine hydraulic characteristics of all parts of a storm drain system, and to develop improvements over existing designs.

(g) 1:3 model of roadway cross-section with mountable gutter and gutter at edge of shoulder, inlets at lower end, tested for various rates of discharge on grades up to 6 percent, also with super-elevation and vertical curvature. Water admitted from upper end of gutter, along center line of roadway and along outside edge of shoulder gutter. Other models of inlet boxes, connecting pipes, junctions, and manholes will be tested (scale not determined). Bentonite models may be used to investigate velocity distribution in inlet basins.

(h) 1:3 model of roadway section is almost ready for operation. Work on other models not started.

(i) Investigation is intended initially to furnish design data for drainage system of depressed express highways in Chicago, but will be expanded to supply information for hydraulic design of storm drains on urban highways in general.

STATE UNIVERSITY OF IOWA, Iowa Institute of Hydraulic Research, Iowa City, Ia.

(66) HYDROLOGIC STUDIES - RALSTON CREEK WATERSHED.

(b) Cooperative project, Iowa Institute of Hydraulic Research, U. S. Dept. of Agriculture, U. S. Geological Survey.

(c) R. L. Smith.

(d) Prof. J. W. Howe, State University of Iowa, Iowa City, Ia.

(e) For general hydrologic information.

(f) Study of the relation between rainfall and runoff over a small area.

(g) Discharge from 3-square-mile area measured by U. S. Geological Survey; rainfall at five stations measured by the Soil Conservation Service by means of recording gages.

(h) Continuous records since 1924 of precipitation, runoff, groundwater levels, and vegetal cover.

(i) "Synthesis of the runoff hydrograph on Ralston Creek." M. R. Carstens. Master's thesis, State University of Iowa, June 1947.

(67) COOPERATIVE SURFACE WATER INVESTIGATIONS IN IOWA.

(b) Cooperative project between U. S. Geological Survey and Iowa Institute of Hydraulic Research.

(d) L. C. Crawford or Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(g) Standard methods on a state-wide basis.

(h) Gaging stations are maintained cooperatively and on a continuing basis.

(68) HYDROLOGIC STUDIES - RAPID CREEK WATERSHED.

(b) Cooperative project, Iowa Institute of Hydraulic Research, U. S. Dept. of Agriculture, U. S. Geological Survey.

(d) Prof. J. W. Howe, State University of Iowa, Iowa City, Ia.

(e) For general hydrologic information.

(f) Study of the relation between rainfall and runoff over a small area.

(g) Discharge from 25-square-mile area measured by U. S. Geological Survey; rainfall at five stations measured by the Soil Conservation Service by means of recording gages.

(h) Continuous records since 1941 of precipitation, runoff, groundwater levels, and vegetal cover.

(i) "A study of infiltration on Rapid Creek watershed." R. W. Moorman. Master's thesis, State University of Iowa, August 1947.

(69) RELATION OF SEDIMENT CHARACTERISTICS TO BED EROSION.

(b) Laboratory project. (c) E. M. Laursen.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Experimental project, for doctoral thesis.

(f) To evaluate the general relationship between geometric and kinematic parameters of flow and the mean size and grading of the bed material for an arbitrary condition of scour.

(g) Experiments to be conducted in glass-walled flume 3 feet deep and 1 foot wide. Arbitrary geometrical proportions are kept constant during all runs, the sole variables being the rate of flow, the mean diameter and standard deviation of the sediment, and the time and depth of scour.

(h) Equipment under construction.

(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.

(c) P. G. Hubbard, M. M. Hassan, A. H. Abul-Fetouh, and A. LeClerc.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Experimental.

(f) 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.

(g) Lucite models of various boundary forms, simulating a wedge-shaped section of the body of revolution, are provided with suitable electrical contacts and mounted in a copper sulphate bath. The voltage drop between successive contacts is determined by means of proper instrumentation and used as the basis for computing the velocity and pressure distributions along the boundary. Free-surface profiles are determined to satisfy the conditions of constant velocity or constant piezometric head along the surface.

(h) A preliminary report was submitted to the David Taylor Model Basin under the title "Exploratory tests on application of the three-dimensional electrical analogy", by P. G. Hubbard. Report No. 16. July 1947.

A doctoral thesis on nozzle studies by M. M. Hassan will be submitted in the spring of 1948. Studies of jet profiles by A. H. Abul-Fetouh and A. LeClerc are in progress.

(73) MEASUREMENT OF TURBULENCE IN FLOWING WATER.

(b) David Taylor Model Basin, U. S. Navy Dept.

(c) M. C. Boyer, P. G. Hubbard.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Experimental project.

(f) To develop practical instruments for the measurement of turbulence in flowing water.

(g) Electromagnetic and hot-wire devices and the effects of variation of electrical potential at a liquid-solid interface 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.

(h) Work continuing.

(i) "The measurement of velocity of flowing water by electrical methods." M. C. Boyer. Master's thesis, State University of Iowa, August 1947.

See Project No. 175, "Variable Pressure Water Tunnel - 60-inch", David Taylor Model Basin, page 131.

(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.

(c) W. D. Baines, H. K. Liu.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Experimental project, for master's theses.

(f) To provide information as to distribution of velocity and turbulence in two- and three-dimensional submerged jets.

(g) In the initial phase the velocity distribution in the air jet was studied as a function of longitudinal and lateral position, velocity of efflux, and size of outlet, and results were reduced to dimensionless relationships. In the second phase the distribution of turbulence is being studied in a similar manner. The third phase extends the problem to the diffusion of the flow from a submerged sluice gate.

(h) Work continuing.

(i) A paper entitled "Diffusion of submerged jets", by M. L. Albertson, Y. B. Dai, R. A. Jensen, and Hunter Rouse, has been accepted by the American Society of Civil Engineers for publication.

(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.

(c) C. S. Yih and members of the Institute staff.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Analytical and experimental.

(f) To provide general information as to flow characteristics (such as velocity pattern, distribution of turbulence, etc.) for relative motion between fluids of slightly different specific weight due to temperature, salinity, or suspended sediment.

(g) Studies involved characteristics of sub-surface waves, diffusion across an interface, and mixing due to gravitational convection.

(h) First phase was completed for the NDRC during the war; second phase was described in a master's thesis, "A study of the characteristics of gravity waves at a liquid interface", by C. S. Yih, State University of Iowa, February 1947; the

third phase was described in the paper "Gravitational diffusion from a boundary source in two-dimensional flow", by Hunter Rouse, Journal of Applied Mechanics, September 1947; a fourth phase, involving the patterns of mean flow and turbulence produced by a boundary source of heat under conditions of zero relative motion, is now being investigated by C. S. Yih as a doctoral thesis.

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

(b) Rio de Janeiro Tramway, Light, and Power Company, Ltd.

(c) E. M. Laursen, D. E. Metzler.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Experimental project.

(f) To determine means of diverting bed load of Paraiba River from intake forebay of four 40 cubic meters per second pumps. To study the discharge characteristics of tainter gates in dam across Paraiba River, constructed in connection with the pumping plant, and to determine best operation procedure for diversion of bed load past intake forebay.

(g) A model of a 1300-meter reach of the Paraiba River has been built of concrete at a 1:75 undistorted scale. Prevailing currents and sediment movement have been determined, and a sediment-diversion structure consisting of groins and walls about the intake forebay has been studied. A low dam for control of the water elevation and the passage of bed load and consisting of a series of tainter gates, has been constructed.

(h) Investigations of the flow conditions of the unimproved river and recommendations for improving the river and diverting the bed load have been completed. A half-model of one tainter gate, in 1:14 scale, is being installed in a 2.5-foot glass-walled channel for study of discharge characteristics. Comparison will be made with flow in the river model to determine gate-operation procedures.

(79) CAVITATION.

(b) Office of Naval Research. (c) E. Y. Hsu, C. A. Lamb, A. Spengo.

(d) Prof. J. S. McNown, State University of Iowa, Iowa City, Ia.

(e) Experimental project, supplemented by theoretical studies.

(f) To furnish basic design information on pressure distribution around systematically varied boundary forms under various degrees of cavitation.

(g) Tests are conducted in a 13-inch variable pressure water tunnel. Measurements are made, using 1-inch models to determine effect of variation of boundary form, Reynolds number, and degree of cavitation on the pressure distribution around two- and three-dimensional boundaries. The boundary forms being tested 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. Both open- and closed-throat test sections are used with the present tunnel, to compare the operational characteristics of the two and to provide flexibility. A second water tunnel is to be constructed for the study of two-dimensional forms.

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 to be continued in the closed throat of that water tunnel to obtain data for various combinations of slot dimensions and curvature of the downstream edge of the slot.

(h) A bulletin is essentially ready for publication, describing the preliminary tests and the results of measurements on various head forms at zero angle of yaw. Equipment has been constructed for studies at other yaw angles, and the extension of the study of boundary discontinuity is under way.

(i) Data collected under this project are discussed in the paper "Pressure distribution and cavitation on submerged boundaries", by J. S. McNown, Proc. Third Hydraulics Conference, University of Iowa Bulletin 31. See also "Fundamental

aspects of cavitation", by Hunter Rouse, Proc. Second Conference on Industrial Hydraulics, Illinois Institute of Technology.

"Cavitation at sluice-gate slots". A. H. Abul-Fetouh. Master's thesis, State University of Iowa, August 1947.

(80) TURBULENCE BEHIND SCREENS.

(b) Office of Naval Research. (c) E. G. Peterson and Institute staff.

(d) Prof. J. S. McNown, State University of Iowa, Iowa City, Ia.

(e) Experimental project.

(f) To study the energy losses due to flow through screens, and the scale, intensity, and rate of decay of the resulting turbulence.

(g) Screens are formed of bar lattices and of uniformly perforated plates with systematic variation of scale and area proportions. The pressure drop across these screens and the scale and intensity of the turbulence at various distances downstream are measured in a low-velocity air tunnel. The different techniques for measuring turbulence are: hot-wire anemometer, heat diffusion, and gas diffusion. A comparison of results in air and water is planned.

(h) Preliminary studies have been completed. The development of an instrument for more precise measurement of turbulence is under way. An investigation of the effect of screens upon inequalities of the velocity distribution is now being conducted.

(i) "Exploratory tests on flow through screens." J. S. McNown and M. L. Albertson, with D. R. Bianco, P. G. Hubbard, and E. G. Peterson. Report No. 15, prepared for the David Taylor Model Basin, April 1947.

See Project No. 175, "Variable Pressure Water Tunnel - 60-inch", David Taylor Model Basin, page 131.

(81) MATHEMATICAL ANALYSIS OF PRESSURE DISTRIBUTION.

(b) Laboratory project, combined with studies conducted for the David Taylor Model Basin, U. S. Navy Dept.

(c) E. Y. Hsu, C. S. Yih, A. Spengo.

(d) Prof. J. S. McNown, State University of Iowa, Iowa City, Ia.

(e) A theoretical analysis of flow around various boundary forms.

(f) To advance the application of analytical methods to design procedure and to obtain information on specific problems.

(g) 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, two-dimensional faired struts, and nozzle forms. The methods of hydrodynamics, including modifications of the approximate source-sink method presented by von Kármán, are utilized.

(h) Computations for wedge shapes of various angles and representative computations for several boundary forms have been completed. Three reports, which are in progress and should be available during 1948, will deal with adaptations of the von Kármán approximate method of determining pressure distribution, comparisons of the pressure distribution on two- and three-dimensional forms, and nozzle shapes.

(82) HYDRAULICS OF MANIFOLDS.

(b) Laboratory project, sponsored by the Committee on Hydraulic Research, Hydraulics Division, A.S.C.E.

(c) J. Escobar.

(d) Prof. J. S. McNown, State University of Iowa, Iowa City, Ia.

(e) Experimental studies conducted as theses by graduate students.

(f) To obtain a better understanding of divided and confluent flow, and to provide basic design information for inflow and outflow manifolds.

(g) Tests are being 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, for both divided and confluent flow. Piezometer connections along the three sections of pipe make possible the determination of the significant pressure changes. The effect of spacing in multiple lateral manifolds and the pattern of flow and pressure variation in the immediate vicinity of the junction are being studied.

(h) Studies of a single-lateral manifold with both divided and confluent flow have been completed. Studies of the flow pattern and the effect of lateral spacing are under way.

(i) "A study of diverging flow in pipe lines." J. R. Barton. Master's thesis, State University of Iowa, August 1946.

"A study of converging flow in pipe lines." S. M. Niaz. Master's thesis, State University of Iowa, June 1947.

Results of a similar study applied specifically to lock-manifold design are contained in "Lock manifold experiments", by Edward Soucek and E. W. Zelnick. Trans. A.S.C.E., Vol. 110: 1357. 1945.

(298) FALL VELOCITY OF SEDIMENT.

(b) Laboratory project. (c) S. M. Engez, J. Malaika.

(d) Prof. J. S. McNown, State University of Iowa, Iowa City, Ia.

(e) Experimental, for master's and doctoral theses.

(f) To determine the effect of coaxial cylindrical boundary, particle shape, and particle size and spacing on the fall velocity of regular shapes and of sediment samples.

(g) The settling velocities of spheres of various sizes along the axes of vertical cylinders of selected diameters and through fluids of different viscosities are being determined. Data have been obtained throughout the practical sediment range ($R<1{,}000$) by use of a thermostatically controlled bath and stroboscopic timing. Approximate theoretical analyses have been made which agree well with the experimental results within the Stokes range. Measurements are to be made of the effect of particle spacing, using clouds of uniform sediment. To be made also are measurements on a systematic series of particle shapes within a fixed Reynolds number range.

(h) The first series of experiments on the effect of coaxial cylindrical boundary are essentially complete, and experiments on the effects of particle shape have been started.

(i) "A modification of Stokes' law to account for boundary influence." H. M. Lee. Master's thesis, State University of Iowa, February 1942.

"Boundary influence on the fall velocity of spheres at Reynolds numbers beyond the Stokes range." M. B. McPherson. Master's thesis, State University of Iowa, August 1947.

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

(b) Laboratory project. (c) Ning Chien, Yin Feng, and H. J. Wang.

(d) Prof. J. W. Howe, State University of Iowa, Iowa City, Ia.

(e) Experimental, for master's thesis.

(f) To determine pressure distribution on three-dimensional building forms of various

proportions.

(g) Experiments in air tunnel; maximum wind velocities approximately 25 fps.

(h) Work in progress.

(300) INVESTIGATION OF THE VERTICAL-AXIS WATER VELOCITY METER.

(b) Laboratory project. (c) Erik Raestad.

(d) Prof. M. C. Boyer, State University of Iowa, Iowa City, Ia.

(e) Experimental, for master's thesis.

(f) Investigation of the effects of various sizes, shapes, and spacings of the rotating elements on the operation of the vertical-axis water velocity meter.

(g) Studies made by towing through still water and rotation in moving water of the stalling speed, frictional resistance, drag, etc., of the rotating elements. The Price meter studied in particular, by changing size, shape, and number of buckets on the rotor.

(h) Equipment being constructed.

(301) TESTS OF A MUSHROOM-TYPE SIPHON SPILLWAY.

(b) Laboratory project. (c) H. S. Chowdhary.

(d) Prof. C. J. Posey, State University of Iowa, Iowa City, Ia.

(e) Experimental, for master's thesis.

(f) To test the performance and attempt the improvement over existing design of a mushroom-type spillway developed by Ganesh Iyer in India.

(g) Model tests.

(h) Models and equipment being constructed and installed.

(302) SEDIMENT SIZE ANALYSIS BY MEANS OF UPWARD FLOW.

(b) Laboratory project. (c) H. J. Skidmore.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Experimental, for doctoral thesis.

(f) To investigate the feasibility of rapid size-frequency determinations by variation of pressure differentials occasioned by varying the rate of upward water flow through a dispersed sample.

(g) Regulated and increasing rates of flow are passed upward through a dispersed sample of sediment. As sediment having fall velocity less than velocity of flow is removed by the flow, pressure differentials over a section of the tube permit determination of sediment of each class removed, or conversely, net weight of sediment of greater fall velocity than the velocity of flow.

(h) Equipment assembled, check runs being made, and results compared with determinations as made by bottom-withdrawal method.

(193) (195) (196) (197) (198) CORPS OF ENGINEERS.

For report on projects being carried on at the Iowa Institute of Hydraulic Research by the Corps of Engineers, see Projects Nos. 193 and 195 to 198, incl., listed under Corps of Engineers, St. Paul District, pages 94 to 97.

LEHIGH UNIVERSITY, Department of Civil Engineering, Bethlehem, Pa.

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

(b) A.S.C.E. Sub-committee on Cavitation.

(c) Prof. M. B. McPherson and R. E. Crispen.

(d) Prof. W. J. Eney, Head, Dept. of Civil Engineering, Lehigh University, Bethlehem, Pa.

(e) Experimental determination of pressure variation as function of velocity head, magnitude of misalignment, and Froude number. An attempt will be made to correlate data with cavitation phenomena experiencee with hydraulic structures.

(f) An attempt to define misalignment tolerances for hydraulic structures.

(g) Pressure is measured along the bottom of an open channel in which a transveree step of variable height has been placed. Velocity and depth of flow, size and shape of stepe are varied.

(h) Tests in progress.

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

Inquiries concerning Projects Nos. 303 and 304 should be addressed to Prof. Glen N. Cox, Director, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge 3, La.

(303) A COMPARATIVE STUDY OF SECTOR GATES.

(b) Laboratory project. (c) E. Q. Moulton and W. M. Robbins.

(e) An experimental study for thesis of various types of sector gates and a comparison of one model with its prototype.

(f) To determine the limitatione and possibilities of this type of structure.

(g) A model lock will be constructed in which gates of varying proportions will be tested. It is hoped that a gate can be developed which will create a minimum turbulence during filling and emptying.

(h) Preliminary plans have been made, and construction of the model will begin during December 1947.

(304) ANALYSIS OF THE CAUSES OF SILT DEPOSITION IN CANALS IN THE LOWER ATCHAFALAYA BASIN AND PROPOSED METHODS OF EFFECTING ITS ELIMINATION.

(b) Laboratory project. (c) Charles Cohen and O. L. Fontenot.

(e) Experimental project for a student thesis.

(f) Barge canals in the Atchafalaya Basin suffer from severe silting, and it is the purpose of this study to develop means for eliminating or greatly reducing the quantity of material deposited in these canals.

(g) A model has been constructed, and powdered coal has been used as the sediment. Changes have been made at the outlets of the canals for a qualitative study.

(h) The qualitative etudy which has been completed indicates that a submerged sill will be quite effective in reducing the deposition. Plans are now going forward for a quantitative study.

(305) A STUDY OF A SEA HARBOR ON A SANDY COAST OF A BAY; WITH SPECIAL CONSIDERATION TO THE CONDITIONS OF CHAPU HARBOR ON THE EAST COAST OF CHINA.

(b) Laboratory project. (c) Pao-Chang Sun.

(d) Dr. V. Merkys, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge 3, La.

(e) Experimental study for student thesis.

(f) To provide information for the construction of harbors on sandy coasts.

(g) The study will include an analysis of data, and a model study of the advantageous location for the outer protective construction for the harbor.

(h) The preliminary study is under way, and the model will be constructed during December 1947.

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

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

(306) SCOUR AROUND PILE BRIDGE PIERS.

(b) Laboratory project. (c) R. D. King, L. E. Cox.

(e) Graduate research; experimental study.

(f) Qualitative study of scour patterns for various geometric arrangements of pile groups.

(g) A number of pile arrangements were tested in a small flume using the same bed material and the same flow conditions. By comparison of scour patterns a design was evolved which gave a minimum depth of scour for equilibrium conditions. The number of experiments was not sufficient to derive general conclusions.

(h) Limited study completed. Systematic further studies with different bed materials and flow conditions are to follow.

(i) "Scour around pile bridge piers." R. D. King and L. E. Cox. M.S. thesis, June 1947.

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

(b) Laboratory project, to be continued under sponsorship of the A.S.C.E. Research Committee.

(c) D. R. F. Harleman, E. Kuiper. (e) Theoretical and experimental project.

(f) Theoretical analysis of instability at interface of density flow. Laboratory studies of criteria for mixing.

(g) Comprehensive analysis of density flows on basis of gravity and inertia forces was compiled. Experimental study of underflow in reservoirs at equilibrium of gravity and viscous forces was carried out in a glass-walled tank.

(h) Incomplete, to be continued.

(i) "Characteristics of density currents." D. R. F. Harleman. M.S. thesis, June 1947.

"Sedimentation in storage reservoirs." E. Kuiper. M.S. thesis, June 1947.

(308) SUPERCRITICAL FLOW IN OPEN CHANNEL CONTRACTIONS.

(b) Laboratory project.

(c) M. P. Barschdorf, H. G. Woodbury, A. A. Stone.

(e) Theoretical and experimental projects.

(f) Theoretical analysis of standing wave patterns in open channel contractions and experimental verification.

(g) Experimental work has been carried out for limited range of Froude numbers in high velocity channel.

(h) Results have been compared to experiment, and the theoretical analysis has proved essentially correct.

(i) "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.

(309) CHARACTERISTICS OF OSCILLATORY WAVES.

(b) Laboratory project, to be continued under sponsorship of A.S.C.E. Research Committee.

(c) J. W. Daily, J. V. Allen, J. F. Michel.

(e) Basic experimental study.

(f) Systematic investigation of forms and propagation of oscillatory waves.

(g) Development of techniques to record instantaneously wave forms, internal velocities, and pressure during passage of a wave.

(h) A Lucite wave tank of 18 inch by 12 inch cross-section was built with a tilting device. Preliminary studies were made to photograph by stroboscopic technique the particle motion within the wave.

(i) "Measurement of the characteristics of small waves." J. V. Allen and J. F. Michel. Master's thesis, June 1947.

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

(b) Graduate thesis. (c) A. T. Gifford, T. M. Nosek, R. I. Dice.

(e) Theoretical study for general information.

(f) Study of formation of flood waves due to a sudden dam failure and of their progress downstream. Prediction of maximum water elevations.

(g) Survey of theoretical and experimental solutions. Development of feasible methods of stage prediction on basis of information available.

(h) Master's thesis completed, June 1947. Experimental studies are planned.

(311) HYDRAULIC ANALOGY TO SUPERSONIC FLOW OF GASES.

(b) U. S. Army Air Forces.

(c) A. T. Ippen, D. R. F. Harleman, C. E. Carver, Jr.

(e) Basic experimental research.

(f) Applicability of hydraulic analogy to supersonic flow of gases.

(g) Experimental work to be conducted in high velocity flume of special design.

(h) Project is in active status.

(i) See Project No. 95, "Hydraulic Analogy to Flow of a Compressible Gas", Massachusetts Institute of Technology, Dept. of Mechanical Engineering, page 36.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Department of Mechanical Engineering, Cambridge, Mass.

(95) HYDRAULIC ANALOGY TO FLOW OF A COMPRESSIBLE GAS.

(b) Bureau of Ordnance, U. S. Navy Dept. (c) A. H. Shapiro, D. Rush.

(d) Prof. A. H. Shapiro, Massachusetts Institute of Technology, Cambridge 39, Mass.

(e) Primarily experimental. Now being carried on in form of student theses.

(f) To derive information on the high-speed flow of gases from measurements on water flowing in a channel with a free surface.

(g) Water at supercritical velocities flows in an open channel. Flow patterns for flow around bodies and for flow through channels are examined in respect to wave patterns and water heights.

(h) Various flow patterns simulating supersonic gas flow have been reproduced. A shadowgraph technique has been developed. Tests of supersonic diffusers and of supersonic blade cascades are under way.

(i) See Project No. 311, "Hydraulic Analogy to Supersonic Flow of Gases", Massachusetts Institute of Technology, Dept. of Civil and Sanitary Engineering, page 35.

(312) EXPERIMENTAL STUDY OF THE EFFECT ON DAMAGE TO A METAL SURFACE OF THE SUDDENNESS OF APPLICATION OF REPEATED PRESSURE BY A LIQUID.

(b) Cavitation Laboratory, Dept. of Mechanical Engineering, Massachusetts Institute of Technology.

(c) B. G. Rightmire, C. G. Bragaw, Jr.

(d) Prof. B. G. Rightmire, Massachusetts Institute of Technology, Cambridge 39, Mass.

(e) Experimental, student thesis.

(f) It is known that repeated pressure applied very suddenly (impact) by a liquid to a metal surface produces damage similar to that caused by cavitation, but that a gradually applied pressure, even though of greater amplitude than the impact, does no damage. It is proposed to determine more precisely how sudden the application of repeated pressure must be to cause damage.

(g) Pressure waves of controlled amplitude and steepness are impressed on liquid in a steel tube of about 1/2-inch internal diameter. The waves are generated by a piston struck by an electric hammer, and are absorbed at the far end of the tube by a packing of glass wool. A specimen is placed either flush with the inner wall of the tube or adjacent to the glass wool for normal impingement of the wave. The waves are measured by a wire resistance strain gage on a dural rod 1/8-inch in diameter, one end of which is set flush with the inner surface of the tube, the other being fastened to a lead rod of the same diameter. Since very little reflection occurs at the dural-lead interface, practically all the acoustic energy is absorbed by the lead, and the gage is affected almost exclusively by the pressure to be measured. Various liquids and specimen materials will be used during the tests.

(h) Just starting.

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

(313) SHIP PROPELLER INVESTIGATIONS.

(b) Laboratory project. (c) F. M. Lewis, A. J. Harno.

(d) Prof. F. M. Lewis, Dept. of Naval Architecture and Marine Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.

(e) The work involves investigations on the efficiency of non-cavitating propellers, studies of cavitating propellers, vibratory propeller forces, special propeller forms, and related projects.

(f) Increased knowledge regarding the above factors and improved propeller forms.

(h) A continuing project.

UNIVERSITY OF MICHIGAN, College of Engineering, Ann Arbor, Mich.

Inquiries concerning Projects Nos. 314 to 316, incl., should be addressed to Prof. L. A. Baier, Room 326 West Engineering Bldg., University of Michigan, Ann Arbor, Mich.

(314) COMMERCIAL SMALL HULL DESIGN DEVELOPMENT.

(b) General Motors Corporation. (c) L. A. Baier.

(e) Form design. (f) To develop efficient form.

(g) Small commercial vessels have lacked the benefit of tank testing and technical design. Considerable improvement in fuel economy and capacity can be effected.

(h) Three designs completed.

(315) EFFECT OF TRANSOM IMMERSION ON RESISTANCE OF HIGH-SPEED MOTOR BOATS.

(b) Laboratory project. (c) C. W. Spooner.

(e) For design.

(f) To develop level running and efficient form.

(g) Many high speed motor boats operate at hump speed, due to inefficient lines and improper immersion of transom.

(h) Six models completed.

(316) RESISTANCE OF A SERIES OF VESSELS 150 FEET TO 250 FEET LONG.

(b) For Fairbanks-Morse & Company. (c) L. A. Baier.

(e) For general design information.

(f) To enable estimates of power for this type vessel.

(g) No data at hand. (h) Three models completed.

MISSISSIPPI STATE COLLEGE, Engineering and Industrial Research Station, State College, Miss.

Inquiries concerning Projects Nos. 4 and 5 should be addressed to Dr. Harold Flinsch, Mississippi State College, Box 365, State College, Miss. These projects were listed in Volume XI under Bucknell University, and have been transferred to Mississippi State College with Dr. Flinsch.

(4) DEVELOPMENT OF SURFACE WAVES BY WIND.

(b) Laboratory project. (c) Harold Flinsch.

(e) General theoretical and experimental research.

(f) To develop a theory of the growth of surface waves under the action of wind, and to compare this theory with the results of measurements.

(g) Research leading to papers on the theories of surface wave growth, on measurements in the laboratory and in nature, and on the comparative results of theory and measurement.

(h) A paper on the proposed theoretical approach of the project is in preparation. New experimental equipment has been acquired.

(i) "An experimental investigation of wind-generated surface waves." Harold v. N. Flinsch. Ph. D. thesis, University of Minnesota, May 1946.

A discussion of the paper by H. U. Sverdrup and W. H. Munk, "Empirical and theoretical relations between wind, sea, and swell", Trans. American Geophysical Union, Vol. 27, No. VI: 823-827, December 1946, was published in the Trans. American Geophysical Union, Vol. 28, No. VI, 946-947, December 1947.

(5) SHIP STABILITY AND ROLLING PERIOD.

(b) Laboratory project. (c) Harold Flinsch.

(e) General theoretical and experimental research.

(f) To develop general formulas for the measure of stability and the rolling period of ships.

(g) 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.

(h) Preliminary experiments have been performed on a basic model, and some of the results assembled in a brief report. The model has been improved, in particular with regard to adjustment of the center of gravity.

MISSOURI SCHOOL OF MINES AND METALLURGY, Rolla, Mo.

Inquiries concerning Projects Nos. 116, 117, and 317 to 319, incl., should be addressed to Prof. Joe B. Butler, Missouri School of Mines and Metallurgy, Rolla, Mo.

(116) FLOW THROUGH SMALL LOW HEAD SIPHONS.

(b) Laboratory project.

(c) C. B. Butler, E. R. Broadbent, R. C. Pletz.

(e) For general information.

(f) To note discharge, friction loss, and peak suctions in siphons made of rubber hose, smooth bent iron, lead and brass pipes, welded-joint pipes, pipes connected with common screw-end pipe elbows and in deviated flow around common screw-end Tees under low heads varying from 4 to 0 feet. Later in project, flaring outlets and changing of pipe sizes throughout the length of the siphons will be introduced.

(g) The primary purpose will be for student demonstrations in hydraulics to demonstrate friction and suction effects. If a more thorough search of hydraulic literature shows a substantial part of this project to involve new research, the results so obtained will be prepared for publication.

(h) Largely qualitative and observational with garden hose and screw-end jointed pipe used in student demonstration with outlet heads varying from 3 to 0 feet.

(i) Present references are short statements from hydraulics text. Currently searches will be made into the full field of published literature so that more of the search can go into fields not covered by experiments.

(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) J. B. Butler, E. W. Carlton, V. A. C. Gevecker.

(e) For general information.

(f) To note actual suction values where the application of Bernoulli's theorem indicates specific values, and to crowd each device to where the tendency to flow full through action of adhesion and cohesion of water is cancelled against limiting suction values.

(g) The primary purpose will be for student demonstration in large hydraulic classes. As an extension of the search of hydraulic literature shows where a substantial part of this project as expanded can involve new research, the results so obtained will be prepared for publication.

(h) Largely qualitative and observational to start with, as showing students the limits where suction devices break down tendency for full flow at exit.

(i) Present references are short statements from hydraulic texts. Currently searches will be made into the full field of published literature, so that more of the search can go into fields not covered by experiments.

(317) STUDY OF VERTICAL FLOW THROUGH SHORT PIPES AND TUBES.

(b) Laboratory project. (c) J. G. Duba, J. B. Butler, R. C. Pletz.

(e) Experimental project.

(f) To note discharge and friction loss under various conditions of flow and to compare the experimental values with published data or with values readily computed by application of Bernoulli's theorem.

(g) This project will be used primarily to substantiate theoretical solutions for vertical flow.

(h) Experiments are now being set up.

(318) FLOW THROUGH PIPE TRANSITIONS.

(b) Laboratory project.

(c) V. A. C. Gevecker, E. A. Weinel, E. R. Broadbent. (e) Experimental.

(f) To study the discharge, friction loss, and limitations of various shaped transitions from larger to smaller pipes.

(g) The primary purpose will be for student demonstrations and student use as measuring devices for other experimental studies.

(h) Largely qualitative and illustrative.

(i) If results indicate the feasibility of using easily constructed pipe transitions as better than average measuring devices, investigations will be extended.

(319) WEIR STUDIES.

(b) Laboratory project.

(c) E. W. Carlton, E. A. Weinel, J. G. Duba. (e) Experimental.

(f) To determine the flow characteristics of a Cippoletti weir placed in a narrow rectangular channel.

(g) Several Cippoletti weirs of widths increasing up to that of channel width are to be calibrated under similar conditions. Results obtained will be compared with published values to see what effect a large velocity of approach will have.

(h) Planning stage.

NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY, Newport News, Va.

Inquiries concerning Projects Nos. 320 to 324, incl., should be addressed to Mr. C. H. Hancock, Hydraulic Laboratory, Newport News Shipbuilding and Dry Dock Company, Newport News, Va.

(320) SEAWORTHINESS TESTS.

(b) Bureau of Ships, U. S. Navy Dept. (c) W. F. Taylor.

(e) Experimental, for design information.

(f) To tow in head seas and stern seas, six various designs, for the purpose of obtaining the relative merits of each.

(g) Values of pitching angle, acceleration, and speed are obtained for various wave lengths. Models are dynamically balanced. Pitching angles obtained by photographic light trace method and accelerations obtained electronically. Slow-motion moving pictures accompany report.

(h) Head seas work completed and report submitted to Bureau of Ships. Stern seas work now in progress.

(i) Confidential project.

(321) ELECTRIC ANALOGY.

(b) Laboratory project. (c) R. G. Stiles.

(e) Experimental and theoretical, for design purposes.

(f) To investigate the electrolytic tank type of electric analogy for the purpose of adapting it to applications in shipbuilding, turbine and pump design.

(g) Electrodes are immersed in a shallow tank of electrolyte and a potential applied. By means of a search probe electrode equipotential lines may be traced.

(h) Literature search has been made and preliminary work done on several models. Stress trajectories have been investigated, and the flow in ship condenser scoops has been attempted by this method. Project is temporarily inactive.

(i) "Measurements of potential by means of the electrolytic tank." G. Hepp. Phillips Technical Review, Vol. 4, No. 8: 223-230. August 1939.

(322) SUPERSONIC ANALOGY TOWING TANK.

(b) Laboratory project. (c) J. W. Hoffman, Jr.

(e) Experimental and product improvement.

(f) To investigate the analogy between surface shock waves in liquids and supersonic shock waves in compressible gases and the possible use of this technique.

(g) Models towed in shallow water basins or held stationary in shallow water channels of high velocity.

(h) Bibliography started.

(i) Details of one line of attack on this problem can be found in "Application of the methods of gas dynamics to water flows with free surface, Part I and II", by Ernest Preiswerk, Institut für Aerodynamik Eidgenossiche Technische Hochschule, Zürich, NACA Technical Memoranda Nos. 934 and 935.

(323) FLUID FLOW BY BENTONITE METHOD, DESIGN OF POLARISCOPE.

(b) Laboratory project.

(c) Roscoe Meadows, Jr., B. R. Lee, W. F. Taylor.

(e) Design information.

(f) To design a large field polariscope suitable for photoelastic and fluid flow

investigations at the hydraulic laboratory.

(g) The polariscope is used for stress analysis studies by the photoelastic method and for fluid flow studies using the property of streaming double refraction. The polariscope has a 12-inch field with Polaroid polarizers, sheet acetate quarter-wave retardation plates, and eight-foot focal length collimating lenses. It can be set up as a transmission type or doubling polariscope. Because of its large size, remote control is provided.

(h) Because the polariscope is being used full time for photoelastic stress analysis, the fluid flow studies are inactive at present.

(i) The above equipment is described in "The photoelastic laboratory at the Newport News Shipbuilding and Dry Dock Company", by B. R. Lee, Roscoe Meadows, Jr., and W. F. Taylor in the Proc. Society for Experimental Stress Analysis, Vol. V, No. 2.

(324) CIRCULATING WATER CHANNEL.

(b) Laboratory project. (c) W. F. Taylor.

(e) Experimental, for design information.

(f) To obtain high-speed, circulating water channel model on which to make alterations. This "cut and try" model to furnish basis for final design of large channel. Primary emphasis on supercritical flow.

(g) Channel constructed with test section (open on top) 2 feet wide, 10 inches deep, and 6 feet long. Single, adjustable-vane impeller driven by 40 hp motor furnishes water flow. Model has numerous bolted flanges to facilitate change of pieces.

(h) Channel completed and installed. Inactive at present due to higher priority work.

(i) Design of this channel follows that of Lee at David Taylor Model Basin. See "The circulating water channel at the David Taylor Model Basin", Trans. Society of Naval Architects and Marine Engineers, Vol. 52: 325-346, 361-364, 1944.

See Project No. 174, "Circulating Water Channel", David Taylor Model Basin, page 130.

NEW YORK UNIVERSITY, Department of Chemical Engineering, New York, N. Y.

(325) CHARACTERISTICS OF LIQUID-LIQUID EXTRACTION COLUMNS.

(b) Laboratory project, in conjunction with M. W. Kellogg Company, New York, N. Y.

(c) R. E. Treybal.

(d) R. E. Treybal, Associate Professor of Chemical Engineering, New York University, University Heights, New York 53, N. Y.

(e) Experimental and theoretical, for gathering design data. Student theses.

(h) Current.

NORTHWESTERN UNIVERSITY, The Technological Institute, Evanston, Ill.

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

(b) Laboratory project. (c) W. S. Hamilton.

(d) W. S. Hamilton, Civil Engineering Dept., Northwestern Technological Institute, Evanston, Ill.

(e) Experimental, for fundamental information.

(f) 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.

(g) Barge models are towed at constant speed in a tank in which the depth and width are variable. The tow line and pulleys are driven by an electric motor; the velocity is measured with a spark chronograph, and the towing force with a recording dynamometer carried by the model.

(h) Temporarily inactive.

(i) For a description of the towing tank, see "A simple apparatus for measuring the speed and resistance of hull models", by W. S. Hamilton, Marine Engineering and Shipping Review: 163-166, September 1945.

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

(b) Laboratory project. (c) M. B. Gamet, L. H. Kessler.

(d) Prof. M. B. Gamet, Acting Chairman, Civil Engineering Dept., Northwestern Technological Institute, Evanston, Ill.

(e) Experimental, for design purposes.

(f) To increase the shock-absorbing capacity of mechanical-pneumatic water hammer arresters by placing nitrogen under pressure in the compression chamber, at a unit pressure equal in magnitude to flow pressures encountered in practice. The effective shock-absorbing capacity is increased with a corresponding reduction in overall size of the surge suppressor, rather than having the compression chamber filled with a gas at atmospheric pressure.

(g) Performance is analyzed by pressure-time diagrams on water pipe lines upstream from the quick-closing valve and surge suppressor. Fatigue tests of compression chamber unit are also conducted.

(h) One suppressor is under test with pressures of nitrogen in compression chamber varying from 5 to 90 psi. A large suppressor with 300 psi in compression chamber is under construction. Two-inch pipe lines supplied by standpipe and centrifugal pump are used at present.

(326) CAVITATION DAMAGES UNDER CONTROLLED CONDITIONS.

(b) Laboratory project. (c) A. N. Harkauli, W. S. Hamilton.

(d) W. S. Hamilton, Civil Engineering Dept., Northwestern Technological Institute, Evanston, Ill.

(e) Experimental, for basic information.

(f) To relate such variables as static load, size of cavity, dissolved air content, and proximity of specimen to point of cavity collapse to the amount of pitting caused in concrete and other engineering materials.

(g) The pressure in a vertical column of liquid will be caused to fluctuate by means of a piston and bellows arrangement at the bottom of a closed container filled with the liquid. Motion of the piston will be produced mechanically and restricted to slow speeds so that the pressure distribution in the liquid column is essentially hydrostatic and cavities form at the top. Samples of material will be suspended near the point of origin and collapse of the cavities.

(h) The apparatus is under construction. The equipment is being built as a M.S. thesis project for Mr. Harkauli. Various phases of the experimental work will be undertaken by subsequent students.

THE UNIVERSITY OF OKLAHOMA, Norman, Okla.

(327) MEASUREMENT OF VISCOUS FLUIDS.

(b) Cooperative project, A.S.M.E. and Univereity of Oklahoma.

(c) Members of faculty and graduate assistants.

(d) W. H. Carson, Dean, College of Engineering, The University of Oklahoma, Norman, Okla.

(e) Experimental.

(f) To determine ways and means of metering viscous fluids.

(g) Approximately $30,000 worth of equipment arranged in a suitable manner for testing orifice, nozzle, and displacement meters.

(h) Inactive.

(i) Prior to the war, approximately 40,000 test runs were made on different types of meters. Information was submitted to the Fluid Meters Committee of the A.S.M.E.

See "Research Committee on Fluid Meters, A.S.M.E.", page 179.

THE PENNSYLVANIA STATE COLLEGE, School of Engineering, State College, Pa.

Inquiries concerning Projects Nos. 129, 131, 133, and 328 to 330, incl., should be addressed to Prof. J. M. Robertson, Hydraulics Laboratory, School of Engineering, The Pennsylvania State College, State College, Pa.

(129) WATER TUNNEL MODEL STUDIES.

(b) Ordnance Research Laboratory at The Pennsylvania State College.

(c) J. M. Robertson, D. Ross, A. M. Feiler, W. M. Wachter.

(e) An experimental and theoretical study for design purposes.

(f) To develop methods for predicting flow conditions in water tunnel components.

(g) Water tunnel components, with diameters one-eighth the proposed prototype dimensions, are being studied in an experimental tunnel which does not include a model pump. Flow is taken from and returned to a pump in a single-pass system and is measured over a standard rectangular weir. The test section diameter is 6 inches and velocities up to 50 fps are possible. As the sections are interchangeable, various lengths of components, shapes of nozzles, and angles of diffusion, and various sized turns may be tested. The components are studied as they are interrelated; thus in the diffuser, to simulate prototype entrance conditions over a large range of Reynolds numbers, the length of the straight (or test) section preceding the diffuser is varied over wide limits. Experimental results are integrated with theoretical methods, in an attempt to develop means for predicting prototype flow conditions for use in design.

(h) Tests have been terminated. Reports are being written on the experimental water tunnel, and the design of the large tunnel. Reports are to be written on nozzles and transition sections, boundary layer action in diffusers, and other results.

(131) SHAVER CREEK HYDROLOGIC STUDY.

(b) Cooperative project with U. S. Weather Bureau and U. S. Forest Service.

(c) W. M. Wachter.

(e) Long term study on hydrologic action of a watershed.

(f) To obtain data on rainfall, runoff, and evaporation for a small mountain watershed.

(g) The watershed area is about 3.8 square miles. Runoff is measured by a calibrated stream control, rainfall is measured with three recording rain gages, and evaporation from a standard pan.

(h) Measurements are under way; initial reduction of data is continuing.

(133) WEIR STUDIES.

(b) Laboratory project. (c) J. R. Villemonte.

(e) Experimental project.

(f) Study of proportional and other weirs and the effect of submergence on their discharge characteristics.

(h) Inactive. For further information concerning this project, address Prof. J. R. Villemonte, Hydraulic and Sanitary Laboratory, University of Wisconsin, Madison, Wis.

(i) See Project No. 149, "Effect of Submergence on Discharge of Sharp-Crested Weirs", The University of Wisconsin, page 62.

(328) FLOW PAST SLOTS IN SURFACES.

(b) Ordnance Research Laboratory at The Pennsylvania State College, and laboratory project.

(c) W. M. Wachter, J. M. Robertson.

(e) Experimental, for general information.

(f) To investigate the flow conditions near slots in surfaces.

(g) Studies will be made on the pressure and flow conditions near slots in surfaces. Tests will be made on slots varying from 1/2-inch wide and 1/2-inch deep to 4 inches wide and 4 inches deep.

(h) A channel 8 inches wide with a slot in the bottom has been constructed and some preliminary tests have been made.

(329) RESISTANCE IN OPEN CHANNEL FLOW.

(b) Laboratory project. (c) W. M. Wachter, J. M. Robertson.

(e) Experimental project, for general information.

(f) To study the effect of hydraulic radius and other factors on open channel flow resistance.

(g) It is planned to measure the losses in various rectangular and trapezoidal shaped open channels. The channels are to be long enough to allow fully developed turbulent flow to occur in the measuring reach.

(h) A 7 inch wide by 10 inch deep, adjustable slope, wooden channel 50 feet long has been constructed for the first tests. It is planned to start the experiments soon.

(330) FLUID POLARISCOPE.

(b) Laboratory and personal project. (c) J. H. Dawson.

(e) Experimental, for general information.

(f) To find instantaneous velocity of any point and all points in a given field of view.

(g) An attempt is being made to correlate the fringe patterns developed when a streaming birefringent flows past an object with the velocity at some point in the field of flow.

(h) A fluid polariscope is under construction. A small propeller-type current meter three-sixteenths of an inch in diameter is being built to measure average

velocities. Some work was done at the University of Colorado in 1946.

(331) INDUSTRIAL WASTE-MEASURING FLUME.

(b) Sanitary Engineering Laboratory project.

(c) R. R. Kountz, R. H. Amthor.

(d) Prof. R. R. Kountz, Civil Engineering Dept., The Pennsylvania State College, State College, Pa.

(e) Experimental.

(f) To develop a flume which will measure industrial wastes without clogging or altering the waste through sedimentation.

(g) Two flumes have been designed to date in this development. The objective is to handle and measure quantities of waste from 0 to 2 cfs while maintaining a scouring velocity (in all parts of the device) sufficient to prevent sedimentation of any solids encountered in industrial wastes. At present the head (and discharge) is being measured by a hydraulic weighing device for which the sensitivity can be adjusted for different discharge ranges.

UNIVERSITY OF PENNSYLVANIA, Department of Civil Engineering, Philadelphia, Pa.

(134) THE EFFECT OF SIZE AND CONDITION OF THROAT VENTS ON THE COEFFICIENTS OF VENTURI METERS.

(b) Simplex Valve and Meter Company, and laboratory project.

(c) W. S. Pardoe.

(d) Prof. W. S. Pardoe, Civil Engineering Dept., University of Pennsylvania, Philadelphia 4, Pa.

(e) To determine limitations for manufacturers of Venturi meters.

(f) To find effects on coefficient.

(g) Tests conducted on a 10-inch by 5-inch Simplex Herschel type Venturi meter with a removable bronze throat, six vents 1/16 inch to 1 inch diameter, 1/4-inch vents with outside and inside burrs, countersunk and rounded.

(h) A continuing project; about one-half done.

(i) This is not paralleling Prof. Allen's work on piezometer holes.

PRINCETON UNIVERSITY, School of Engineering, Princeton, N. J.

(139) TOWING TANK RESEARCH.

(b) David Taylor Model Basin, U. S. Navy Dept., and laboratory projects.

(c) A. D. Hay and graduate students.

(d) Prof. A. Donald Hay, Towing Tank Director, School of Engineering, Princeton University, Princeton, N. J.

(e) Theoretical and experimental research.

(f) To explore some fundamental research in hydraulics hitherto untouched by the larger model basins.

(g) Present work is confined to towing simple geometric forms through the surface of

water for resistance and wave measurements, and analyzing the relations between results.

(i) "Effects of varying one end of barge forms with simple geometrically-shaped ends." A. Donald Hay. November 1, 1946.

This report is an extension of a Princeton report to the David Taylor Model Basin entitled "Barge forms with simple geometrically-shaped ends". In the original report, the shape of the bow and stern were identical for any one model. The resistance and wave pattern were recorded. In this report, one end was held constant while the other end was varied, using the same shaped ends as those in the original report. The model was tested both forward and backward in order to place the variable end in both bow and stern positions. In this manner the influence of the bow and stern shapes could be studied separately.

The models were towed free to trim at speed-length ratios of from 0.14 to 1.4, or actual speeds of from 0.42 to 4.2 fps, and the resistance measured. Photographs of each model, showing trim angles and wave patterns, were taken at 0, 1, 2, 3, and 4 fps.

"Photographs and resistance measurements of semi-submerged right parallelepipedons." A. Donald Hay and John P. Runyon. May 1, 1947.

Parallelepipedon models of 9-in. beam and lengths of 0-in. (flat plate), 9-in., 18-in., 27-in., 36-in., and 45-in. were towed at drafts of 1-1/2-in., 3-in., 6-in., 9-in., and 18-in., at speeds of from 1 to 8 fps. The models were not free either to trim or heave. Resistances were measured, and photographs were taken simultaneously from above and below water to show the flow patterns around the models.

A series of three models based on the 45-in. parallelepipedon, but with forefoot radii of 2-1/4-in., 4-1/2-in., and 9-in., were towed in the same range of conditions, and the same observations were made.

Since the cross-sections of the models were relatively large in comparison with the cross-section of the test channel, the test results were corrected by the method developed in Report No. 460 of the David Taylor Model Basin (L. Landweber: "Tests of a model in restricted channels", May 1939), in order to yield results which would probably have been obtained had the models been towed in deep open water. In order to confirm the validity of this method of correction, test data of other researchers into the effects of channel size and shape on model resistance were analyzed by this method, with some disagreement resulting.

The uncorrected test data are presented in dimensional form, while the corrected test results are presented in dimensionless form, showing the effects on model resistance caused by varying the length, speed, draft, and forefoot radius.

All test equipment, including novel photographic methods and equipment employed in obtaining pictures of the flow patterns from beneath the surface of the water, is explained in detail.

"Flow about semi-submerged cylinders of finite length." A. Donald Hay. October 1, 1947.

A brief summary of the nature of flow around completely submerged cylinders of infinite length (two dimensional flow) and completely submerged cylinders of finite length (three dimensional flow), is presented preliminary to the discussion of the main subject of this report: Flow about cylinders of finite length which protrude through the surface of a fluid, thereby causing gravity waves.

Right-circular cylinders of from 1/8-in. to 8-in. in diameter, and from 1-in. to 32-in. in length (below the water line), were tested at Princeton University. No cylinder with a length-to-diameter ratio greater than 32 was tested. Most of the cylinders were tested at speeds of from 0.4 to 15 fps.

These cylinders were photographed from both above and below the water surface. Photographs and graphs are included to indicate the dimensions of the various waves generated by the motion of the tested cylinders.

A series of contour maps, of two cylinders of different diameter, show the

wave heights at all points near the cylinders. They reveal how the wave pattern varies with changes of Reynolds and Froude numbers.

The water resistance of the above cylinders was measured and the results plotted in dimensionless form. Indicated causes for the changes in resistance coefficient with changes of diameter, length, and speed are analyzed in terms of the visual changes of wave form, as seen in the photographs and contour maps.

·ROCKY MOUNTAIN HYDRAULIC LABORATORY, Allenspark, Colo.

(332) TESTS OF SCOUR AROUND BRIDGE PIERS AND ABUTMENTS.

(b) Laboratory project.

(c) G. H. Matthes, E. W. Lane, C. J. Posey, Ralph Powell, and others.

(d) Carl F. Izzard, U. S. Public Roads Administration, Washington 25, D. C.

(e) Experimental, to obtain information for design.

(f) Study of fundamental characteristics of scour phenomena, of comparative scour patterns, and of proposed design improvements.

(g) Tests in movable-bed model.

(h) Preliminary tests in a 6-foot flume completed at end of 1947 season. Amount of testing to be undertaken in the 1948 summer season will be dependent upon personnel available.

ST. ANTHONY FALLS HYDRAULIC LABORATORY, University of Minnesota, Minneapolis, Minn.

Inquiries concerning Projects Nos. 98 to 100, incl., 103 to 105, incl., 108, and 333 to 339, 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 to 114, incl., should be addressed to F. W. Blaisdell, Project Supervisor, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Minneapolis 14, Minn.

(98) FLOW OF SUSPENDED SOLIDS IN PIPES.

(b) Doctor's thesis, University of Minnesota. (c) H. D. Purdy, Jr.

(e) Experimental and analytical student thesis.

(f) To study effect of suspended matter characteristics on head loss, solids distribution, and velocity distribution of flow of suspensions in pipes.

(g) Proposed to measure head loss, and velocity and solids distribution of glass beads suspended in water flowing in a 2-inch copper pipe, by means of Pitot tube sampling device.

(h) Apparatus completed; preliminary tests begun.

(99) HYDRAULICS OF CULVERTS.

(b) Minnesota Department of Highways, in cooperation with U. S. Public Roads Administration.

(c) L. G. Straub, C. L. Larson.

(e) Experimental investigation for general information on flow through culverts.

(f) To develop functional and practical inlets and outlets for culverts, and to provide simplified criteria for their application to the wide variety of hydraulic problems encountered in culvert practice.

(g) Experiments will be conducted on a model culvert with various slopes, lengths, entrances, and outlets. Tests will be made, using defined approach channels of various sizes and shapes, breaks in grade and alignment, and common types of headwalls arranged to serve as entrance transitions.

(h) Study of literature completed; apparatus under construction.

(100) HIGH VELOCITY FLOW OF WATER IN A SMALL RECTANGULAR CHANNEL.

(b) In cooperation with the Committee on Hydraulic Research, A.S.C.E., and sponsored by the Engineering Foundation.

(c) L. G. Straub, W. W. DeLapp.

(e) General research and experimental study.

(f) To measure the amount of air entrained in water flowing at high velocities and its effects on resistance coefficients.

(g) Observations have been made in a channel one foot wide and 40 feet long, with slopes up to 44° and three types of boundary roughness.

(h) A report and Ph. D. thesis completed. Further studies to be conducted.

(i) "The entrainment of air in open channel flow", by Lorenz G. Straub and W. W. DeLapp, presented at the Hydraulics Division Session, A.S.C.E. Summer Meeting, Duluth, Minn., July 1947.

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

(b) In cooperation with the Committee on Hydraulic Research, A.S.C.E., and sponsored by the Engineering Foundation.

(c) L. G. Straub, L. W. Neubauer.

(e) An experimental and analytical study of a fundamental nature.

(f) To expand earlier studies of mechanics of bed sediment movement with particular emphasis on the influsnce of the mechanical properties of the fluid.

(g) A recirculating system involving temperature control apparatus, sediment supply system, sediment trap, and a test section of 12 inches width, 24 inches depth, and 42 feet length is tested with different fluids and sediments over a wide temperature range.

(h) A series of experiments complete.

(104) FLOW DIVERSION RESEARCH.

(b) David Taylor Model Basin, U. S. Navy Dept.

(c) A. G. Anderson, E. Silberman, O. P. Lamb.

(e) Theoretical and experimental research of general interest, directed toward design of varied turns.

(f) To analyze, integrate, and extend the present knowledge of fundamental mechanics of diverting fluid flow streams with special emphasis on the use of guide vane systems.

(g) American and foreign literature will be collected, translated, abstracted, and summarized. Preliminary analytical and experimental study will be made of flow in a radius elbow, which will be concluded with an analytical and experimental study of vaned turns. This will lead to design data for such turns, particularly in connection with water tunnel design studies.

(h) The bibliography and summary report have been submitted to the David Taylor Model Basin. Some theoretical work has been done, a meter elbow and several vane shapes

have been designed, and experimental work is under way on vaned turns.

(i) "Fluid flow diversion: A summary and bibliography of literature." A. G. Anderson. St. Anthony Falls Hydraulic Laboratory, Project Report No. 1. August 1947. This report will be available for reference at several technical libraries in the United States.

"Fluid flow diversion: The nature of flow in a radius elbow." E. Silberman. St. Anthony Falls Hydraulic Laboratory, Project Report No. 5. December 1947. This report will be available for reference in several technical libraries in the United States.

"The Pitot cylinder." E. Silberman. St. Anthony Falls Hydraulic Laboratory, Ciroular No. 2. October 1947. Copies of this circular are available upon request.

See Project No. 105, "Water Tunnel Design Studies", St. Anthony Falls Hydraulic Laboratory, immediately following.

(105) WATER TUNNEL DESIGN STUDIES.

(b) David Taylor Model Basin, U. S. Navy Dept.

(c) J. F. Ripken, J. S. Holdhusen.

(e) Experimental check of water tunnel designs.

(f) To determine and improve design characteristics of a proposed 60 inch diameter, closed jet, high speed cavitation or water tunnel and an existing 24 inch diameter open jet, medium speed water tunnel.

(g) A metal model of 6 inch jet diameter is under test to determine flow characteristics, design deficiencies, and operating techniques necessary to this construction or revision of the prototype versions.

(h) Model tunnel is being tested.

(i) See Project No. 104, "Flow Diversion Research", St. Anthony Falls Hydraulic Laboratory, page 48; Project No. 175, "Variable Pressure Water Tunnel - 60-inch", David Taylor Model Basin, page 131, and Project No. 466, "Variable Pressure Water Tunnel - 24-inch", David Taylor Model Basin, page 131.

(108) LARGE SCALE CULVERT STUDIES.

(b) American Concrete Pipe Association. (c) L. G. Straub.

(e) Experimental study of hydraulics of commercial culvert types.

(f) To establish entrance losses and pipe friction losses in culverts flowing at various capacities and heads, full and partly full.

(g) 24-inch culverts, 200 feet long, are constructed sucoessively in the main testing channel of the St. Anthony Falls Laboratory, and observations are made of head losses for various rates of discharge.

(h) Experiments have been made on a 24-inch concrete culvert, 200 feet long, set at a slope of 0.2 percent.

(333) RAMAPADASAGAR DAM.

(b) Government of Madras, India. (c) L. G. Straub.

(e) Experimental analysis of hydraulic model cofferdams.

(g) A large scale movable bed model is to be used.

(h) Analytical studies and plans for model are under way.

(334) DISPOSAL OF IRON ORE TAILINGS IN LAKE SUPERIOR.

(b) Reserve Mining Company. (c) L. G. Straub.

(e) Experimental studies involve investigation of the potential effect of iron ore tailings proposed to be deposited in Lake Superior in the processing of low-grade iron ores obtained from Northern Minnesota.

(g) Laboratory studies are made involving density currents developed by the effluent from the processing plant; the effluent contains approximately 4 percent iron ore tailings.

(h) Some experiments have been performed in a tiltable glass-sided channel with the tailings entering in various ways above and below the water surface.

(335) FLOW IN A TRIANGULAR CHANNEL WITH VARIED BOUNDARY ROUGHNESS.

(b) Master's thesis, University of Minnesota. (c) J. M. Forns.

(e) Experimental investigation.

(f) To determine the characteristics of bulk flow in a triangular channel with varied boundary roughness.

(g) Experiments have been conducted, using two different abrasive cloths as boundary roughnesses, and employing kerosene and water as fluids. Both laminar and turbulent flow are being studied.

(h) Nearing completion.

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

(b) Master's thesis, University of Minnesota. (c) O. P. Lamb.

(e) Experimental investigation.

(f) To determine the effect of concentration of air and mean bubble size on the losses in a flowing mixture of air and water.

(g) The losses will be determined over a 26-foot test section of a vertical Lucite pipe (1-1/8-inch diameter). Concentration of air, size of the air bubbles, and velocity will be varied for both upward and downward direction of flow.

(h) Tests are now in progress.

(337) STUDY OF PRESSURE AND VELOCITY DISTRIBUTION IN CURVILINEAR FLOW OF DRAWDOWN CURVE.

(b) Master's thesis, University of Minnesota. (c) C. O. Johnson.

(e) Experimental and analytical student thesis.

(f) To predict the vertical distribution of pressure at the crest of a free overfall by application of two-dimensional flow theory.

(g) The experimental work will consist of obtaining water surface profiles and centerline velocity traverses in the region of the drawdown curve at a free overfall. From a knowledge of two-dimensional flow of a perfect fluid, an attempt will be made to set up a stream function which will approximate experimental results.

(h) Library research has been completed; apparatus is assembled.

(338) THE CONTROL OF THE SCOUR BELOW SPILLWAYS.

(b) Master's thesis, University of Minnesota. (c) A. P. Rodionov.

(e) Library research.

(f) To summarize literature pertaining to control of erosion below spillways and drop structures.

(g) To review and summarize all pertinent literature relative to scour below spillways. The literature in English, German, French, Russian, and Czechoslovakian languages will be investigated.

(h) Collection of literature is under way.

(339) THE FORMATION AND CONTROL OF DENSITY CURRENTS.

(b) Doctor's thesis, University of Minnesota. (c) Feng Hsiao.

(e) Experimental and analytical.

(f) To get a thorough understanding of the characteristics of density currents, and to consider the possible applications of such characteristics in engineering projects.

(g) Investigation of the formation and control of density currents, using water as the fluid medium. English, German, and Chinese literature will be reviewed; study will be made of the available data in the literature and analytical interpretation made; and further experimental investigations will be carried on.

(h) Collection of literature is under way.

(111) DROP INLET CULVERT WITH PIPE CONDUIT.

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

(c) F. W. Blaisdell. (e) For design purposes.

(f) To obtain data on the hydraulic performance, discharge, and pressures.

(g) The tests will cover the complete range of conditions encountered in the field. Data will be obtained for several types of drop inlet and for pipes laid on both steep and flat slopes. Results will be reduced to the simplest possible form. Tests are in progress. Some results have been obtained. The pipe drop inlet culverts laid on steep slopes (1 on 3) flow completely full when the outlet discharges freely.

(h) Study in progress.

(112) DROP SPILLWAY WITH BOX INLET.

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

(c) F. W. Blaisdell, C. A. Donnelly.

(e) To develop a generalized design.

(f) To obtain discharge coefficients and other information required for the design of box inlet drop spillways.

(g) Experiments are run on models to determine the effect of different length to width ratios, height of drop, channel width, dike location, submergence, etc., on the discharge curves.

(h) Some results have been obtained. Tests are now under way.

(113) OUTLET FOR BOX INLET DROP SPILLWAY.

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

(c) C. A. Donnelly. (e) To develop a generalized design.

(f) To develop a satisfactory outlet structure for box inlet drop spillways.

(g) The design is general and dimensionless, so that the outlet can be applied to any size of box inlet drop spillway or any discharge. Empirical methods were used to develop the outlet.

(h) Study completed; project report submitted and now in process of reproduction.

(114) DIVERGING TRANSITIONS FOR SUPERCRITICAL VELOCITIES.

(b) Division of Drainage and Water Control, Soil Conservation Service, U. S. Dept. of

Agriculture, in cooperation with the Minnesota Agricultural Experiment Station.

(c) F. W. Blaisdell. (e) To obtain data for design purposes.

(f) To provide data for the design of transitions where the velocity is greater than the critical.

(g) Study will cover transitions for use in the approach to the St. Anthony Falls stilling basin. Surface contours are determined for different Froude numbers, shapes of entering stream, sidewall flares, bed slopes, etc.

(h) Study dormant. Progress report has been submitted and is scheduled for early reproduction and release. Studies to date give surface configuration for one floor slope and one in $\sqrt[3]{F}$ sidewall divergence for Froude numbers from 1 to 16.

(115) CORRUGATED PIPE DROP INLET CULVERTS.

(b) Minnesota Department of Conservation, Division of Water Resources and Engineering; Division of Drainage and Water Control, Soil Conservation Service, U. S. Dept. of Agriculture; Northwestern Division, Armco Drainage and Metal Products, Inc.; Minnesota Agricultural Experiment Station.

(c) A. W. Sturman.

(d) C. T. Ekman, Director, Division of Water Resources and Engineering, Minnesota Dept. of Conservation, St. Paul, Minn.

(e) To obtain design information.

(f) To obtain information on the hydraulics of the structure; to obtain head-discharge curves for the inlet; to develop an energy dissipator; and to study flow conditions in the downstream channel.

(g) This structure is to be used as a drop structure for drainage ditches and highway culverts. Tests are being conducted on corrugated Lucite pipe and movable bed channels.

(h) Experiments are progressing slowly, due to the inability of personnel to devote full time to the study.

(411) (412) (413) (414) (415) CORPS OF ENGINEERS.

For report on projects being carried on at the St. Anthony Falls Hydraulic Laboratory by the Corps of Engineers, see Projects Nos. 411 to 415, incl., listed under Corps of Engineers, St. Paul District, pages 97 to 99.

SOUTHERN METHODIST UNIVERSITY, School of Engineering, Dallas, Tex.

Inquiries concerning Projects Nos. 144 and 145 should be addressed to Prof. I. W. Santry, Jr., School of Engineering, Southern Methodist University, Dallas, Tex.

(144) AN INVESTIGATION OF THE USE OF THE STANDARD PIPE TEE AS A FLOW MEASURING DEVICE.

(b) Laboratory project. (c) Senior civil engineering students.

(e) General experimental research and student thesis.

(f) The work is to determine whether or not such a simple device as a pipe Tee could be used for measuring flow, and what reliance could be placed on the results of such a device.

(g) The investigations of several different students will be coordinated in a general paper on this subject to treat with the methods followed and results obtained. Work is planned to cover the effects of the different types of Tees, the spacing and location of manometer tubes and Pitot tubes, and the variations caused by age or condition of the Tees.

(h) Has not been worked on in several years because of the war, but will be resumed in the near future.

(i) Three undergraduate student theses have been written for partial fulfillment of the requirements for a B.S. degree in civil engineering.

(145) DISCHARGE RELATIONSHIPS OF CIRCULAR WEIRS.

(b) Laboratory project. (c) Senior civil engineering students.

(e) General experimental research and student theses.

(f) The research is to determine the discharge relationships for circular weirs of both the sharp-edged type and the broad-crested type, and the problems of design of such structures when used as intake structures.

(g) The investigations of different students will be consolidated into a general paper on this subject that will cover the problems of design of such structures under varying conditions of flow. Only the preliminary work has been done up to the present, but as more students become available for thesis work, the problem will be expanded into definite model studies and their actions. In determining the discharge relationships of these weirs, the head and discharge were determined during the process of increasing the head and decreasing the head, showing different characteristics with the same head. After sifting the data, empirical equations have been determined for the discharge. In the problem to date, only certain sizes of weirs have been considered, but since the actions of all sizes have proved to be the same, the advance work can now be considered.

(h) The project has not been worked on for several years, as the equipment was removed during the war. With the advance work which should start in the next year, new equipment will be built.

(i) Three undergraduate theses have been written on this subject to establish the necessary preliminary work.

STEVENS INSTITUTE OF TECHNOLOGY, Experimental Towing Tank, Hoboken, N. J.

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, U. S. Navy Dept. 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 Dept.

(c) Prof. B. V. Korvin-Kroukovsky, J. D. Pierson, W. C. Hugli.

(d) Prof. B. V. Korvin-Kroukovsky, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Basic research.

(f) To investigate the fundamental factors affecting the performance of planing surfaces and the wave shape formed in wake of the planing surface.

(g) Investigations will extend from elementary planing surfaces of several dead-rise angles through warped, concave, or flared planing surfaces with Vee or pointed steps.

(h) Investigation is still in progress.

(341) EFFECT OF ROUGH WATER ON DIRECTIONAL STABILITY (Project 980).

(b) Laboratory project.

(c) K. S. M. Davidson, W. H. Sutherland, A. Suarez.

(d) Dr. K. S. M. Davidson, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Theoretical investigation.

(f) To conduct exploratory tests and make calculations to determine the probable extent to which directional stability of surface vessels may be affected by sea conditions.

(g) The scope of this investigation is limited at the moment to the behavior of destroyers in a seaway. At some later date other types of surface vessels are expected to be included in the study.

(h) Project is being continued.

(342) HIGH SPEED DIRECTIONAL STABILITY OF FLYING BOATS (Project CB807).

(b) Bureau of Aeronautics, U. S. Navy Dept. (c) R. R. Williamson.

(d) R. R. Williamson, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Experimental investigation for design and general information.

(f) To develop techniques for and to investigate high speed directional stability of flying boats in order to discover the nature of instability, the effect of hull form on stability, and methods of obtaining more effective control.

(g) This is a broad research program growing out of the frequency of "water looping" of flying boats while landing or taking off at high speeds. It is to be conducted with a number of representative flying boat hulls.

(h) Tests are still in progress. Restricted project.

(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., W. C. Axt.

(d) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Experimental investigation for design information.

(f) To obtain hydrodynamic information on a series of hull models suitable for small flying boats and amphibians.

(g) 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, and high speed resistance, and effect of hull form and proportions.

(h) Testing is in progress.

(344) DETERMINATION OF IMPACT LOADS (Project CF998).

(b) Bureau of Aeronautics, U. S. Navy Dept. (c) R. R. Williamson.

(d) R. R. Williamson, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Experimental investigation for design information.

(f) To determine the impact loads experienced by flying boats while landing in waves.

(g) A series of flying boat hull models were tested, using mechanical accelerometers, at various loads, speeds, and trims in waves of varying heights and lengths, to determine the maximum impact loads which might be encountered in landing normal to the wave crest.

(h) First phase is completed; second phase in progress. Restricted project.

(i) "Impact tests of waves on a series of flying hull boat models." Technical Report No. 317, Experimental Towing Tank.

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

(b) David Taylor Model Basin, U. S. Navy Dept. (c) Randolph Ashton.

(d) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Theoretical analysis for design information.

(f) To analyze the results of an earlier investigation on a series of Vee-vottom motor boat hulls tested at the Experimental Towing Tank and reported in Experimental Towing Tank Report No. 153.

(g) Test results of the earlier investigation will be analyzed in order that information not heretofore published will become available to designers of Vee-bottom motor boats. These data will be issued as a supplement to Taylor Model Basin Report R-47, and will be distributed by the David Taylor Model Basin to all holders of Report R-47.

(h) Work in progress.

(346) HYDROFOIL STUDY (Project CG1002).

(b) John H. Carl and Sons, Inc. (c) W. C. Axt.

(d) W. C. Axt, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Experimental investigation for design and general information.

(f) To carry out a series of tests in the towing tank to determine the practicability of proposed methods for improving the stability of hydrofoils.

(g) A hydrofoil boat will be tested to determine the optimum arrangement and proportions of hydrofoils to obtain the maximum stability possible.

(h) Test work is in progress.

(347) CORRELATION OF BARGE RESISTANCE (Project R810).

(b) Laboratory project. (c) A. B. Murray, Margaret Camp.

(d) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) General information.

(f) To determine the effect of design trends and hull proportions on the overall resistance performance of barges.

(g) The project includes a compilation and correlation of all test results on all barge tests made at this laboratory.

(h) Project uncompleted.

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

(b) Laboratory project. (c) A. B. Murray, Margaret Camp.

(d) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) General information.

(f) To determine the effect on resistance of various hull proportions, drafts, trims, and hull features of high speed motor boats.

(g) All previous test results of high speed motor boats will be compiled and correlated in this project. Over one hundred different models are involved.

(h) In progress.

(349) BARGE YAWING (Project R975).

(b) Laboratory project. (c) A. B. Murray, Randolph Ashton.

(d) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Design information.

(f) To study the forces involved in the directional stability of barges.

(g) The project includes tests of two barges, one of which is stable and the other unstable directionally.

(h) In progress.

(350) SAILBOAT FORM RESEARCH (Project R857).

(b) Sparkman and Stephens. A. E. Luders, F. C. Geiger, Philip Rhodes, Herman Whiton, and others.

(c) A. B. Murray, Margaret Camp.

(d) H. W. MacDonald, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) For design information.

(f) To determine the effect of various form changes and proportions upon the sailing performance of a series of related sailing yacht hulls.

(g) A model of a 30-foot sailing yacht (New York 30) is being used as the parent model in this project. The proportions of the models will be systematically varied in beam, draft, trim, and displacement. Other variations to be undertaken in later phases of this project will include variations in stern overhang, transom width, and fore and aft positioning of the keel.

(h) In progress.

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

(b) Laboratory project. (c) A. B. Murray.

(d) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) Experimental.

(f) To determine if successful self-propelled testing can be conducted using models of less than 12-foot length.

(g) Self-propelled tests will be conduoted on an 11-foot model of the German motorship "San Franoisco", on which considerable full-scale data are available, to determine if SHP test results from a model of this size are practical.

(h) 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.

(352) TOWBOAT CORRELATION (Projeot R809).

(b) Laboratory project. (c) A. B. Murray, Randolph Ashton.

(d) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(e) General information.

(f) To determine the effect of design features and operating conditions on the performance of river towboats.

(g) A number of self-propelled experiments on river towboat hull models have been made, and this project will include a compilation and correlation of the results of these tests.

(h) Compilation and correlation completed; final report in preparation.

THE UNIVERSITY OF TENNESSEE, Department of Civil Engineering, Knoxville, Tenn.

Inquiries concerning Projects Nos. 353 to 355, incl., should be addressed to Prof. Cecil S. Camp, Department of Civil Engineering, The University of Tennessee, Knoxville 16, Tenn.

(353) WEARING OF SAND PARTICLES.

(b) Laboratory project. (c) Harbans Singh.

(e) Graduate thesis.

(f) To measure wear of sand under conditions intended to simulate conditions in a flowing stream.

(g) A revolving drum operating at a speed similar to flow conditions in natural streams will be used to produce movement of the sand. Wear will be measured by sieve analysis and also by photographs using a microscope.

(h) Study of literature is practically complete. Equipment is under construction.

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

(b) Laboratory project. (c) Mohammad A. Ahmad.

(e) Graduate thesis.

(f) To study effect of various size and spacing of blocks in stilling basins, and the effect of this variation on the formation of the hydraulic jump.

(g) A glass-walled flume with either a model dam or a sluice gate, or both, will be used to produce high velocity flow. Various height and spacings of blocks will be used in the stilling basin. The effect on the formation of the hydraulic jump and on the effectiveness of stilling action will be observed.

(h) Study of literature is practically complete. Equipment is under construction.

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

(b) Laboratory project. (c) Bakhteyar Husain.

(e) Graduate thesis.

(f) A rather complete study of elbow meters made from commercial elbows of 6-inch and smaller elbows is planned.

(g) More definite data than are now available are desired in regard to the reliability of equations of flow for various elbows made by different manufacturers and with different approach conditions to the meter. Meters built by different persons from different kinds of elbows will be tested under similar conditions in an attempt to determine the probable error of such procedure in practice.

(h) Set-up of equipment is in progress.

TEXAS A & M COLLEGE, Engineering Experiment Station, College Station Tex.

Inquiries concerning Projects Nos. 356 and 357 should be addressed to Henry J. Miles, Professor of Hydraulics, Texas A & M College, College Station, Tex.

(356) COMPARISON AND CORRELATION OF THE LEADING FORMULAS FOR COMPUTING FRICTION LOSSES IN PIPES BY AN ANALYSIS OF THE STANTON DIAGRAM.

(b) Research project. (c) H. J. Miles.

(e) Mathematical analysis for general information.

(f) To explain some of the differences in the formulas commonly used in computing friction losses in pipes.

(g) The Stanton diagram, properly interpreted, throws some very interesting light on the differences in the various formulas commonly used in computing friction losses in pipes.

(h) Preliminary studies have been completed.

(357) FRICTION LOSS IN STREAMLINE PIPE FITTINGS.

(b) Research project; material furnished by Tube Turns, Inc.

(c) S. J. Durr, Jr., H. J. Miles. (e) Student thesis.

(f) To obtain data on friction loss in this type of pipe fitting.

(g) The friction losses through the fittings are determined by means of a manometer for various rates of flow.

(h) A considerable portion of the experimental data has already been obtained.

THE UNIVERSITY OF TEXAS, Department of Civil Engineering, Austin, Tex.

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

(b) Laboratory project. (c) W. L. Moore.

(d) Walter L. Moore, Associate Professor of Civil Engineering, The University of Texas, Austin 12, Tex.

(e) Experimental project for general information.

(f) To investigate the use of a total head measurement in determining the flow over weirs with a broad range of velocity of approach.

(g) Experiments will be conducted on a weir without end contractions, varying the position of the total head measurement until the best location is found. The discharge-head relation will then be checked to determine the effect of change in size and change in viscosity.

(h) Preparation of apparatus has been started.

UTAH STATE AGRICULTURAL COLLEGE, School of Engineering and Technology, Logan, Utah.

(359) DRAINAGE OF IRRIGATED LANDS.

(b) Utah Agricultural Experiment Station, in cooperation with Utah Power & Light Co.

(c) O. W. Israelsen.

(d) O. W. Israelsen, Research Professor of Irrigation and Drainage, Utah State Agricultural College, Logan, Utah.

(e) General experimental research, for design.

(f) (1) To develop new and improved methods of design, operation, and maintenance of drainage systems, both gravity and pumping; (2) to develop improvements in the design, the placing, and the maintenance of drainage tile, with special reference to prevention of inflow of excessive silt and clay which clog tile drains and necessitate very costly cleaning or abandonment; (3) to develop a clear understanding, by field inspection and experiment, of the reasons for successful drainage of 100,000 acres of Utah irrigated land, now well-drained, and of the reasons for failure of the drainage systems covering an additional 100,000 acres; (4) to find the conditions under which, and the extent to which, drainage by pumping is preferable to drainage by gravity systems, and to design, locate, drill, and develop drainage wells so as to obtain maximum water yield per foot of drawdown, and thus decrease drainage costs.

(g) It is planned to study the hydraulics of soils and the engineering aspects of drainage with existing open and closed drains, additional open drains, and drainage and irrigation pumps under procedure substantially as follows:

(1) Selection of typical waterlogged areas and study of the effectiveness of drainage by present methods, using tensiometers and piezometers to determine the changes in hydraulic heads, the fluctuations of the water table, and ground water flow patterns.

(2) Locating the sources of excess water that cause waterlogging, and measuring the amounts in relation to water conveyance and application.

(3) Measuring the flow from established drains in relation to soucres of water and adequate drainage.

(4) Finding the lateral extent to which drains are effective, with the view toward determining the proper depth and spacing of drains.

(5) Select saline soils for which drainage is considered ample, and other soils for comparison, and systematically sample to determine the salinity status.

(6) Lay out system of field plots for conducting experiments with leaching.

(7) Study of logs of wells (irrigation, drainage, and culinary) in the drainage-problem area and the relationships of the logs of wells to their specific water yields as measured in gallons per minute per foot of drawdown.

(8) Drilling of special small-diameter test wells for obtaining data on soil formations and probable specific capacities of large-diameter pumped wells.

(9) Drilling and pumping from one or more large-diameter wells for experimental purposes.

(10) Installation and reading of piezometers in the pump drawdown area.

(11) Such other technical studies as the progress of the research work may necessitate.

Particular attention will be given to field studies of ground water and soil conditions on drained lands in Cache, Box Elder, Salt Lake, and Utah Counties, with special reference to the physical factors influencing success or failure in drainage. Important among these factors are the flow of water from drains, volumes of irrigation water applied, water table patterns, and alkali conditions. Special attention will be given to improvements of tensiometers and piezometers; to water table patterns near drains; and to the effects of differences in hydraulic head in both saturated and unsaturated soils.

(h) A continuing project, initiated in June 1947.

(i) Annual reports will be prepared; special reports and manuscripts for technical papers and bulletins will be prepared as the progress of the work merits.

"Land drainage and reclamation." Ayres and Scoates. McGraw-Hill Book Co. 1928.

"Water table variations - Causes and effects." Ballantyne. Utah Agric. Exp. Station Bulletin 144. 1916.

"Farm drainage: A manual of instructions." Brown. Utah Agric. Exp. Station Bulletin 123. 1913.

"The reclamation of seeped and alkali lands." Brown and Hart. Utah Agric. Exp. Station Bulletin 111. 1910.

"Land drainage and flood protection." Etcheverry. Stanford Univ. Press. 1931.

"Drainage of land overlying a ground water reservoir." Israelsen and McLaughlin. Utah Agric. Exp. Station Bulletin 242. 1932.

"Drainage of land overlying an artesian ground water reservoir." Israelsen and McLaughlin. Utah Agric. Exp. Station Bulletin 259. 1935.

"Seepage of ground water and its relation to alkali accumulation." Jennings, Gardner, and Israelsen. Utah. Agric. Exp. Station Circular 106. 1934.

"The capacity of irrigation and drainage wells." Murdock. Montana Agric. Exp. Station Bulletin 182. 1925.

"Seepage and drainage of irrigated lands." Murdock. Montana Agric. Exp. Station Bulletin 255. 1932.

"Land drainage." Powers and Teeter. John Wiley & Sons Book Co. 1932.

"Alkali reclamation investigations." Snyder, Baker, Kulp, and Marr. Idaho Agric. Exp. Station Bulletin 233. 1940.

(151) LINING OF IRRIGATION CANALS AND DITCHES.

(b) Cooperative project, Utah State Agricultural College and Soil Conservation Service.

For complete report, refer to Project No. 151, "Lining of Irrigation Canals and Ditches", Soil Conservation Service, Irrigation Research Laboratory, Logan, Utah, page 80.

THE STATE COLLEGE OF WASHINGTON, Department of Civil Engineering, Pullman, Wash.

(360) PRESSURE MEASUREMENT BY USE OF STRAIN GAGE.

(b) Laboratory project. (c) M. R. Carstens, C. L. Barker.

(d) M. R. Carstens, Instructor, Dept. of Civil Engineering, The State College of Washington, Pullman, Wash.

(e) Experimental.

(f) To develop a pressure measuring instrument that will have very small inertia.

(h) Experimental equipment now being constructed.

UNIVERSITY OF WASHINGTON, Department of Civil Engineering, Seattle, Wash.

Inquiries concerning Projects Nos. 361 to 364, incl., should be addressed to Prof. C. W. Harris, Hydraulics Laboratory, Dept. of Civil Engineering, University of Washington, Seattle, Wash.

(361) FLOW IN PIPES AND CHANNELS.

(b) Laboratory project.

(c) C. W. Harris, R. E. Shepard, Clifford Dick, Roy Tinney.

(e) Experimental study to obtain general information.

(f) To establish a means conforming to modern concepts of flow of 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 of pipe or channel.

(g) Surfaces of random roughness are produced artificially by spraying sheet metal liners with stainless steel. The liners are then rolled to proper diameter and inserted in standard pipes or formed to proper channel shapes. Pipe tests are run in the usual manner, covering an exceptionally wide range of velocities. Open flow tests will require the construction of a 120-foot channel with adjustable cross-sectional shape.

(h) The pipe tests are essentially completed, as will be noted under Completed Projects for this laboratory, Project No. 495, "Flow in Pipes", page 153. The 120-foot channel is to be designed. At present, incidental investigations are being made to determine the effect of turbulence on piezometer readings, to determine the effect of artificially introduced turbulence on pipe losses, and to develop a gage capable of more accurate readings of head loss in the range normally covered by the oil-water manometer.

(362) VISCOSITY OF OIL UNDER PRESSURE.

(b) Engineering Experiment Station, University of Washington.

(c) H. G. Anson.

(e) Experimental project for general information.

(f) To obtain data concerning effect of pressure on viscosity of oils not yet subjected to such tests, by use of rolling ball viscosimeter.

(g) To design, build, and calibrate rolling ball viscosimeter capable of accurately measuring fiscosities at pressures up to approximately 40,000 pounds per square inch, and to obtain data on viscosity of various oils up to this pressure, at temperatures within atmospheric range. Pressure will be supplied by intensifier used in conjunction with a hydraulic jack. Preliminary gaging will be supplied by a Bourdon-tube type pressure gage. Some design criteria will be gained from building and using rolling ball viscosimeter designed for atmospheric pressure.

(h) Atmospheric pressure viscosimeter in use, and preliminary design completed on high pressure apparatus.

(i) The publications below are being used as primary references:

"Viscosities of lubricants under pressure." Mayo D. Hersey and Henry Shore. Mechanical Engineering, Vol. 50: 221. 1928.

"On the viscosities and compressibilities of liquids at high pressures." Proc. Roy. Soc. A., Vol. 97: 240-259. 1920.

(363) INTERNAL PRESSURES IN TURBULENT FLOW IN PIPES.

(b) Laboratory project. (c) W. W. Saxton.

(e) Experimental, employing fundamental hydraulics in the design of the testing apparatus and in the actual testing.

(f) To determine if there is some characteristic of turbulent flow (especially in turbulence caused by sudden enlargement) which interferes with surface piezometer measurements. It has been demonstrated by other experiments that under certain conditions piezometer readings are inexplicably high when taken by the conventional method. This experiment is to determine the cause of these high readings.

(g) A special piezometer tube has been designed to measure actual pressure at any point within a 12-inch pipe. Pressure readings may be taken at any point along a diameter of the pipe and compared with piezometer readings of pressure at the inside surface of the pipe.

Original interest in the problem was occasioned by experiments in connection with losses due to sudden expansion performed by Archer. No published experimental work has been done in this field since Archer ran his experiments.

(i) "Experimental determination of loss of head due to sudden enlargement in circular

pipes." W. H. Archer. Trans. A.S.C.E., Vol.LXXVI: 999-1026. 1913.

(364) THE EFFECT OF INDUCED TURBULENCE UPON LAMINAR FLOW.

(b) Laboratory project. (c) L. E. Johnson.

(e) Experimental study to obtain specific information.

(f) To establish the effect of turbulence, induced at a given section in a pipe carrying a liquid under laminar flow conditions, upon the flow conditions downstream from the point of application of turbulence.

(g) Turbulence is induced in a pipe carrying liquid under laminar flow conditions by injecting a jet of water into the pipe. Piezometer readings are made at various points downstream from the point of application of turbulence. Head losses are determined accurately by a floating mirror gage recently developed in this laboratory. The tests will cover the range of Reynolds numbers from a few hundred to about ten thousand.

(h) Readings are still being made, and no definite conclusion has as yet been reached.

THE UNIVERSITY OF WISCONSIN, Hydraulic Laboratory, Madison, Wis.

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

(b) Laboratory project. (c) J. R. Villemonte and undergraduate students.

(d) Prof. James G. Woodburn, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(e) Experimental laboratory study as theses in partial fulfillment of requirements for Ph. D. and B.S. degrees.

(f) To substantiate experimentally a new formula based partly on mathematical theory and partly on results obtained by previous investigators.

(g) Tests will be run with free and submerged discharge over sharp-crested weirs of various shapes -- proportional, rectangular full-width and contracted, circular, parabolic, triangular, and cusp parabolic. Tests are now being run with various degrees of submergence on a rectangular weir 2 feet high and a flume 2 feet wide.

(h) Work in progress.

(i) A paper by Mr. Villemonte stating a proposed formula for submerged weir flow and giving experimental verification has been accepted for publication.

(365) MODEL TESTS OF PETENWELL DAM SPILLWAY.

(b) Wisconsin River Power Company. (c) A. T. Lenz.

(d) Dr. Arno T. Lenz, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(e) Experimental study of designs prepared by Harza Engineering Co. of Chicago.

(f) To determine final design of spillway structure of dam now under construction on the Wisconsin River.

(g) A 1:25-scale model of a single spillway gate and sloping apron is being tested to determine the effect on the water surface profile and sand erosion downstream from the dam of the following variables: location and length of apron, position and design of end sill, advantages to be gained from the use of baffle blocks. Measurements are also being taken on apron and uplift pressures, discharge calibration at full and part gate openings. Further tests are being run on the design of an apron extension to be used with pilot spillway which permits the operation of a single gate at low tailwater levels.

(h) Tests are nearly completed, and a model of the entire powerhouse and spillway section will be installed next.

(366) HEAD LOSSES IN FLOW OF LIQUIDS IN PIPE AND FITTINGS.

(b) Laboratory project. (c) T. H. Feng.

(d) Prof. James G. Woodburn, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(e) Study of friction factors and their relationship to Reynolds number and absolute roughness of pipe wall.

(f) To substantiate or revise values of absolute roughness, "k", which have been proposed for use with Colebrook-White formula for flow in commercial pipes.

(g) New data on head losses in pipe flow will be obtained by laboratory tests, and if possible by field tests.

(h) Former test results are being analyzed.

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

(b) Laboratory project. (c) F. C. Dreher.

(d) Prof. James G. Woodburn, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(e) Continuation of experimental study started before the war.

(f) To determine relation of flow to head for orifices attached to the ends of pipes for the purpose of measuring flow in locations where it is not possible to tap the pipe from the side to determine pressure.

(g) Orifices one-fourth, three-eighths, one-half, and two-thirds the diameter of the approach pipe will be tested. Approach pipes will be 8-inch, 10-inch, and 12-inch diameter. The discharge will be measured either volumetrically or gravimetrically.

(h) Data previously obtained with orifices on 10-inch and 12-inch pipes will be checked. Equipment is now being erected for study of orifices on the end of an 8-inch approach pipe.

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

(b) Laboratory project. (c) Duncan McIntyre.

(d) Dr. Arno T. Lenz, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(e) Thesis study for M.S. degree in Civil Engineering.

(f) To develop a flood forecasting procedure, taking into account power plant operations on the Wisconsin River.

(g) A modified form of the unit hydrograph is being tested to route flood flows down the Wisconsin River starting from the stream gaging station below Rainbow Reservoir.

(h) Project in progress.

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

(b) Laboratory project. (c) G. A. Rohlich and undergraduate students.

(d) Dr. Gerard A. Rohlich, Hydraulic and Sanitary Laboratory, University of Wisconsin, Madison, Wis.

(e) Experimental laboratory study for general information.

(f) To determine head-discharge relationship of flow into U-shaped troughs and gutters such as are used as effluent final sedimentation tanks in sewage treatment plants.

(g) U-shaped weirs eight inches wide, six inches deep, and five feet long are being tested with heads up to 0.3 feet. Flows are being measured gravimetrically.

(h) Project in progress.

U. S. DEPT. OF AGRICULTURE, FOREST SERVICE California Forest & Range Experiment Station, Berkeley, Calif.

(261) WATERSHED MANAGEMENT (Southern California).

(b) California Forest & Range Experiment Station, Forest Service, U. S. Dept. of Agriculture; Division of Forestry, Dept. of Natural Resources, State of California; and other agencies responsible for the management of watersheds or production of water supplies.

(c) C. J. Kraebel, J. D. Sinclair, P. B. Rowe, H. C. Storey, E. L. Hamilton, J. S. Horton, E. A. Colman.

(d) S. N. Wyckoff, Director, or C. J. Kraebel, Chief, Division of Forest Influences, California Forest & Range Experiment Station, 329 Giannini Hall, Berkeley 4, Calif.

(e) Comprehensive investigation of hydrology, erosion, and related studies in mountainous watersheds of Southern California.

(f) (1) To study the disposition of rainfall as influenced by watershed conditions, including topography, geology, soils, and vegetation; and (2) to develop methods of watershed management which will assure both the maximum yield of usable water and satisfactory regulation of flood runoff and erosion.

(g) Major work center is the San Dimas Experimental Forest, a 17,000-acre area on the south slopes of the San Gabriel Mountains comprising Big Dalton and San Dimas Canyons. More than 400 rain gages have been installed to measure rainfall. Ten large and seven small watersheds within the two drainages are equipped with gaging stations to measure streamflow. The seven small watersheds also have reservoirs to measure erosion. The Big Dalton and San Dimas reservoirs of the Los Angeles County Flood Control District provide measurements of runoff and erosion from the two main drainages. More intensive measurements of surface runoff and erosion are obtained from eighteen small plots. A series of twenty-six large lysimeters is designed to compare the use of water by the more important species of shrubs and one species of pine. Essential climatic data have been obtained from several meteorological stations within the Experimental Forest.

(h) Collection of records was begun upon completion of each research installation, principally during the period 1933 to 1937, and continued on the entire Experimental Forest until October 1, 1946. At that time the loss of emergency assistance made it necessary to suspend about 80 percent of the hydrologic records. Full operation of research installations was resumed on October 1, 1947, with financial assistance provided by the State of California through the Division of Forestry. Activities now in progress include:

(1) Continuation of precipitation and streamflow measurements on the entire Experimental Forest, including ten large and seven small watersheds.

(2) Collection of erosion records from the seven small watersheds.

(3) Operation of the series of large lysimeters and maintenance of essential climatic measurements.

(4) Special rainfall studies, including rain-gage placement and exposure in relation to topography.

(5) The testing of a direct reading electrical soil moisture meter that has been developed by this station.

(6) The analysis of accumulated data and preparation of reports for publication.

(i) "A laboratory procedure for determining the field capacity of soils." E. A. Colman. Soil Science, Vol. 63, No. 4: 277-283. April 1947.

U. S. DEPT. OF AGRICULTURE, FOREST SERVICE, Intermountain Forest & Range Experiment Station, Ogden, Utah.

Inquiries concerning Projects Nos. 371 to 373, incl., should be addressed to the

Director, Intermountain Forest & Range Experiment Station, U. S. Forest Service, Ogden, Utah.

(371) WATERSHED MANAGEMENT AND PROTECTION (Bunchgrass-granitic soils of southwestern Idaho).

(b) Intermountain Forest & Range Experiment Station, U. S. Forest Service.

(c) G. W. Craddock, in charge, Division of Watershed Management and Protection Research, and P. E. Packer.

(e) Experimental studies of runoff, water losses, and soil stability on mountainous forest and range lands.

(f) To determine plant cover and soil mantle conditions required for maximum yields of usable streamflow and for soil stability, and to develop land management methods for restoring and maintaining desirable watershed conditions.

(g) Effects of plant cover and its use on runoff and erosion are being determined on three 150-acre watersheds, two 10-acre watersheds, six 1-milacre lysimeters, and more extensively by portable infiltrometers and related laboratory studies of soil characteristics. These studies are carried out from Boise Research Center near Idaho City, Idaho, within the Boise River drainage basin.

(h) Exploratory studies were initiated in 1930. Experimental equipment was installed in 1934 and 1935. Measurements were suspended in 1940. Infiltrometer studies were reactivated in 1947.

(i) "The erosion-streamflow and range situation on the Boise River Watershed." George W. Craddock, Jr. The Utah Juniper, Vol. 5: 13-16. 1934.

"Conditions influencing erosion on the Boise River Watershed." F. G. Renner. U.S.D.A. Tech. Bul. No. 528, 32 pp, illus. 1936.

"The influence of range plant cover on the rate of absorption of surface water by soils." C. Kenneth Pearse and Samuel B. Woolley. J. Forestry, Vol. XXXIV: 844-847. 1936.

"Surface runoff and erosion on granitic mountain soils of Idaho as influenced by range cover, soil disturbance, slope, and precipitation intensity." George W. Craddock and C. Kenneth Pearse. U.S.D.A. Circular No. 482, 24 pp, illus. 1938.

(372) WATERSHED MANAGEMENT AND PROTECTION (Mixed forest and brush on steep mountain lands, northern Utah).

(b) Intermountain Forest & Range Experiment Station, U. S. Forest Service.

(c) G. W. Craddock, in charge, Division of Watershed Management and Protection Research, A. R. Croft, Richard Marston.

(e) Experimental studies of runoff, water losses, and soil stability on steep watershed lands.

(f) To determine plant cover and soil mantle conditions required for maximum yields of usable streamflow, flood prevention, and soil stability, and to develop land management methods for restoring and maintaining desirable watershed conditions.

(g) Effects of plant cover and supplemental mechanical devices, such as contour trenches, on runoff and erosion, are being determined on 14 experimental watersheds of from about 150 to 6,000 acres each, batteries of runoff and erosion plots, and soil moisture pits, and by related laboratory studies of soil and water relations. Most of these studies are carried out on the Wasatch Branch Experimental Watersheds near Farmington, Utah.

(h) Exploratory studies of cloudburst type summer rain floods were initiated in 1930. Methods of restoring flood source areas by means of contour trenching and artificial reseeding for flood prevention purposes were begun in 1933 and carried through 1938. Evaluation of these measures and supplementary studies on runoff behavior have been continued on a limited scale to date.

(i) "Torrential floods in northern Utah, 1930." Report of Special Flood Commission appointed by Gov. George H. Dun. Agr. Exp. Sta., Utah State Agricultural College

Circular 92, 51 pp, illus. January 1931.

"Floods and accelerated erosion in northern Utah." Reed W. Bailey, C. L. Forsling, and R. J. Becraft. U.S.D.A. Misc. Pub. No. 196, 21 pp, illus. August 1934.

"Contour trenches control floods and erosion on range lands." Reed W. Bailey and A. R. Croft. Emergency conservation work Forestry Publication No. 4, 22 pp, illus. May 1937.

"A comparison of accelerated erosion losses in Emigration, Red Butte, and City Creek Canyons." A. R. Croft, Lowell Woodward, and D. A. Anderson. Utah Academy of Science, Arts and Letters, Vol. XIV. 1937.

"Measurement of accelerated erosion on range-watershed land." A. R. Croft, Lowell Woodward, and D. A. Anderson. J. Forestry, Vol. 41, No. 2: 112-116. 1943.

"Some recharge and discharge phenomena of north and south-facing watershed-lands in the Wasatch Mountains." A. R. Croft. Trans. American Geophysical Union, Pt. VI: 881-889. 1944.

"Some factors that influence the accuracy of water-supply forecasting in the Intermountain Region." A. R. Croft. Trans. American Geophysical Union, Vol. 27: 375-388. 1946.

"Salt Lake City flood, 1945." George W. Craddock. Proc. Utah Academy of Science, Arts and Letters, Vol. 23: 51-61. 1945-46.

"A land use management cycle." A. R. Croft. J. Forestry, Vol. 44, No. 11. November 1946.

(373) WATERSHED MANAGEMENT AND PROTECTION (Range-watersheds in south-central Utah).

(b) Intermountain Forest & Range Experiment Station, U. S. Forest Service.

(c) G. W. Craddock, in charge, Division of Watershed Management and Protection Research, and Howard Lull.

(e) Experimental studies of runoff, water losses, and soil stability on forest and range lands of high plateaus.

(f) To determine plant cover and soil mantle conditions required for maximum yields of usable streamflow and for soil stability, and to develop land management methods for restoring and maintaining desirable watershed conditions.

(g) Effects of plant cover and its use on runoff and erosion are being determined on two 10-acre watersheds and two 300-acre watersheds, in soil pits, and more extensively by portable infiltrometers and related laboratory studies of soil characteristics. This program centers mainly at Great Basin Branch Experiment Station near Ephraim, Utah.

(h) Exploratory studies of surface runoff and erosion were initiated in 1912. A-B experimental watersheds equipped to measure runoff and soil losses under grazing use were installed in 1915, and have been in continuous operation to date. Supplemental studies of snow accumulation and melting, evapo-transpiration losses, and infiltrometer studies have been added in recent years.

(i) "Range preservation and its relation to erosion control on western grazing lands." Arthur W. Sampson and Leon H. Weyl. U.S.D.A. Bul. No. 675, 35 pp, illus. June 1918.

"A study of the influence of herbaceous plant cover on surface runoff and soil erosion in relation to grazing on the Wasatch Plateau in Utah." C. L. Forsling. U.S.D.A. Tech. Bul. 220, 71 pp, illus. 1931.

"Epicycles of erosion in the valleys of the Colorado Plateau Province." Reed W. Bailey. J. Geology, Vol. XLIII, No. 4: 337-355. 1935.

"Some recharge phenomena of a Wasatch Plateau Watershed." A. R. Croft and Richard B. Marston. Trans. American Geophysical Union, Vol. 24, Pt. II: 460-464. 1943.

"Infiltration capacities of some plant-soil complexes on Utah range watershed lands." Lowell Woodward. Trans. American Geophysical Union, Vol. 24, Pt. II: 468-473. 1943.

"Surface runoff potentials of some Utah range watershed lands." Lowell Woodward and George W. Craddock. J. Forestry, Vol. 43, No. 5: 357-365. 1945.

U. S. DEPT. OF AGRICULTURE, FOREST SERVICE, Northeastern Forest Experiment Station, Philadelphia, Pa.

Inquiries concerning Projects Nos. 374 and 375 should be addressed to The Director, Northeastern Forest Experiment Station, Forest Service, Philadelphia, 7, Pa.

(374) FROST SURVEY IN ALLEGHENY RIVER WATERSHED.

(b) Northeastern Forest Experiment Station, U. S. Forest Service.

(c) Sidney Weitzman, N. Bethlahmy.

(e) Extensive field studies to determine the influence of cover and site conditions on the type and depth of frost in the Allegheny River watershed.

(f) Preliminary investigation of the role of land use and condition in the management of watersheds for flood control and water conservation.

(g) Periodic frost observations will be taken on 60 sites established in forest and open areas in gaged sub-watersheds of the Allegheny River watershed. The frost observations will relate the depth and type of frost in the ground to cover, land use, and condition.

(h) Measurements will be taken during the winter of 1947-1948.

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

(b) Cooperative project of the Northeastern Forest Experiment Station, U. S. Forest Service, Philadelphia, Pa., and the Soil Conservation Service, Upper Darby, Pa.

(e) A field study of frost and ground freezing over a wide range of land use and conditions.

(f) To determine the effect of cover type and site condition on ground freezing in the Northeastern United States.

(g) Frost observations will be made weekly on 64 sites, including forest and open land through New England, New York, and northern Pennsylvania. The major soil and cover types in the Northeast will be included. Frost observations will be related to the depth and type of frost in the ground to land use condition.

(h) Measurements will be taken during winter of 1947-1948.

U. S. DEPT OF AGRICULTURE, FOREST SERVICE, Rocky Mountain Forest & Range Experiment Station, Fort Collins, Colo.

Inquiries concerning Projects Nos. 376 to 379, incl., should be addressed to The Director, Rocky Mountain Forest & Range Experiment Station, U. S. Forest Service, Fort Collins, Colo.

(376) FRONT RANGE WORK CENTER - MANITOU EXPERIMENTAL FOREST.

(b) Rocky Mountain Forest & Range Experiment Station, U. S. Forest Service.

(c) W. M. Johnson (acting center leader) and E. G. Dunford (forest influences research technician), working under the supervision of W. G. McGinnies, Director, and H. G. Wilm (field division chief in charge of forest influences research).

(e) Experimental project, employing field experiments on plots and watersheds.

(f) To work out the solutions of problems in watershed management for the forest- and range-covered watershed lands of the Rocky Mountain Front Range.

(g) The project includes a variety of experiments, all designed to show the influence of grazing, timber cutting, and revegetation of depleted watershed lands upon water supplies and more particularly upon erosion and sedimentation. These experiments range in magnitude from small lysimeters, 1/10,000-acre in surface area, through small plots and larger watersheds and pastures up to a large watershed 4,800 acres in area. In addition to these studies, a large number of measurements of infiltration and erosion are obtained by portable equipment.

(h) Watershed and plot studies are being continued, and plans developed for applying treatments to vegetation. Studies of cattle grazing on large pastures are being brought to conclusion, and manuscript for bulletin is now in process of preparation.

(i) "Infiltration capacity of forest soil as influenced by litter." W. M. Johnson. J. Forestry. June 1940.

"Some relationships of plant cover to runoff, erosion, and infiltration on granitic soils." W. M. Johnson and C. H. Niederhof. J. Forestry. October 1941.

"Watershed management research in the Rocky Mountain region. III. Grass, water, and erosion." H. G. Wilm. Engineer's Bulletin. July 1941.

"The interception of rain and snow by a forest of young ponderosa pine." W. M. Johnson. Trans. American Geophysical Union, Pt. II: 566-570. 1942.

(377) CONTINENTAL DIVIDE WORK CENTER - FRASER EXPERIMENTAL FOREST.

(b) Rocky Mountain Forest & Range Experiment Station, U. S. Forest Service.

(c) B. R. Lexen (acting center leader) and B. C. Goodell (influences research), under supervision of W. G. McGinnies, Director, and H. G. Wilm (division chief).

(e) Experimental project, employing field experiments on plots and watersheds.

(f) To work out solutions of problems in watershed management for forested watersheds of the Continental Divide zone of the central Rockies.

(g) Experiments in this project are designed to show the influence of lodgepole pine and spruce-fir forests and of the cutting of this kind of timber upon a number of factors associated with the yield of water, largely from stored snow. Some studies are conducted on sample plots ranging in size from 3/4 acre to 8 acres, on which various timber-cutting methods are applied to young and mature forest cover. Other experiments are being conducted on watersheds with perennial streams; the smallest is 1.11 square mile in area, and the largest is 32.8 square miles.

(h) First phase of experiments in mature lodgepole pine completed in 1944. A number of articles have been published and a bulletin is now awaiting print. Studies in aspen, young pine, and open areas have been completed and articles published. Treatments applied and post-treatment data being collected in young lodgepole pine and spruce-lodgepole transition. Pre-treatment records being obtained in spruce-fir plots, and on watersheds in lodgepole and spruce-fir types. Plans are being drawn for cutting timber on one watershed.

(i) "Range and watershed problems." C. A. Connaughton. J. Forestry. February 1940.

"Research on snow by the Forest Service." C. A. Connaughton. Trans. American Geophysical Union, Pt. III: 920-925. September 1940.

"Watershed management research in the Rocky Mountain region. I. Why research in watershed management." H. G. Wilm. Engineers' Bulletin. May 1941.

"Watershed management research in the Rocky Mountain region. II. Forests, snow, and rain." H. G. Wilm. Engineers' Bulletin. June 1941.

"Watershed management research in the Rocky Mountain region. III. Grass, water, and erosion." H. G. Wilm. Engineers' Bulletin. July 1941.

"A portable electric water-depth gage." H. G. Wilm and M. H. Collet. Civil Engineering. May 1941.

"The influence of a lodgepole-pine forest on storage and melting of snow." H. G. Wilm and M. H. Collet. Trans. American Geophysical Union, Pt. II: 505-508. 1940.

"New gaging station for mountain streams." H. G. Wilm. Civil Engineering. October 1942.

"The effect of openings in a young lodgepole pine forest on the storage and melting of snow." C. H. Niederhof and E. G. Dunford. J. Forestry. October 1942.

"The effect of cutting mature lodgepole pine stands on rainfall interception." C. H. Niederhof and H. G. Wilm. J. Forestry. January 1943.

"Determining net rainfall under a conifer forest." H. G. Wilm. J. of Agr. Research, Vol. 67: 501-512. December 1943.

"Statistical control of hydrologic data from experimental watersheds." H. G. Wilm. Trans. American Geophysical Union, Pt. II: 618-622. January 1944.

"Soil moisture under a coniferous forest." H. G. Wilm. Trans. American Geophysical Union, Pt. III: 11-13. December 1943.

"Proper timber cutting will increase water supply available for irrigation use." E. G. Dunford. Colo. Farm Bulletin: 10-12. January 1944.

"The influence of aspen, young lodgepole pine, and open grassland types upon factors affecting water yield." E. G. Dunford and C. H. Niederhof. J. Forestry, Vol. 42: 673-677.

"The effect of timber cutting in a lodgepole pine forest on the storage and melting of snow." H. G. Wilm. Trans. American Geophysical Union, Pt. I: 153-155. September 1944.

"Quaking aspen as seen by the watershed researcher." B. C. Goodell. The Green Thumb. July-August 1947: 8-11.

(378) WESTERN COLORADO WORK CENTER - WATERSHED RESEARCH IN WESTERN COLORADO.

(b) Rocky Mountain Forest & Range Experiment Station, U. S. Forest Service.

(c) George Turner (acting work center leader) and E. J. Dortignac (forest influences teohnician), under supervision of W. G. McGinnies, Director, and H. G. Wilm (field division chief).

(e) Experimental project, employing field experiments on plots and watersheds.

(f) To work out solution of watershed-management problems for forest- and range-covered watersheds of the upper Colorado River and other drainage basins of western Colorado.

(g) This is a new project, in which the major effort at present is being devoted to the analysis of range and watershed problems for this area. Experiments will be laid out to show the influence of forest and range vegetation and of its use and misuse upon water yields, erosion, and sedimentation.

(h) At present two small forested watersheds in the headwaters of the Eagle River have been placed under experimental control to show the influence of timber cutting on water yields from high-altitude watershed lands. Small grazing and reseeding experiments have been established, and plans are being drawn for studies of the effects of vegetation and grazing on infiltration and erosion.

(379) STUDY OF TRAPEZOIDAL FLUMES FOR OPEN CHANNEL FLOW.

(b) Rocky Mountain Forest & Range Experiment Station, U. S. Forest Service, in cooperation with Colorado A & M College, Division of Engineering.

(c) B. C. Goodell (forest influences technician), under supervision of H. G. Wilm (field division chief).

(e) Experimental project in hydraulic laboratory, for gaging-station design.

(f) To work out the design for an improved gaging station for use in mountain stream channels. It is desired to obtain a station which will not become clogged with bed load material, silt, ice, and snow, or other obstructions, and will provide

an accurate stage-discharge relation over a wide range of discharges.

(g) Scale models of trapezoidal flumes have been tested in the hydraulic laboratory of Colorado A & M College. Models tested included several variations in overall length, piezometer position, and floor and wall slope.

(h) Studies temporarily discontinued. Reasonably satisfactory flume shapes have been obtained, and a progress report is in process of preparation.

U. S. DEPT. OF AGRICULTURE, FOREST SERVICE, Southeastern Forest Experiment Station, Asheville, N. C.

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

(b) Southeastern Forest Experiment Station, U. S. Forest Service. For general public use.

(c) C. R. Hursh, M. D. Hoover, J. A. Lieberman, P. W. Fletcher.

(d) I. T. Haig, Director, Southeastern Forest Experiment Station, U. S. Forest Service, P.O. 252, Asheville, N. C.

(e) General and complete investigation of forest influences in southeastern United States. Includes fundamental hydrologic research and applied research in water resource and watershed management.

(f) To determine the effect of vegetation on the phases of the hydrologic cycle. To find out the effect of land use and land management practices on water yield and water quality. To develop standards and methods of watershed management so as to derive the greatest benefit from the land and water resources.

(g) Most of the actual research experiments and hydrologic data collection is carried out on the 5500 acre Coweeta Hydrologic Laboratory which is located in the zone of maximum precipitation in the eastern United States (Nantahala Range of the Southern Appalachian Mountains). Within this experimental area are approximately 35 individual watersheds whose streamflow is being continuously gaged and which are either being treated experimentally or being used as control checks. In addition to the streamflow gaging, there are 13 recording and 63 non-recording (standard) rain gages, 21 recording and 19 non-recording ground water wells, 5 recording hygrothermographs, 2 recording anemometers, and one evaporation pan. Water samples for quality analysis are collected on a daily basis from selected experimental watersheds. All individual projects are planned to completion through analysis of data, preparation of reports, and publication of technical articles.

Three small watersheds with appurtenant rain gages and wells are maintained at the Bent Creek Experimental Forest near Asheville, N. C.

A work center to be primarily concerned with soil hydrology has recently been established on the John C. Calhoun Experimental Forest near Union, S. C.

(h) Entire project completely active. New individual experiments are being planned, which include studies of the effect of logging operations on water quality and yield and the influence of rhododendron (R. maximum) stands on water yield. Research projects which are active include the following:

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) local logging practices; (5) mountain agriculture; (6) woodland grazing; and (7) forest fires.

(i) "Litter keeps forest soil productive." C. R. Hursh. Southern Lumberman, Vol. 134: 1-3. December 1928.

"Forest averts erosion on abandoned mountain farm land." C. R. Hursh. U.S.D.A. Yearbook. 1930.

"Abandoned mountain farms an erosion menace but a forestry opportunity." C. R.

Hursh. Farmers' Federation News. August 1931.

"Eroded fields as forest sites." C. R. Hursh. Forest Worker. September 1931.

"Effects of 1925 drought on southern Appalachian hardwoods." C. R. Hursh. Ecology, Vol. 12: 380-386. 1931.

"Forests of Georgia highlands." C. R. Hursh. Georgia Forest Service Bulletin No. 15, 32 pp. July 1931.

"Positive gas and water pressure in oaks." C. R. Hursh. Science. April 24, 1931.

"The forest legion carries on!" C. R. Hursh. American Forests. January 1932.

"Oldfield primary vegetation in the southern Appalachians and Piedmont." Abstract. C. R. Hursh. Bulletin Ecological Society of America, Vol. 16: 33. 1935.

"Control of exposed soil on road banks." C. R. Hursh. Station's Tech. Note No. 12. March 7, 1935.

"Plant indicators of soil conditions on recently abandoned fields." C. R. Hursh and W. M. Crafton. Station's Tech. Note No. 17. November 6, 1935.

"Terminology of storm water." C. R. Hursh. Trans. American Geophysical Union, Pt. II: 301-302. 1936.

"Mulching for road bank fixation." C. R. Hursh. Station's Tech. Note No. 31. September 15, 1938.

"Effects of forests upon local climate." C. R. Hursh and C. A. Connaughton. J. Forestry, Vol. 36: 864-866. 1938.

"Low cost erosion control on highway slopes in the southeastern United States." C. R. Hursh and John Snyder. Proc. Highway Research Board, Pt. I: 213-215. 1938.

"Determination of a formula for the 120-V-notch weir." R. A. Hertzler. Civil Engineering, Vol. 8: 756-757. 1938.

"Engineering aspects of the influence of forests on mountain streams." R. A. Hertzler. Civil Engineering, Vol. 9: 487-489.

"Outline for compiling precipitation and runoff data from small drainage areas." C. R. Hursh. Station's Tech. Note No. 34. August 23, 1939.

"Stream observations and ground water studies." C. R. Hursh. Civil Engineering, Vol. 9: 672. November 1939.

"Road bank stabilization at low cost." C. R. Hursh. Station's Tech. Note No. 38. 1939.

"The unit hydrograph principle applied to small watersheds." E. F. Brater. Proc. A.S.C.E.: 1191-1215. September 1939.

"Interception and streamflow in a pine plantation." J. Kittredge, H. J. Loughead, and A. Mazurak. J. Forestry, Vol. 39: 505-522. 1941.

"The geomorphic aspects of mudflows as a type of accelerated erosion in the southern Appalachians." C. R. Hursh. Trans. American Geophysical Union, 22nd Annual Meeting, Pt. II: 253-254. 1941.

"Separating storm hydrographs from small drainage areas into surface and subsurface flow." C. R. Hursh and E. F. Brater. Trans. American Geophysical Union, 22nd Annual Meeting, Pt. III: 863-870. 1941.

"Soil profile characteristics pertinent to hydraulic studies in the southern Appalachians." C. R. Hursh and M. D. Hoover. Soil Science Soc. of America, Proc., Vol. 6: 414-422. 1941.

"The naturalization of roadbanks." C. R. Hursh. Station's Tech. Note No. 51. 1942.

"Stabilization of roadbanks." C. R. Hursh. Better Roads, Vol. 12: 13-15. June-July 1942.

"Studies on the balanced water economy of experimental drainage areas." C. R. Hursh, M. D. Hoover, and P. W. Fletcher. Trans. American Geophysical Union, Pt. II: 509-517. 1942.

"The naturalization of roadbanks." C. R. Hursh. Roads and Bridges (Canada), Vol.

80: 22-26. July 1942.

"Installation of shallow observation wells." C. R. Hursh and M. D. Hoover. Station's Tech. Note No. 56. 1943.

"The soil profile as a natural reservoir." C. R. Hursh and P. W. Fletcher. Proc. Soil Science Soc. of America, Vol. 7: 480-486. 1943.

"Discussion of paper by C. L. Wicht." C. R. Hursh. Trans. American Geophysical Union, Pt. II: 606-608. 1943.

"Influence of topography and soil-depth on runoff from forest land." C. R. Hursh and M. D. Hoover. Trans. American Geophysical Union, Pt. II: 693-697. 1943.

"Water storage limitations in forest soil profiles." C. R. Hursh. Proc. Soil Science Soc. of America, Vol. 8: 412-414. 1944.

"Effect of removal of forest vegetation upon water yields." M. D. Hoover. Trans. American Geophysical Union, Pt. VI: 969-977. 1944.

"Appalachian hardwood trees browsed by cattle." H. H. Biswell and M. D. Hoover. J. Forestry, Vol. 43: 675-676. 1945.

"Report of sub-committee on sub-surface flow." C. R. Hursh. Trans. American Geophysical Union, Pt. V: 743-746. 1944.

"Plants, shrubs, trees in slope stabilization." C. R. Hursh. Contractors and Engineers Monthly, Vol. 42: 6, 26-27. 1945.

"Watershed management in the southeastern states." C. R. Hursh and J. A. Lieberman. Paper given before Southeastern Section of American Water Works Association, Savannah, Ga. Proc. 18th Annual Convention: 62-72. September 10, 1946.

"Water resources of South Carolina." C. R. Hursh. Abstract of address before Eighth Annual South Carolina Chemurgic Conference, Columbia, S. C. Chemurgic Papers 1946, Series No. 4: 473. April 3, 1946.

"The eastern forester and his watershed." C. R. Hursh. J. Forestry, Vol. 44, No. 12: 1037-1040. December 1946.

"Where little waters write big stories." C. R. Hursh. American Forests, Vol. 52, No. 12: 574-577. December 1946.

"Effects of cutting streambank vegetation upon water yields." E. G. Dunford and P. W. Fletcher. Trans. American Geophysical Union, Vol. 28: 105-110. 1947.

"Further studies of the balanced water cycle on experimental watersheds." J. A. Lieberman and P. W. Fletcher. Trans. American Geophysical Union, Vol. 28, No. 3: 421-424. June 1947.

"Water resource management." C. R. Hursh. North Carolina Engineer, Vol 3: 9-12, 40. 1947.

"Water resource and watershed management research in the southeast." J. A. Lieberman. J. American Water Works Assn., Vol. 39, No. 5: 443-454. May 1947.

"Research in the Central Piedmont." E. G. Dunford. The Forest Farmer, pp 4, 8. September 1947.

"Watershed experiments conducted in Giant Outdoor Laboratory." C. R. Hursh. Timber Topics, Vol. 10, No. 4: 2, 3, 4, 9. July-August 1947.

U. S. DEPT. OF AGRICULTURE, FOREST SERVICE, Southwestern Forest & Range Experiment Station, Tucson, Ariz.

Inquiries concerning Projects Nos. 381 to 383, incl., should be addressed to Mr. Raymond Price, Director, Southwestern Forest & Range Experiment Station, Box 951, Tucson, Ariz.

(381) RELATION OF PINE-FIR HIGH MOUNTAIN FOREST COVER TO STREAMFLOW AND EROSION.

(b) Southwestern Forest & Range Experiment Station, U. S. Forest Service.

(c) W. P. Martin, L. R. Rich, R. K. Hudson.

(e) Experimental, and for general information.

(f) Investigation of the influence of dense pine-fir forest cover conditions, characteristic of watersheds in the high precipitation headwater areas, on streamflow, total water yield, and erosion.

(g) Work center is at Sierra Ancha Experimental Forest, a 13,255-acre area on the southwest slope of the Sierra Ancha Mountains in the Salt River drainage area above Roosevelt Reservoir. Workman Creek, the area used for this study, ranges in elevation from 6,500 to 7,700 feet. Three drainages are equipped with weirs and water level recorders to measure streamflow. Two small areas of 248 and 318 acres are within the main watershed of 1,087 acres. Ten seasonal rain and snow gages and one weighing recording gage measure precipitation, and one climatic station measures air and soil temperatures. These watersheds are undergoing calibration, and eight years' records are available. Treatment will consist of one or more of the following: Removal of stream bottom (riparian) vegetation, thinning according to silvicultural practices, belt cutting, or denudation, to study the effects of vegetation on total quantity, rate of delivery, and quality of water yield.

(h) Calibration period is nearing completion. Treatment or treatments will be started within the next few years.

(i) For progress reports, see Annual Reports of Southwestern Forest & Range Experiment Station for 1944, 1945, and 1946, and Research Note series.

(382) WATER UTILIZATION BY SEMI-DESERT AND/OR CHAPPARAL VEGETATION AS RELATED TO TOTAL WATER YIELD.

(b) Southwestern Forest & Range Experiment Station, U. S. Forest Service.

(c) W. P. Martin, L. R. Rich, R. K. Hudson.

(e) Experimental, and for general information.

(f) To determine the effect of land condition and different types of vegetation on amount of evaporation, transpiration, and water yield under southwestern conditions.

(g) Methods for determining water evaporated from bare soils and water used by grasses, half-shrubs, and chaparral shrubs include: (1) Periodic weighing of natural soil blocks in open-top containers under natural influences of climate; and (2) measurement of precipitation and of surface and subsurface runoff from small and large lysimeters of natural soil blocks.

(h) The experimental work with the open-top cans has been completed and the results are being prepared for publication. Lysimeter studies are continuing.

(i) For progress reports on this work, see Annual Reports of Southwestern Forest & Range Experiment Station for 1945 and 1946.

(383) INFLUENCE OF SEMI-DESERT AND WOODLAND-CHAPARRAL OPEN TIMBER VEGETATION ON STREAMFLOW AND EROSION.

(b) Southwestern Forest & Range Experiment Station, U. S. Forest Service.

(c) W. P. Martin, L. R. Rich, R. K. Hudson.

(e) Experimental, and for general information.

(f) To determine the relation of ground cover conditions to streamflow and the requirements of long-time management practices for obtaining maximum yields of usable water.

(g) Major work center is at Sierra Ancha Experimental Forest, Arizona, a 13,255-acre area on the southwest slope of the Sierra Ancha Mountains above Roosevelt Reservoir and in the adjacent Roosevelt basin area. Within this area it is possible to sample semi-desert, chaparral, woodland, ponderosa pine, and Douglas-fir forest types. In the cross-section of these areas, lysimeters, small and large plots, and small and large watersheds have been established to measure climate,

rates of water runoff, total quantity of runoff, and erosion as affected by changes in density and composition of the different vegetation types.

(h) Collection of records was begun upon completion of each installation, beginning in 1926, and office reports prepared summarizing seasonal measurements.

(i) For progress reports, see Annual Reports of Southwestern Forest & Range Experiment Station for 1938-46, and Research Note series.

U. S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, Hydrologic Studies, Fennimore, Wis.

(392) HYDROLOGIC STUDIES.

(b) Soil Conservation Service, U. S. Dept. of Agriculture, and the Agricultural Experiment Station of the University of Wisconsin.

(c) N. E. Minshall, project supervisor.

(d) Lewis A. Jones, Chief, Division of Drainage and Water Control, Soil Conservation Service, Washington 25, D. C.

(e) Experimental, for design of farm ponds and conservation structures.

(f) To obtain information on peak rates of surface runoff and water yields from small agricultural areas under various conditions of cover and climate.

(g) Surface runoff and rainfall are measured with recording gages from four privately owned cultivated watersheds ranging in size from 22 to 330 acres. Air temperature, relative humidity, and soil temperature at various depths are also measured.

(h) Nine years of records have been collected. These data have been analyzed, and recommended design values for use by field technicians have been included in technical reports either published or in the process of publication.

(i) Similar studies are being conducted in cooperation with the State Agricultural Experiment Stations at the following locations: Edwardsville, Ill., N. E. Minshall, project supervisor; Blacksburg, Va., T. W. Edminster, project supervisor; College Park, Md., Harold W. Hobbs, project supervisor.

"Hydrologic design of farm ponds and rates of runoff for design of conservation structures in the claypan prairies." D. B. Krimgold and N. E. Minshall. Soil Conservation Service Tech. Pub. 56. May 1945.

"Rates of runoff in the coastal plains of New Jersey, Delaware, and Maryland." Harold W. Hobbs. Soil Conservation Service Tech. Pub. 60. July 1946.

U. S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, Division of Irrigation, Logan, Utah.

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

(53) SAND TRAPS AND SLUICEWAYS.

(b) U. S. Soil Conservation Service and Agricultural Experiment Station, Colorado A & M College.

For a complete report on this project, refer to Project No. 53, listed under Colorado A & M College, page 18.

(54) MEASURING DEVICE AND INTEGRATING INSTRUMENT.

(b) U. S. Soil Conservation Service and Agricultural Experiment Station, Colorado A & M College.

For a complete report on this project, refer to Project No. 54, listed under Colorado A & M College, page 19.

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

(b) U. S. Soil Conservation Service and Agricultural Experiment Station, Colorado A & M College.

For a complete report on this project, refer to Project No. 56, listed under Colorado A & M College, page 20.

(287) PERFORMANCE TESTS OF WELL SCREENS.

(b) Cooperative project, U. S. Soil Conservation Service, Colorado Agricultural Experiment Station, and various well-screen manufacturers.

For a complete report on this project, refer to Project No. 287, listed under Colorado A & M College, page 20.

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

(b) Laboratory project.

(c) A. T. Mitchelson, research project supervisor; F. C. Scobey, project leader.

(e) Experimental.

(f) To develop or determine a single formula expressing the law of flowing water in pipe lines closely enough to be acceptable to the many agencies using such formulas.

(g) Field research is done. It is proposed to take three formulas for flow of water in wood stave, in concrete, and in riveted steel, welded steel, and such metal pipes, and analyze the data and resulting formulas in terms of conformity with some single formula. It is proposed to explain the background (theoretical and empirical) of all other formulas used to any great extent.

(h) Active; project will be completed this year.

(385) FLOW OF WATER IN CONCRETE PIPE.

(b) Laboratory project.

(c) A. T. Mitchelson, research project supervisor; F. C. Scobey, project leader.

(e) Experimental.

(f) Since publication in 1920 of Dept. of Agriculture Bulletin 852, "Flow of water in concrete pipe", irrigation use of such pipe has greatly increased throughout the seventeen western states. Likewise, most of the pipe lines of the past twenty-five years have been made by more or less automatic machinery.that developed a smoother interior that has undoubtedly resulted in a general increase in capacity. It is proposed to do enough field work on machine made irrigation pipe (concrete) to establish the proper coefficients in the formula for flow of water in concrete pipe so that better design and operation of such pipes will result.

(g) It is planned to concentrate the field work in Arizona and California. Each test involves a determination of discharge and the corresponding head loss for a conduit of known dimensions and length, and from these elements the coefficients for the flow formula can be developed.

(h) Active.

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

(b) Laboratory project.

(c) Dean W. Bloodgood, research project supervisor and project leader.

(e) Experimental.

(f) (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 the suspended silt load to be handled; (3) to determine the characteristics of silt deposits 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 the silt load and the management of the tributary watersheds.

(g) (1) Establish silt collecting stations on the streams of the principal watersheds of Texas at or near established gaging stations; (2) collect water samples for silt determinations daily at one or more points in the cross-section of the stream; (3) make silt determinations of water samples, using standard laboratory methods; (4) convert silt in samples to equivalent acre feet based on 70 pounds per cubic foot; (5) calculate the amount of silt carried in suspension during given time interval by a given stream; (6) analyze the relationship of suspended silt load and the state of flow rising or falling together with rates of rise and fall; and (7) determine by means of analyses the effect of suspended silt load on such facilities as canals, control structures, turbines, pumps, water treatment plants, etc.

(h) Active. Silt measurements at many stations are being continued. Municipal and agricultural water users are demanding expansion of measuring network.

(i) See "Silt load of texas streams", by O. A. Faris, U.S.D.A. Tech. Bul. 382.

(387) HYDROLOGY OF SNOW AND STREAMFLOW IN RELATION TO IRRIGATION.

(b) Laboratory project.

(c) R. A. Work, project supervisor; C. E. Houston, project leader; R. L. Parshall, J. C. Marr, L. T. Frost, D. K. Fuhriman.

(e) Experimental.

(f) (1) To develop from snow surveys and related data advance knowledge of the amount and distribution of the water supply to be 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 streamflow and ground waters in principal stream basins will be studied in relation to occurrence (origin, volume, and time of runoff), distribution (flow patterns and rate of movement), utilization (direct diversion or through surface or sub-surface storage, amount and purpose of use), and efficiency of use.

(g) It is proposed that a research project be conducted for each state in cooperation with the State Agricultural Experiment Station, to determine methods of developing and applying general forecasting principles to local conditions. Where necessary, suitable field laboratories will be selected and a state leader will be assigned by the Soil Conservation Service to work with the State Experiment Station. The results from all laboratories will be correlated to avoid duplication and to solve problems encountered in forecasting irrigation water supplies in western states.

(h) Active in several states. Snow cover runoff relations being established and used as basis for water forecasts.

(i) See Project No. 55, "Snow Course Measurements and Forecast Analysis", Colorado A & M College, page 19.

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

(b) Laboratory project.

(c) G. D. Clyde, research project supervisor; D. K. Fuhriman, project leader.

(e) Experimental.

(f) (1) 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) determine the effect of temperature and other climatic factors upon the quantity and distribution of runoff from Utah's snow-fed streams; (3) 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.

(g) It is proposed: (1) to measure precipitation which falls as rain on the high watersheds during the fall months before snowfall and rain or snow during the period after the annual snow survey has been made. Measurements will be made on the Logan and Blacksmith Fork River watersheds as a beginning, and expanded as is deemed necessary as the project progresses. Precipitation stations will be established at 6,000, 7,000, 8,000, and 9,000 foot elevation on each of these watersheds. A mountain snowfall station is maintained at the Tony Grove Ranger Station (elevation 6,250) on the Logan River watershed, and records from this will be utilized in this study. These precipitation data will be used in analyzing their modifying effect on the predicted runoff as determined from snow cover measurements alone.

(2) To measure temperature variation on the high watersheds of the state, particularly during the melting season, to determine the relationship of temperature variation on the distribution and quantity of runoff yielded from a measured snow cover. If it is found after several seasons' measurement of high elevation temperatures, that a reasonable correlation exists between these measured temperatures and those recorded at the lower elevation stations maintained by the U. S. Weather Bureau, then these low elevation station records will be used to further refine the studies of temperature effects on watershed yields.

(3) To study daily weather maps showing storm movements and other meteorological data to determine the extent, intensity, and distribution of precipitation resulting therefrom, and the effectiveness of present snow courses in representing the snow cover used in predicting runoff. Weather maps of the U. S. Weather Bureau will be used for this study.

(h) Preliminary work only and review of literature.

(389) STORAGE OF WATER UNDERGROUND FOR IRRIGATION.

(b) Laboratory project.

(c) A. T. Mitchelson, research project supervisor; Dean C. Muckel, project leader.

(e) Experimental.

(f) The objective of this study is to determine the factors affecting the percolation rate on water-spreading areas, and to devise ways and means by which the percolation rate might be increased. In some soils, the percolation rate has been found to decrease during spreading, and one of the principal objectives of this study is to determine the cause of the rate decrease and to find practical methods of maintaining the higher initial rates.

(g) A study of the factors affecting percolation rates will be made by field test ponds or check strips in selected areas. The test ponds will be given different treatments and run against check ponds. The strips will be similarly treated. By comparison of the percolation rate curves, the effect of the treatments will be noted. Forty-four test ponds are now available for study in the San Joaquin Valley, California, in addition to records from adjacent large areas consisting of 100 acres or more in size.

(h) Active. Measurements on experimental ponds are being continued at Bakersfield. Other large experimental ponds are being operated at Madera.

(390) IMPERIAL VALLEY DRAINAGE INVESTIGATIONS.

(b) Laboratory project.

(c) Harry Blaney, research project supervisor; W. W. Donnan, project leader.

(e) Experimental and for general information.

(f) The objectives of the investigation are (1) to continue the refinement of criteria established during the past five years by research, for the installation of drainage facilities on irrigated farms; (2) to study specific phases of district-wide drainage and irrigation problems; and (3) to improve irrigation practices.

(g) Drainage investigations in farm areas:

(1) Drainage by deep wells. The Imperial Irrigation District has developed one deep drainage well, and it may develop one or more wells on the margins of the valley. The Division of Irrigation will endeavor to analyze the effect of pumping from the wells on the water levels of the surrounding area by means of piezometer measurements.

(2) Imperial Irrigation District experimental farm. The Imperial Irrigation District is now engaged in developing an experimental farm, located in the southern portion of the East Mesa. It is proposed that a study of the soil and ground water hydrology be undertaken in cooperation with the Imperial Irrigation District. This study would include analyses of the virgin and future soil-water relationships as they will affect irrigation practices and ground water conditions. A piezometric study of the changes in water table elevations within and adjacent to the experimental farm will be carried on. These studies will be for the purpose of determining what effect extensive development of the East Mesa will have upon the ground water of the Mesa as a whole and upon the existing agricultural lands of the Imperial Valley.

(3) Tile spacing. Evaluation of designed tile drainage systems for the purpose of determining the effectiveness of criteria developed by previous studies will be continued. The study of complex stratified soil conditions will be continued as time permits.

East Mesa water table study:

A review will be made of all available observation wells and stratigraphic data, including a series of well logs and water-table observations. Field inspection of the morphological and stratigraphic aspects of the areas under study will be made. From analysis of these data, a series of observation wells (piezometers) will be installed adjacent to and out from the East Highline Canal, as well as the Coachella Branch Canal. Chemical analyses will be made of the water taken from these wells to determine the source. New well installations will be made to complement those already installed. These piezometers will be tied into the existing observation wells on the Mesa and on the fringe of the present cultivated area. Data derived will be utilized to establish the possible effects of (1) seepage from the East Highline Canal; (2) existing extent, source, and quantity of subterranean flow and its effect upon water-table levels in the present valley cultivated area; and (3) deep percolation from new irrigated areas on the East Mesa upon the main valley floor.

Salton Sea:

Since the Salton Sea is a closed basin and provides the only outlet of drainage from the Imperial Valley and adjacent mesa lands, the rates of evaporation and surface fluctuations of Salton Sea are of great importance to the valley. The water level of the sea remains static as long as the evaporation from the surface is equal to inflow from Imperial Valley and other areas. The irrigation of new lands on the East and West Mesas of Imperial Valley and Coachella Valley will increase the flow into the sea, thus increasing the drainage problem. It is proposed that the Division of Irrigation, in cooperation with the Imperial Irrigation District, set up one or more evaporation stations on the edge of Salton Sea for the purpose of obtaining continuous records of evaporation for a long period. Analysis of existing fragmentary evaporation records will be undertaken. From evaporation and water level records there may be derived an estimate of future Salton Sea water surface levels under present and potential drainage from the development of new agricultural areas.

Drainage manual:

A manual will be prepared, outlining procedure for drainage investigation on irrigated farms and program for solving drainage problems. The purpose of this

manual will be to present a condensed report of the results of research studies in such a form that they may be readily utilized by the personnel of the Imperial Irrigation District and the Soil Conservation Service in their farm planning program. It will include an outline of procedure and technique developed by research studies and their application to various drainage problems encountered in the field.

Irrigation studies:

Using soil moisture sampling procedures, piezometric methods, water-measuring devices, and ponding time observations upon selected sites, the following conditions under border irrigation will be analyzed: (1) length of run; (2) width of border; (3) irrigation grade; (4) head of water application; and (5) pre-irrigation moisture conditions. A limited number of leaching studies in the field and laboratory will be undertaken. On selected fields which are to be tiled and leached, measure salt concentrations in the soil profile before and after leaching, to determine the effect of such leaching upon the soil salinity. Measure tile effluent, surface waste, application rate of the leach water and the salt concentration of these waters. Determine the effect of prolonged leaching on the fertility level of the soil. From these observations, derive a broad inclusive recommendation regarding the most efficient methods of leaching. In the laboratory, some leaching experiments will be conducted on representative soil profiles packed in lysimeters. Records will be kept of the soil salinity of each layer before and after a known quantity of leaching water is applied.

(h) Active. Entering second 5-year period. Making application of basic findings obtained during first five years to field practices. This project has been very productive of results, and thousands of acres of land are now being drained.

(391) SAN FERNANDO VALLEY DRAINAGE INVESTIGATIONS.

(b) Laboratory project.

(c) Harry Blaney, research project supervisor; W. W. Donnan, project leader.

(e) Experimental and for general information.

(f) 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.

(g) (1) Compilation, correlation, and analysis of the large volume of existing hydrologic, irrigation, and other data now in the files of city, county, state, and federal agencies; (2) initiation of additional field work necessary to supplement observations now being carried on, and to complete information now available, including survey of existing wells and pumping plants; (3) survey of farm areas affected by high ground water and determination of nature and local drainage problems, including soil borings for profile to depths of 6 to 15 feet, depending upon the kind of crop and other developments; (4) determination of the source and type of ground water in problem areas; (5) investigation of existing drainage systems; (6) determination of effect of pumping on shallow and deep water tables and adjacent artesian wells; (7) study of the effect of channelization and lining of minor streams, crossing the valley floor, on the high-water table in problem areas; and (8) evaluation studies of remedial measures and methods of alleviating the high water table in each of the problem areas.

(h) New project. Only preliminary work completed.

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

(393) A STUDY OF THE IRRIGATION AND SOIL LOSS CHARACTERISTICS OF CONTOUR AND DOWNSLOPE IRRIGATION AT THREE MINIMUM LEVELS OF SOIL MOISTURE.

(b) U. S. Soil Conservation Service and Washington Agricultural Experiment Station.

(c) S. J. Mech, research project supervisor and project leader.

(d) George D. Clyde, Chief, Division of Irrigation, Soil Conservation Service, College Hill, Box D, Logan, Utah.

(e) Experimental research on soil and water relationships under irrigation.

(f) To compare the erosion and irrigation characteristics of different sizes of furrow streams in contour and downshope irrigation.

(g) A comparison of contour and downhill irrigation will be studied at three different minimum soil moisture levels. Three different blocks of plots will be irrigated in furrows directed across the slope at a grade of 2 percent. Another three blocks will be irrigated straight down a slope of 7 percent. Irrigations will be applied to crops in a 7-year rotation of wheat, alfalfa 3 years, potatoes, sugar beets, and corn. The plots will be located on a 7 percent slope, which is the steepest slope on the station suitable for experimentation.

(h) Data are available for the four years of wheat and alfalfa, or the soil building phase of the rotation. Now entering that segment of the rotation cycle involving clean tilled crops.

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

(151) LINING OF IRRIGATION CANALS AND DITCHES.

(b) U. S. Soil Conservation Service and Utah Agricultural Experiment Station.

(c) G. D. Clyde, research project supervisor; C. W. Lauritzen, project leader; O. W. Israelsen.

(d) George D. Clyde, Chief, Division of Irrigation, Soil Conservation Service, College Hill, Box D, Logan, Utah; or C. W. Lauritzen, Soil Conservation Service, College Hill, Box 179, Logan, Utah.

(e) General experimental research.

(f) (1) To determine the value of various materials for lining irrigation canals and ditches as a means of conserving water and soil; and (2) to obtain information relative to specifications and management influencing the effectiveness and durability of linings in irrigation canals and ditches.

(g) Laboratory data will serve as a guide to the selection of linings for testing. Materials which have been demonstrated to have a low permeability will be employed as linings for experimental units simulating canal sections to further test their value as linings for irrigation canals and ditches. These units will be located outdoors and so designed as to permit the catchment of all water percolation through the lining as a measure of the effectiveness of the lining and as a means of integrating the influence of climatic conditions in the life and continued effectiveness of the linings.

Materials which will be used as lining and tested are clay; clay, silt, and sand mixtures; clay and salt; soil-Bentonite mixtures; oil and asphalt-treated materials; resin-treated soil materials; and prefabricated linings.

Selected linings will be subjected simultaneously to paired treatments involving continuous flow vs. intermittent flow, presence and freedom from aquatic plant growth, and other environmental factors. The initial soil compaction, water content at which compacted, changes in the specific weight of the linings with time, changes in the quality of the percolating water, and other factors will be measured as a basis for explaining the success or failure of linings and as a means of developing data which will be useful as controls on field construction.

The tests described above supply information only as related to the deterioration of linings through causes other than erosion. It is known that linings such as

clays and Bentonite mixtures must be restricted to low-velocity streams, and under most conditions will require some protection against erosion such as a topping of gravel. In order to test the relative stability of linings, it is contemplated that some sloping channels will be installed and subjected to tests to determine their relative stability. The tests will be made over a range of slopes normally found in canals, and with streams of such size as to operate the channels up to capacity. Erosion will be determined by noting the removal as measured for a reference plane and sampling of the bed load and discharge water. Until such time as the initial outdoor sloping channels are available, the erosion tests will be confined to a 32-foot indoor flume simulating a section of canal and pivoted at the center as a means of securing the desired slope.

The U. S. Bureau of Reclamation is cooperating this year to expand the shape of the program.

(h) Much progress is being made at the irrigation outdoor laboratory. A description of this laboratory is given under Laboratory Notes, "Irrigation Research Laboratory", page 182.

U. S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, North Appalachian Experimental Watershed, Coshocton, Ohio.

(150) HYDROLOGIC EXPERIMENT STATIONS.

(b) Soil Conservation Service, U. S. Dept. of Agriculture, and the Ohio Agricultural Experiment Station.

(c) L. L. Harrold, project supervisor; Leonard Schiff, hydraulic engineer; Walter Pomerene, agricultural engineer; and F. R. Dreibelbis, soil scientist.

(d) M. L. Nichols, Chief of Research, Soil Conservation Service, Washington 25, D. C.

(e) Experimental, for design and general information in planning farms for soil and water conservation.

(f) On whole farm units and watersheds to study the hydrologic effect of physiography, tillage, and ground surface conditions, vegetal covers, and soils and geology. Also to study the effect of conservation farming on runoff and erosion, as well as the characteristics of flood runoff on agricultural watersheds. On smaller areas studies are made of all the rainfall disposal factors, such as surface runoff, evapo-transpiration, moisture storage and moisture transmission through the soil, and percolation of water to the ground water table.

(g) On 1,000 acres of Government operated land and 5,000 acres of privately owned land, observations of rates and amounts of precipitation and runoff are made. About 35 recording rain gages and runoff stations are operated. Runoff stations have drainage areas ranging from 1 to 5,000 acres. Lysimeters, 1/500-acre in area and 8 feet deep of undisturbed soil and bed rock, are used to measure disposal of rainfall. Three of these soil blocks which are weighed automatically at 10-minute intervals furnish reliable data on evapo-transpiration, as well as condensation of moisture from the atmosphere onto vegetation and into the soil. Periodic soil-moisture observations in the root zone along with a few continuous records of soil moisture furnish data for the study of moisture movement under different crops in relation to the capacity of the soil to take up storm rainfall.

(h) About ten years of records are available on the larger watersheds and records for one complete crop rotation on the small watersheds. Thus, sufficient data are now available for a detailed preliminary analysis. Such has been started.

(i) Similar studies are being conducted in cooperation with the State Agricultural Experiment Stations at the following locations: Waco, Tex., Ralph W. Baird, project supervisor; Hastings, Nebr., John A. Allis, project supervisor; and East Lansing, Mich., George A. Crabb, Jr., project supervisor.

"Comparison of lysimeter runoff, infiltration, and percolation to stream flow." L. L. Harrold. Trans. American Geophysical Union, Vol. 28, No. 3: 438-442. June 1947.

"Preliminary report on watershed studies near Waco and Garland, Texas." L. L. Harrold, D. B. Krimgold, and L. A. Westby. Soil Conservation Service Tech. Pub. 53. April 1944.

"The effect of conservation practices on peak rates of runoff." Ralph W. Baird. The Texas Engineer, Texas Section of A.S.C.E.: 8-15. August 1946.

"Preliminary results of land use practices on runoff and erosion from agricultural watersheds." L. L. Harrold. Amer. Soc. Agr. Eng. June 1947.

U. S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, Purdue Agricultural Experiment Station, Lafayette, Ind.

(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, I. D. Mayer, Helmut Kohnke.

(d) R. B. Hickok, Research Project Supervisor, Soil Conservation Service, Agricultural Engineering Building, Purdue University, Lafayette, Ind.

(e) Experimental and for design information.

(f) 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.

(g) Continuous time-rate records of rainfall and runoff are collected for 20 small watersheds, 2 in wood lots, 2 in permanent pasture, and 14 in rotation crops. Measurements and records are kept on watershed cover, soil character and conditions, farming operations, etc. The watersheds range in size from approximately 2 to 4-1/2 acres. The results are intended to be applicable for soil conditions, the climate, and a type of agriculture generally representative of a large part of the eastern section of the corn belt.

(h) 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 six years for corn, and four years each for wheat and meadow under the conservation type of treatment. Analyses of present measurement data indicate several important correlations. More extensive data will be needed to determine these values and relationships within entirely practical, fiducial limits.

(i) "Some runoff control and moisture conservation possibilities in the eastern part of the corn belt." R. B. Hickok, I. D. Mayer, and H. Kohnke. Presented at meeting of the Soil and Water Division of the American Society of Agricultural Engineers at Chicago, December 16, 1947 (for subsequent publication in "Agricultural Engineering", American Society of Agricultural Engineers, St. Joseph, Mich.).

U. S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minn.

For reports on projects conducted by the Soil Conservation Service at the St. Anthony Falls Hydraulic Laboratory, refer to Projects Nos. 111 to 115, listed under St. Anthony Falls Hydraulic Laboratory, University of Minnesota, pages 51 and 52.

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

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

(b) Soil Conservation Service, U. S. Dept. of Agriculture, and the Oklahoma Agricultural Experiment Station.

(c) W. O. Ree, project supervisor.

(d) Lewis A. Jones, Chief, Division of Drainage and Water Control, Soil Conservation Service, Washington 25, D. C.

(e) Experimental research at an outdoor hydraulic laboratory.

(f) To obtain data on (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.

(g) Measured flows up to 150 cfs are passed through outdoor test channels of various cross-sections up to 40 feet in width and slopes up to 10 percent. Measurements of hydraulic elements and scour rates are made for flows of different velocities and for various channel linings.

(h) Vegetal linings tested to date include Bermuda grass, weeping lovegrass, Sudan grass, yellow bluestem, smooth brome, and mixtures of native Oklahoma grasses including little bluestem, rye grass, side oats grama, blue grama, and miscellaneous annuals. In addition, scour rates have been compared for soils of different texture with Bermuda grass as a lining.

(i) "Handbook of channel design for soil and water conservation." Stillwater Outdoor Hydraulic Laboratory, Soil Conservation Service Tech. Pub. 61. March 1947.

U. S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, Sub-Tropical Experiment Station, Homestead, Fla.

Inquiries concerning Projects Nos. 395 to 397, incl., should be addressed to Lewis A. Jones, Chief, Division of Drainage and Water Control, Soil Conservation Service, Washington 25, D. C.

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

(b) Soil Conservation Service, in cooperation with the Sub-Tropical Experiment Station of the University of Florida and Dade County Division of Water Control.

(c) M. H. Gallatin, project supervisor; J. E. Browning, engineering aide.

(e) Experimental research.

(f) To determine the effectiveness of chloride barriers in canals.

(g) Periodic samplings are made of canal waters on canals with and without controls, to study the effectiveness of these control structures in controlling the intrusion of chlorides. Observations are made on the tolerance of crops grown on various soil types to the intrusion of chlorides.

(h) Experiment in progress.

(i) Monthly reports are made to Dade County Engineers. At completion of project, a bulletin will be written covering intrusion studies and plant tolerance.

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

(b) Soil Conservation Service, in cooperation with Sub-Tropical Experiment Station of University of Florida.

(c) M. H. Gallatin, project supervisor; J. E. Browning, engineering aide.

(e) Experimental research.

(f) To develop a method of water control by means of shallow ditches and dikes.

(g) The experiment covers 30 acres of deep marl. Records are kept of all water removed, cost of removal, seepage into ditches, infiltration capacity, and internal ditches. Observations are made on methods of surface water removal and the effect of high ground water on removal of water. Records are kept of time of plowing and discing with relation to surrounding undrained land. Crop records and planting records are kept by the Sub-Tropical Experiment Station.

(h) Experiment in progress.

(i) Summary report is made each year to Chief, Division of Drainage and Water Control, Soil Conservation Service.

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

(b) Soil Conservation Service, in cooperation with Sub-Tropical Experiment Station of University of Florida.

(c) M. H. Gallatin, project supervisor; J. E. Browning, engineering aide.

(e) Experimental research.

(f) To determine cycle, rates of application, and types of irrigation system best suited to this area.

(g) Observations are made of (1) the distribution of water in irrigation ditches for various water application patterns; (2) rates of application and height of water table for various irrigation cycles; (3) rates of application and their effect on the leaching of plant nutrients; and (4) the responsiveness of the water table to rainfall.

(h) Experiment in progress.

(i) Summary report is made each year to Chief, Division of Drainage and Water Control, Soil Conservation Service.

DEPT. OF THE ARMY, OFFICE OF THE CHIEF OF ENGINEERS, Beach Erosion Board, Washington, D. C.

Inquiries concerning Projects Nos. 181 to 185, incl., and 398 and 399 should be addressed to The Resident Member, Beach Erosion Board, Little Falls Road, N.W., Washington 16, D. C.

(181) EQUILIBRIUM PROFILE OF BEACHES.

(b) Beach Erosion Board, Corps of Engineers.

(c) J. M. Caldwell, F. J. Syrewicz. (e) Experimental research.

(f) To evaluate the effect of wave form, initial beach slope, range and frequency of tides, and sand grain size in determining the equilibrium profile of beaches.

(g) Clean sand is placed in each compartment of the large divided concrete wave tank, 88 by 14 by 4 feet, at the Beach Erosion Board laboratory. Waves having selected characteristics are generated therein and allowed to shape the beach to a stable profile for the particular wave being studied.

(h) Tests on the 1:30 uniform slope molded in both sides of the divided tank, utilizing sand having an average median diameter of 0.21 mm in one half and 0.56 mm in the other half, have been completed for wave periods of 1.2 and 3.3 seconds, respectively. Both tests were conducted for 100 hours. A third test run of 100 hours employing a wave period of 2.2 seconds has also been completed.

The 1:15 slope, previously tested utilizing the full tank width, has been repeated with a wave period of 1.3 seconds in both sides of the divided tank to determine the effect, if any, of the center partition.

(i) Quarterly Summary, Waterways Experiment Station.

(182) STUDY OF WAVE REFLECTION.

(b) Beach Erosion Board, Corps of Engineers.

(c) J. M. Caldwell, L. H. Senser. (e) Experimental research.

(f) 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 and exponents thereof.

(g) Solitary wave crests were made to impinge upon various substances mounted in the end of the tank in which the crest is generated. The energy loss resulting from the impingement was determined.

(h) Tests were made in a wooden flume 66 feet long and 7 inches by 10 inches in cross-section. A special type of wave generator was used to generate the solitary wave used in the study. Various substances and beach slopes were placed at one end of the tank and the energy-absorbing characteristics determined. Additional tests will be made on permeable slopes.

(i) Quarterly Summary, Waterways Experiment Station.

(183) SETTLING VELOCITY OF BEACH SANDS.

(b) Beach Erosion Board, Corps of Engineers.

(c) M. A. Mason. (e) Experimental research.

(f) To develop an apparatus capable of measuring the settling velocity distribution curves of beach sands, and to study the settling velocity ourves of representative beach samples as a possible index to their action under various types of wave attack.

(g) The ultimate goal of the instrument for determining the settling velocities of sand samples is to obtain an accurate record of the velocity distribution of a representative beach sand sample. It is believed that the settling velocity of beach sand is an important parameter to consider in the analysis of beach erosion problems.

(h) A satisfactory instrument has been developed. A report on the apparatus is being prepared.

(i) Quarterly Summary, Waterways Experiment Station.

(184) STUDY OF MODEL SCALE EFFECTS.

(b) Beach Erosion Board, Corps of Engineers.

(c) J. M. Caldwell, F. J. Syrewicz. (e) Experimental research.

(f) To determine the laws of model similarity governing the action of waves on movable sand beaches.

(g) The study is being made in the steel flume, 42 feet by 1.5 foot by 2 feet, at the Beach Erosion Board. Conditions of wave height, wave length, wave period, beach slope, and grain size are adjusted to a predetermined scale in an attempt to simulate the results of the tests obtained in the concrete tank for the Equilibrium Profile Study (Project No. 181, page 84).

(h) Tests have been completed, using scales of 1:4.5, 1:7, and 1:10 for 1:10 and 1:20 parabolic beach slopes with a wave period of 2.2 seconds. An additional test, using a scale ratio of 1:2, a beach slope of 1:15, and a wave period of 1.2 seconds, has also been completed.

(i) Quarterly Summary, Waterways Experiment Station.

(185) STEEL SHEET PILING INVESTIGATION.

(b) Beach Erosion Board, Corps of Engineers.

(c) C. W. Ross (report). (e) Experimental research.

(f) (1) To determine the probable life of steel sheet piling as used in maritime structures along the Atlantic coast; (2) to evaluate the causes of deterioration of steel sheet piling; and (3) to determine practical methods of extending the probable life.

(g) Thickness measurements of representative steel sheet piling samples located along the East Coast were taken in 1936, 1940, and 1946. Measurements were taken above high water, at high water, between high and low water, and at low water. When available, data on salinity, pH, water temperature, and pollution were also compiled.

(h) The report on this investigation has been completed and is being edited for publication.

(i) Quarterly Summary, Waterways Experiment Station.

(398) WATER TRANSPARENCY TEST.

(b) Beach Erosion Board, Corps of Engineers.

(c) J. V. Hall.

(e) Evaluation of British Water Transparency Method of Determining Water Depths from Aerial Photographs.

(f) To ascertain the practicability of use under normal field conditions of a method developed in England for the determination of water depths from selected pairs of aerial photographs.

(g) A segment of the Florida coast at Pensacola on the Gulf of Mexico was surveyed by standard hydrography methods. Aerial photographs of the same coastal area were obtained, using special filters and twin synchronized cameras. The depth of the ocean along a line previously surveyed by standard hydrographic methods was determined from selected pairs of the aerial photographs, using the technique and procedure outlined in the British Method.

(h) The test has been completed and a report is being prepared.

(i) Quarterly Summary, Waterways Experiment Station.

(399) DEVELOPMENT OF 6-FOOT WAVE TANK.

(b) Beach Erosion Board, Corps of Engineers.

(c) M. A. Mason, J. M. Caldwell, L. H. Senser.

(e) Design of a suitable tank and wave-producing apparatus which will enable a full-scale study of waves 6 feet high and 300 feet long. It is estimated at present that the tank will be about 15 feet wide, 18 feet deep, and 550 feet long.

(f) The development of a suitable wave tank and wave generator for testing various methods of protecting earth embankments from wave action, including a study of wave uprush. The tank will also be used to study shore phenomenon, including tests of shore protection structures.

(g) A 1:12-scale model of the 6-foot wave tank is being built. This model will be utilized to establish design criteria for the large wave generator and tank.

(h) Construction of the 1:12-scale model for the 6-foot wave tank is under way.

(i) Quarterly Summary, Waterways Experiment Station.

DEPT. OF THE ARMY, CORPS OF ENGINEERS, Buffalo District, Buffalo, N. Y.

(400) HYDRAULIC MODEL STUDIES FOR THE SPILLWAY AND OUTLET WORKS OF MOUNT MORRIS DAM ON THE GENESEE RIVER AT MOUNT MORRIS, N. Y.

(b) Great Lakes Division of the Corps of Engineers, Buffalo District, Buffalo, N. Y., in cooperation with the Warner Hydraulic Laboratory, Dept. of Civil Engineering and Engineering Mechanics, Case Institute of Technology, Cleveland, O.

(c) The laboratory work is under the direction of Prof. George E. Barnes, consulting engineer and supervising engineer on tests. The laboratory staff at Case School of Applied Science during the first and second series of tests included H. H. Ambrose, associate hydraulic engineer in charge of the conduct of the laboratory work; J. W. Jackson, R. M. Kemper, C. J. Kessler, G. A. Nyerges, J. S. Stock, G. F. Sowers, and J. W. Parma, assistant engineers. In the third series of tests at the Case Institute of Technology, the laboratory staff, under the direction of Prof. Barnes, included F. A. Pieper, in charge; A. H. Barnes, and G. A. Nyerges.

The work was under the general direction of Col. H. D. Vogel, District Engineer, Buffalo District, Corps of Engineers; J. I. Thomas, J. E. Deignan, and S. B. Hunt, successively principal engineers for the Buffalo office; and B. R. Fuller and H. H. Schipper, senior engineers.

(d) Col. H. D. Vogel, District Engineer, Buffalo District, Corps of Engineers, 930 Ellicott Square Bldg., Buffalo 3, N. Y.; or Prof. George E. Barnes, Case Institute of Technology, Cleveland, O.

(e) Experimental, for design purposes.

(f) The purpose of the first series of tests was to examine hydraulic performance of the proposed structure by means of a 1:64-scale model of a section of the spillway and stilling basin, including sluices; to make revisions to the proposed design as needed for capacity or safety; and to supply the Government with supporting data on the tests, as the basis of recommendations to be made on the hydraulic features of the design.

The purpose of the second series of tests was to develop a final design for the stilling basin, by means of a 1:100-scale general model of the spillway and stilling basin, with the transverse distance from toe to toe across the stilling basin much reduced and the training walls built on a slope of 1:1.

The purpose of the third series of tests was to find the extent to which the training walls in the 1:100-scale general model could be altered in alignment and similarity to each other, and the elevation of the floor of the stilling basin raised without seriously affecting the satisfactory hydraulic operation of the spillway.

(g) The first tests on a 1:64-scale model corresponded to a section of dam 150 feet long in nature with three sluices. The ogee section is 216 feet high, upstream batter 1:10, downstream 8:10, with a 50-foot radius bucket. The model was made of sheet brass. Aprons, baffles, and sill were of wood. Comparisons were made between calculated and test values for spillway discharge and for discharge through the sluices for various heads, which showed that the calculated flows were in close agreement with the model tests. Tests were run on 11 different aprons in which the length of basin and size, shape, and height of baffle and sill varied. Tests were run for two or three different discharges, the maximum being 335,000 cfs.

In the second series, the dam was made of sheet brass, with sluices omitted. Apron, baffles, sill, and training walls were of wood. Channel contours upstream and downstream were produced by templates, filled between with compacted sand and covered with two inches of mortar. Twelve different designs of sloping training walls, spillway chutes, and baffle arrangements were tested under three different discharges. Motion pictures were taken of some of the tests.

The third series used the same model as the second series, with the rock contours changed as the result of investigations at the site. Tests were made with various numbers and lengths of steps on the sloping training walls. The alignment of the walls were inclined at angles other than 90 degrees to the axis of the dam, and the toe of the wall was also moved in relation to the width of the spillway. Various heights of floor of the basin were also tested. Three stages of

discharge were usually tried.

(h) The first tests were completed in March 1946, and indicated that the sluices and spillway shape were satisfactory, but that the baffles should have a sloping upstream face.

The second series of tests showed the stilling basin action quite unsatisfactory with the above design. Eddies and cross currents were caused by the junction of spillway and sloping training walls, and the baffles had little effect. The tests completed in June 1946 developed a series of steps on each training wall which merged into the spillway and carried the water normal to the axis of the dam for some distance into the stilling basin. By lengthening the stilling basin and turning the baffles with the vertical face upstream, satisfactory results were obtained which would mean a substantial saving in excavation and concrete costs.

The third series of tests, completed in November 1947 but not yet reported upon, indicated that deviation of the training walls from a line normal to the axis of the dam was detrimental to the satisfactory operation of the stilling basin, but angles of up to 15 degrees could be made without undue danger. It was also found that the relation of the width of the stilling basin at water level with the width of the spillway was important. As the spillway width increased, allowing tailwater to flow back into the basin, the hydraulic jump was impaired and dangerous eddies were created. A movement of 10 feet would be about the maximum allowable. Experiments showed that the size of the steps on the 1:1 slope of the training walls could be made as small as six feet in height and width and still function well. The steps did not need to be carried beyond the first of the two rows of baffles.

It was found, as expected, that the floor of the stilling basin could be raised until the tailwater depth was proper for forming a perfect jump. However, since the depth required varied with the different flows, a floor elevation was selected which gave the best conditions for the greatest change in flow and no dangerous conditions at other flows.

(i) "A report on hydraulic model studies for Mount Morris Dam." George E. Barnes. Case School of Applied Science, Cleveland, Ohio, March 1946. 35 pp, 65 plates.

"Supplementary and final report on hydraulic model studies for Mount Morris Dam." George E. Barnes. Case School of Applied Science, Cleveland, Ohio, June 1946. 32 pp, 46 plates.

"Case School engineers devise novel energy dissipation for Mount Morris Dam." Engineering News-Record, Vol. 14: 212. August 15, 1946.

"Model tests conducted for Mount Morris spillway." Civil Engineering, Vol. 16, No. 9: 415. September 1946.

"Sowers invents spillway device." Tennessee Valley Engineer. September 1946: 9.

DEPT. OF THE ARMY, CORPS OF ENGINEERS, Los Angeles District Hydraulic Laboratory, Los Angeles, Calif.

Inquiries concerning Projects Nos. 186 and 188 should be addressed to The District Engineer, Los Angeles District, Corps of Engineers, 751 South Figueroa St., Los Angeles 14, Calif.

(186) SUPERELEVATED FLOW IN CURVED OPEN CHANNELS.

(b) Dept. of the Army, Corps of Engineers, Los Angeles District.

(c) Hydraulic Design Unit, A. P. Gildea, Chief. (e) Experimental.

(f) To provide design criteria for high velocity flow in curved rectangular channels.

(g) Series of model tests to check theoretical criteria for transition spirals and superelevated bottoms for rectangular channels.

(h) Work curtained at present. No immediate resumption contemplated.

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

(b) Dept. of the Army, Corps of Engineers, Los Angeles District.

(c) Hydraulic Design Unit, A. P. Gildea, Chief. (e) Design.

(f) To determine effect on water surface of series of curves and reverse curves with transition spirals and superelevated bottoms for rectangular channels with various discharges. Also to determine flow conditions at the confluence with Tujunga Wash for various combinations of discharges.

(g) A 1:30-scale model of a portion of the upper Los Angeles River channel improvement under consideration has been constructed. Depth and velocity distribution measurements to be taken.

(h) Tests have been partially completed. Work has been curtailed. Immediate resumption contemplated.

DEPT. OF THE ARMY, CORPS OF ENGINEERS, Portland District, Portland, Ore. (Bonneville Hydraulic Laboratory.)

Inquiries concerning Projects Nos. 189 to 192, incl., and 401 to 410, incl., should be addressed to The District Engineer, 628 Pittock Block, Portland 5, Ore.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) Experimental study to assist in structure alignment and design of navigation approaches, fishway approaches and fishways, powerhouse tailrace, and cofferdams.

(g) A fixed-bed, concrete, 1:100-scale, undistorted model, covered by an 85-foot by 220-foot shelter, reproduces a 3.7 mile reach of the Columbia River, at the site of McNary Dam. After verification of natural river conditions had been completed, the powerhouse, spillway, navigation lock, and fishway structures were installed, and then tested under various basic conditions with discharges ranging from 40,000 cfs to 2,200,000 cfs. The final alignment of the structures was first determined, and then the 14-unit powerhouse tailrace was investigated. Hydraulic conditions upstream and downstream from the 22-bay spillway were obtained under various plans of spillway gate operation, and data for the design and alignment of the upper and lower guide walls of the navigation lock were completed. Hydraulic conditions affecting the approaches to the various proposed fishladders were partially obtained. Selection of the most favorable plans on the above were made by setting various overall river discharges with fixed flows through the powerhouse and spillway, and then comparing observed water-surface elevations, velocities, and current directions, as well as confirming photographic records with each set-up tested to ascertain the relative hydraulic characteristics.

(h) The testing schedule is about 77 percent completed. Studies are now being made on the several proposed plans for cofferdam construction and the pull on mooring lines during crib cofferdam installation. Additional testing is contemplated on the tailrace alignment, conditions around the fishway structures, and spillway gate operation.

(i) Preliminary reports have been issued on all problems tested to date.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) Experimental study to determine the hydraulic characteristics of the spillway structure, including crest shapes, pier design, gates, and stilling basin details.

(g) A 1:36-scale model of plexiglass and waterproofed plywood reproduces three complete 50-foot width bays of the spillway section, including ogee crest, piers, 50-foot by 50-foot gates, and stilling basin. The model is confined within a glass and brick flume 5 feet wide, 6 feet high, and 70 feet long. Spillway discharge and pier contraction coefficients have been determined for use in design of the prototype spillway structure. Tests have been completed and data obtained concerning hydraulic characteristics of split vertical and sectional radial gates to assist in determining the most satisfactory type for installation of the spillway structure. Tests to determine the most efficient pier shapes have also been completed.

(h) Model testing is about 55 percent completed. Experimentation is now under way on the various types and designs of split radial gates. Upon the completion of these tests, extensive studies will be conducted on the spillway stilling basin, baffle design and arrangement, and the spillway bucket. A larger scale model of one spillway gate is contemplated for construction in the near future.

(i) Preliminary reports have been compiled on the results to date.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) Experimental study to determine the hydraulic design features of the navigation lock filling and emptying systems.

(g) The model reproduces on a scale of 1:25 a section of the forebay, the entire lock chamber, and lower lock approach channel, as well as the ports, culverts, and control valves of the filling and emptying systems. Waterproofed plywood and transparent plastics have been used in the model construction. The operation of the lock filling and emptying valves and the recording of hawser stresses was accomplished with electrical equipment controlled from a central panel. Each set-up was investigated by simulation of various head conditions up to a maximum of 92 feet. Tests of bottom lateral and bottom longitudinal filling and emptying systems have been completed and the filling and emptying times established with the original 86 feet wide by 500 feet long lock chamber. An auxiliary 1:20 valve model has been constructed of transparent plastics to facilitate the observation of flow conditions, pressures, and venting requirements with various type of proposed valves.

(h) The model has just been reconstructed to the recently enlarged chamber dimensions of 86 feet by 675 feet, and tests with this size lock and a bottom lateral filling system will conclude the study.

(i) Preliminary reports are being compiled of the results to date.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To study the hydraulic characteristics of the spillway and stilling basin as designed and to determine what changes are desirable, particularly as pertains to the depth of stilling basin and type and spacing of baffles; to determine effective changes that might increase efficiency of that structure and to eliminate undesirable conditions.

(g) The model was constructed to a scale of 1:50 with a portion of the forebay and 120-foot earth fill dam, gravity type 200 feet wide spillway, stilling basin, the five 5-foot by 6-foot sluiceways, and a portion of the tailbay being reproduced. The forebay, tailbay, and dam are of concrete, the spillway and sluiceways are of transparent plastics, and the stilling basin of waterproofed plywood. Data have been taken on the hydraulic characteristics of the spillway and stilling basin with simulated spillway discharge up to 97,500 cfs. Emphasis was given to the possibility of reducing the required depth and length of the stilling basin by the use of the broad-crested end sill, which tends to raise the effective tailwater and permit satisfactory hydraulic jump conditions to obtain when same could not be expected to occur with natural tailwater conditions.

(h) All experimentation has been completed and the final report is now being prepared.

(i) A model study was previously conducted with a converging type spillway and tower culvert outlet works. The results of this study were published in Report No. 11-1, dated November 16, 1942, entitled "Model study of the spillway and tunnel for Dorena Dam, Row River, Oregon".

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To study flow conditions in the simulated 6-foot depth fishladder, with both 20-foot and 30-foot widths, 1:20 and 1:16 slopes, depths of flow over the weirs varying between 6 inches and 24 inches, and several types of submerged orifices as related to the upstream migration of fish through the proposed ladders.

(g) The model, constructed to a scale of 1:16 out of waterproofed plywood and transparent plastics reproduces a section of one of the fishladders proposed for McNary Dam. This section includes a 180° curve and 13 bays upstream and 7 bays downstream therefrom. Facilities for determining discharges, velocities, water-surface profiles, and currents were included in the model. Tests to determine conditions in the pools of the fishladder as originally designed and with certain suggested changes in spacing of weirs, width of ladder, overall slopes, and location of submerged weirs have been completed.

(h) Model testing is approximately 75 percent completed, with sufficient information on the original design having been obtained to permit determination of the most effective width and slope of ladders. Experimentation will continue to assist in the final planning of fishladder facilities.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To determine the best means of introducing auxiliary water into the fishladder under tailwater and operating conditions which will exist at McNary Dam.

(g) The model is constructed of waterproofed plywood and transparent plastics to a scale of 1:10, and reproduces 3-bay section of the 30-foot width fishladder. The 20-foot by 30-foot center bay contains a diffuser consisting of a chamber 8 feet in depth beneath the normal floor of the ladder, into which flow is introduced from an auxiliary water supply system and from which diffused flow is extruded

into the bottom of the fishladder through baffles to merge with the flow passing downstream through the ladder proper.

(h) The construction of the model has been completed, and tests have just been initiated to determine the characteristics of the proposed design of the diffuser. Modifications of the design may have to be made, and testing will continue until a satisfactory design has been obtained.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To study the hydraulic performance of both the side channel spillway and a gravity type spillway to permit determination of the most satisfactory type for site available for the structure.

(g) 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 are reproduced in concrete. A 2,200-foot section of the 250-foot earth fill dam is included in the model, and the 1,900-foot long side channel spillway with a 725-foot long ogee crest, chute, and 150-foot wide stilling basin at the base thereof is reproduced in its entirety by use of waterproofed plywood and plastics. Flows up to 243,000 cfs can be simulated, and provisions have been made to install the gravity type spillway crest if required.

(h) Tests upon the original design of the side channel spillway have been completed, and model study of minor modifications is in progress. A gate controlled spillway control section and possibly the gravity type spillway have yet to be tested.

(404) MODEL STUDY OF MERIDIAN DAM TUNNEL AND OUTLET WORKS (LOOKOUT POINT SITE), MIDDLE FORK, WILLAMETTE RIVER, OREGON.

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) 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.

(g) The model is designed to a scale of 1:25 and includes a portion of the forebay, 750 feet by 1,000 feet, in which the topography is molded of concrete; the intake tower containing the tunnel entrances; the 20-foot and 27-foot tunnels fabricated of transparent plastics; Howell-Bunger valves of machined brass; and a portion of the tailbay area. Facilities for measuring discharge, velocities, and pressures have been provided. Flows up to 35,000 cfs and 18,900 cfs will be reproduced to scale in the power and flood control tunnels respectively.

(h) Construction of the model is nearing completion, and initiation of tests are scheduled for December 1, 1947.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To determine the best general layout of the structures from standpoints of navigation, power generation, and fishladder approaches.

(g) The model is to be a fixed bed concrete type to an undistorted scale of 1:100, reproducing the river from mile 8.3 to mile 11.0. After verification of the natural river conditions up to flows of 850,000 cfs has been completed, a base test with various operating conditions will be made in which the proposed dam structures including the spillway with fourteen 40-foot width crest gates, powerhouse with five turbine generator units, single lift navigation lock 86 feet by 500 feet, and fishways will be simulated. Determination of required modifications will then be made, and such modifications subsequently tested. Axis of the structure will be located at river mile 9.7.

(h) The model is now being designed, and construction will be begun in December 1947.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To investigate various designs of spillway, gates, and stilling basin, to determine the most effective design for dissipation of energy and control of flow.

(g) The model will consist of a 3-bay section of the spillway dam constructed to a scale of 1:32. Waterproofed plywood and transparent plastics will be used in fabrication of the model, and the whole will be contained in a glass-sided wood laminated flume approximately 5 feet by 6 feet in section and 70 feet in length. Usual provisions for determining discharges, water surface profiles, velocities, and pressures on crest, piers, gates, baffles, and end sill will be made. Flows up to a maximum of some 61,000 cfs per bay will be simulated. Maximum head conditions prevailing will be approximately 100 feet.

(h) The model is under design, with construction scheduled to begin about January 1, 1948.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To develop satisfactory hydraulic filling and emptying system for this 100-foot head, 86-foot by 500-foot single lift navigation lock.

(g) The model is to be built to a scale of 1:25, including the entire lock chamber, and a portion of the approach and exit channels. The lock proper will be constructed of waterproofed plywood with waterway systems and tainter valves of transparent plastics. Operation of the model and recording of hawser stresses and water levels will be accomplished electrically from a central control panel. A bottom lateral filling system will probably be first investigated in the model.

(h) Design of the model is in its initial stage.

(408) GENERAL MODEL STUDY OF FOSTER CREEK DAM, COLUMBIA RIVER, WASHINGTON.

(b) Dept. of the Army, Corps of Engineers, Seattle District, Seattle, Wash.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

into the bottom of the fishladder through baffles to merge with the flow passing downstream through the ladder proper.

(h) The construction of the model has been completed, and tests have just been initiated to determine the characteristics of the proposed design of the diffuser. Modifications of the design may have to be made, and testing will continue until a satisfactory design has been obtained.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To study the hydraulic performance of both the side channel spillway and a gravity type spillway to permit determination of the most satisfactory type for site available for the structure.

(g) 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 are reproduced in concrete. A 2,200-foot section of the 250-foot earth fill dam is included in the model, and the 1,900-foot long side channel spillway with a 725-foot long ogee crest, chute, and 150-foot wide stilling basin at the base thereof is reproduced in its entirety by use of waterproofed plywood and plastics. Flows up to 243,000 cfs can be simulated, and provisions have been made to install the gravity type spillway crest if required.

(h) Tests upon the original design of the side channel spillway have been completed, and model study of minor modifications is in progress. A gate controlled spillway control section and possibly the gravity type spillway have yet to be tested.

(404) MODEL STUDY OF MERIDIAN DAM TUNNEL AND OUTLET WORKS (LOOKOUT POINT SITE), MIDDLE FORK, WILLAMETTE RIVER, OREGON.

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) 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.

(g) The model is designed to a scale of 1:25 and includes a portion of the forebay, 750 feet by 1,000 feet, in which the topography is molded of concrete; the intake tower containing the tunnel entrances; the 20-foot and 27-foot tunnels fabricated of transparent plastics; Howell-Bunger valves of machined brass; and a portion of the tailbay area. Facilities for measuring discharge, velocities, and pressures have been provided. Flows up to 35,000 cfs and 18,900 cfs will be reproduced to scale in the power and flood control tunnels respectively.

(h) Construction of the model is nearing completion, and initiation of tests are scheduled for December 1, 1947.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To determine the best general layout of the structures from standpoints of navigation, power generation, and fishladder approaches.

(g) The model is to be a fixed bed concrete type to an undistorted scale of 1:100, reproducing the river from mile 8.3 to mile 11.0. After verification of the natural river conditions up to flows of 850,000 cfs has been completed, a base test with various operating conditions will be made in which the proposed dam structures including the spillway with fourteen 40-foot width crest gates, powerhouse with five turbine generator units, single lift navigation lock 86 feet by 500 feet, and fishways will be simulated. Determination of required modifications will then be made, and such modifications subsequently tested. Axis of the structure will be located at river mile 9.7.

(h) The model is now being designed, and construction will be begun in December 1947.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To investigate various designs of spillway, gates, and stilling basin, to determine the most effective design for dissipation of energy and control of flow.

(g) The model will consist of a 3-bay section of the spillway dam constructed to a scale of 1:32. Waterproofed plywood and transparent plastics will be used in fabrication of the model, and the whole will be contained in a glass-sided wood laminated flume approximately 5 feet by 6 feet in section and 70 feet in length. Usual provisions for determining discharges, water surface profiles, velocities, and pressures on crest, piers, gates, baffles, and end sill will be made. Flows up to a maximum of some 61,000 cfs per bay will be simulated. Maximum head conditions prevailing will be approximately 100 feet.

(h) The model is under design, with construction scheduled to begin about January 1, 1948.

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

(b) Dept. of the Army, Corps of Engineers, Portland District.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

(f) To develop satisfactory hydraulic filling and emptying system for this 100-foot head, 86-foot by 500-foot single lift navigation lock.

(g) The model is to be built to a scale of 1:25, including the entire lock chamber, and a portion of the approach and exit channels. The lock proper will be constructed of waterproofed plywood with waterway systems and tainter valves of transparent plastics. Operation of the model and recording of hawser stresses and water levels will be accomplished electrically from a central control panel. A bottom lateral filling system will probably be first investigated in the model.

(h) Design of the model is in its initial stage.

(408) GENERAL MODEL STUDY OF FOSTER CREEK DAM, COLUMBIA RIVER, WASHINGTON.

(b) Dept. of the Army, Corps of Engineers, Seattle District, Seattle, Wash.

(c) Laboratory staff under the direction of R. B. Cochrane, Head, Hydraulic Design Section, Portland District.

(e) Experimental, for design.

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

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

(c) Corps of Engineers' staff at Hydraulics Laboratory, State University of Iowa, Iowa City, Ia.

(e) Design project.

(f) To check the proposed design of the filling and emptying systems for the New Cumberland main and auxiliary locks and to develop improvements in the systems.

(g) 1:25-scale models have been built to simulate the design of a main lock 110 feet wide by 1200 feet long, and an auxiliary lock 110 feet wide by 600 feet long. The normal lift is 22.1 feet. To reduce turbulence in the lock chambers during filling, the slope of the lock chamber ports was reduced in the side-wall culvert system of the main lock, and the design of the laterals of the bottom culvert system of the auxiliary lock was revised to give more uniform lateral distribution of flow. Revisions in both locks indicate improvement of flow conditions during filling. Revisions also have been made in the discharge manifolds to reduce turbulence in the downstream lock approaches during emptying operations. Preliminary tests indicate considerable improvement in flow conditions during emptying in approaches to both locks with the revised discharge manifolds.

(h) Work on this project, which was temporarily suspended in November 1946, was resumed in April 1947. Tests with revisions in the models are in progress. Data from tests completed to date are being prepared for the final report.

(196) MISSISSIPPI RIVER, FILLING AND EMPTYING SYSTEM FOR NEW 1200-FOOT LOCK AT LOCK AND DAM NO. 19, KEOKUK, IOWA.

(b) Dept. of the Army, Corps of Engineers, Rock Island District.

(c) Corps of Engineers' staff at Hydraulics Laboratory, State University of Iowa, Iowa City, Ia.

(e) Design project.

(f) To study the design of the proposed filling and emptying systems for a new 1200-foot lock at Lock and Dam No. 19, including the use of a submergible tainter gate as the upper lock gate to supplement the filling system.

(g) Two complete models with scale ratios of 1:25 and simulating a normal lift of 38.2 feet have been built. Model 1, with separate filling and emptying systems, simulated a lock 110 feet wide by 1200 feet long with intermediate miter gates to provide 800- and 400-foot chambers. A submergible tainter service gate which served as the upper lock gate supplemented the bottom-filling system for the 1200- and 800-foot chambers. For the 400-foot chamber, the bottom-filling system was connected to an intake manifold in the downstream half of the 800-foot chamber. The emptying system consisted of three stub culverts, two of which discharged into the open river and one into the lower lock approach. Model 2, which replaced Model 1, has a combined filling and emptying system and simulates a lock 110 feet wide by 1200 feet long. As in Model 1, the bottom-filling and emptying system is supplemented with flow over a tainter service gate. A stub culvert discharging into the open river supplements flow during emptying.

Filling tests were run in both models to coordinate operations of the culvert valves and the tainter service gate. Extensive tests were made on the landwall emptying system in Model 1 to eliminate low pressures downstream from the valve. Similar tests in Model 2 indicate satisfactory pressures with larger culverts. (The culverts at the valves were increased in size from 12.5 by 12.5 feet in Model 1 to 14.5 by 14.5 feet in Model 2.)

(h) The testing program on Model 2 is in progress. Data from tests on Model 1 and from tests on Model 2 completed to date are being prepared for the final report.

(197) MISSISSIPPI RIVER, FILLING AND EMPTYING SYSTEMS FOR AUXILIARY LOCKS.

(b) Dept. of the Army, Corps of Engineers, St. Paul District.

(c) Corps of Engineers' staff at Hydraulics Laboratory, State University of Iowa, Iowa City, Ia.

(e) Design project.

(f) To obtain data for use in the design of the filling and emptying systems for the unfinished auxiliary locks under a range of heads for systems composed of a single wall culvert and floor laterals of various dimensions, number, and spacing. It is anticipated that the results will be of such scope as to be applicable also to the design of locks in other navigation projects.

(g) Tests were made in a 1:25-scale model simulating a lock 110 feet wide by 360 feet long. The culvert system, from the intakes to a section about 127 feet downstream from the miter gate pintles, simulated a representative design of the systems used in the 20 existing auxiliary locks.

(h) The draft of the final report has been completed. Publication has been suspended indefinitely due to curtailment of funds.

(198) MISSISSIPPI RIVER, FILLING AND EMPTYING SYSTEM FOR LOCK NO. 27, ST. LOUIS, MISSOURI.

(b) Dept. of the Army, Corps of Engineers, Upper Mississippi Valley Division.

(c) Corps of Engineers' staff at Hydraulics Laboratory, State University of Iowa, Iowa City, Ia.

(e) Design project.

(f) To check the design of the proposed filling and emptying systems for Lock No. 27, and to investigate current conditions in the upstream and downstream lock entrances.

(g) After tests were completed on models of the main and auxiliary locks, design lengths were changed from 600 feet to 1200 feet for the main lock, and from 360 feet to 600 feet for the auxiliary lock. Another model was built to a scale of 1:25 to simulate the 1200-foot main lock, but the revised design for the auxiliary lock was made without further model study. The side-wall culvert system for the 1200-foot main lock was supplemented during filling by flow over a vertical-lift service gate and during emptying by flow through a stub culvert discharging from laterals at the lower end of the middle wall. Filling tests were made to coordinate the operations of the vertical-lift gate and culvert valves, and emptying tests were made with different outlet arrangements to reduce turbulence and currents in the tailbay.

(h) Tests have been completed, and final report is being prepared.

(411) ST. ANTHONY FALLS SPILLWAY AND LOCK TAINTER GATES.

(b) Dept. of the Army, Corps of Engineers, St. Paul District.

(c) Corps of Engineers' staff at St. Anthony Falls Hydraulics Laboratory, University of Minnesota, Minneapolis, Minn.

(e) Design project.

(f) The project is part of a study of the extension of the 9-foot channel of the Upper Mississippi River above the Falls of St. Anthony to create an upper harbor at Minneapolis. The project is specifically the study of the spillway and lock tainter gates, and it includes the determination of the length of stilling bay, a satisfactory size and arrangement of baffles, pressure distribution over tainter gates and gate sill, and the effects of scouring.

(g) A model of a spillway tainter gate, with sill, approach section, and stilling bay, was constructed to a scale ratio of 1:26.4 and installed in a 30-inch steel flume which is provided with a glass observation panel. Water surface profile along the center-line of the flume was made with a traversing point gage. Piezometers were installed on center-line of tainter gate and sill to determine the pressure distribution over these structures.

(h) The study is only partially complete and the data are being analyzed.

(i) See also Project No. 412, "St. Anthony Falls Locks", immediately following.

(412) ST. ANTHONY FALLS LOCKS.

(b) Dept. of the Army, Corps of Engineers, St. Paul District.

(c) Corps of Engineers' staff at St. Anthony Falls Hydraulics Laboratory, University of Minnesota, Minneapolis, Minn.

(e) Design project.

(f) The project is part of the study of the extension of the 9-foot channel on the Upper Mississippi River above the Falls of St. Anthony. The project will establish a satisfactory hydraulic system for the navigation locks.

(g) A model of the look, including chambers and hydraulic system, will be constructed to a scale ratio of 1:22.4. Observations by means of a special recorder will be made of time and rate of operation, extent of surging, and intensity of hawser pull.

(h) Plans for the model have been prepared and construction is in progress.

(i) See also Project No. 411, "St. Anthony Falls Spillway and Lock Tainter Gates", page 97.

(413) STUDY OF BALDHILL DAM, SHEYENNE RIVER, NORTH DAKOTA.

(b) Dept. of the Army, Corps of Engineers, St. Paul District.

(c) Corps of Engineers' staff at St. Anthony Falls Hydraulics Laboratory, University of Minnesota, Minneapolis, Minn.

(e) Design project.

(f) The project was initiated to check the prototype dam design and recommend such revisions thereto as were desirable.

(g) A half-model at a scale ratio of 1:51 was constructed and installed in a 20-inch glass flume. The approach channel, ogee section, spillway section, and stilling bay were simulated. A correlation of a variety of flows with various tainter gate openings to the resulting upper pool elevations was made. By visual observation, an alignment of the training wall was obtained to give a satisfactory flow distribution in the stilling bay. Observations were made of the velocity distribution at a section over the end sill and at a section 200 feet downstream.

(h) Testing is complete and data are being analyzed.

(414) PARK RIVER RESERVOIR, SOUTH FORK OF PARK RIVER, NORTH DAKOTA.

(b) Dept. of the Army, Corps of Engineers, St. Paul District.

(c) Corps of Engineers' staff at St. Anthony Falls Hydraulics Laboratory, University of Minnesota, Minneapolis, Minn.

(e) Design project.

(f) The project is a study to verify the prototype design. The study includes a determination of the relation of upper pool elevation to various flows, uniformity of flow in a converging spillway section, efficiency of the stilling bay, and the extent of scouring downstream from the structure.

(g) Model at a scale ratio of 1:36 is being constructed to simulate the reservoir approach area, spillway, stilling bay, and downstream area.

(h) Plans of the model have been prepared, and construction is in progress.

(i) See also Project No. 415, "Park River Reservoir Conduit Outlet, South Fork of Park River, North Dakota", immediately following.

(415) PARK RIVER RESERVOIR CONDUIT OUTLET, SOUTH FORK OF PARK RIVER, NORTH DAKOTA.

(b) Dept. of the Army, Corps of Engineers, St. Paul District.

(c) Corps of Engineers' staff at St. Anthony Falls Hydraulics Laboratory, University of Minnesota, Minneapolis, Minn.

(e) Design project.

(f) The project is to study and check the prototype design of a stilling basin for flow from a 60-inch conduit through the Park River Dam. Prototype flow velocities in excess of 40 fps are anticipated.

(g) The model will be constructed at a scale ratio of 1:20, and it will simulate the conduit outlet, transition to a rectangular section, spillway and chute, stilling bay, and a portion of the downstream channel. The sidewalls of the chute will be adjustable so that various degrees of expansion may be simulated.

(h) The model is undergoing design.

(i) See also Project No. 414, "Park River Reservoir, South Fork of Park River, North Dakota", page 98.

DEPT. OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station, Vicksburg, Miss.

Inquiries concerning Projects Nos. 201, 204 to 206, 210, 211, 213, 214, 216 to 219, 221, 222, 224, 226, 227, 229, 230, 232 to 237, 239, 241 to 243, 245 to 249, 251 to 253, 255, 257, and 416 to 430, incl., should be addressed to The Director, Waterways Experiment Station, 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.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of spillway, stilling basin, and sluice.

(f) 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.

(g) Conemaugh Dam will be one of the main units in the comprehensive plan for flood control in the Pittsburgh District. The dam will consist principally of a concrete-gravity section with an earth embankment section at the right abutment. A centrally located spillway, designed to discharge 370,000 cfs will contain 14 crest gates, each 30 feet by 27 feet high. Normal flow will be regulated by conduits through the spillway. Two models were used originally in this study: (1) a 1:60-scale comprehensive model, reproducing the entire problem area including about 1,000 feet of approach channel, the entire dam, and about 1500 feet of exit channel below the dam; and (2) a 1:24-scale section model was used to study the best design of each type stilling basin produced by tests conducted on the comprehensive model. In order to make a more complete study of sluice action, a 1:15-scale model of one of the sluices was reproduced to select the most favorable invert elevation, intake and trash-rack design, and outlet design.

(h) All tests have been completed; preparation of final report is in progress.

(204) MODEL STUDY OF DEMOPOLIS LOCK AND DAM, TOMBIGBEE RIVER, ALABAMA.

(b) The District Engineer, Mobile District, Corps of Engineers, Mobile, Ala.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To determine scouring action and flow characteristics below the stilling apron and at the lock entrances, and to devise corrective measures or improvements which may be indicated.

(g) The Demopolis Lock and Dam will be built at a site about 2 miles below Demopolis, Ala., on the Tombigbee River, and 3 miles below the existing Lock No. 4, which it

will replace. It will be concrete-gravity section, with a spillway extending the entire length of the dam. A single lock on the left bank end of the spillway will be provided for navigation purposes. A 1:80-scale comprehensive model reproduces 2,300 feet of approach area and 2,500 feet of exit channel, the full width of the channel and overflow area, the spillway, stilling basin, and locks. A 1:40-scale section model of the spillway reproduces a 40-foot section of the spillway and stilling basin and a portion of the exit channel.

(h) All tests have been completed; preparation of final report is in progress.

(205) MODEL STUDY OF SPILLWAY AND CONDUITS, DETROIT DAM, NORTH SANTIAM RIVER, OREGON.

(b) The District Engineer, Portland District, Corps of Engineers, Portland, Ore.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of spillway and conduits.

(f) To analyze the hydraulic characteristics of the spillway and stilling basin, and the flood-control conduits; and to develop means of correcting any uneconomic, unsafe, or otherwise undesirable conditions which may exist in the proposed design of these structures.

(g) Detroit Dam will operate in parallel with six other dams on tributaries of Willamette River to reduce flood heights on the main stream, to provide increased low water flow for navigation or irrigation, and to generate hydroelectric power. An ogee-type spillway near the center portion of the 1580-foot concrete dam is designed to pass a maximum flow of 157,000 cfs at a head of 30.4 feet. Six 42-foot wide by 28-foot high radial crest gates will be used to control extreme floods. Flood control conduits are to be located at three levels in the spillway section of the dam. Two types of conduits are being studied in the model, rectangular conduits controlled by vertical slide gates, and circular conduits controlled by hollow jet valves. Three 15-foot diameter penstocks located to the right of the spillway will conduct flow to the power turbines. Two models are involved in this study: (1) a 1:60-scale general model reproducing the spillway and stilling basin, the dam, the 5 flood-control conduits, and the power structure; and (2) a 1:15-scale model of the flood-control conduits.

(h) Tests of the conduits are in progress; the testing program of the spillway has been completed.

(206) MODEL STUDY OF SPILLWAY, DILLON DAM, LICKING RIVER, OHIO.

(b) The District Engineer, Huntington District, Corps of Engineers, Huntington, W. Va.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of spillway.

(f) To determine extent and magnitude of any destructive eddies which may be formed near the toe of the dam when the spillway is in use, and to devise corrective measures therefor; and to determine whether the ogee-type spillway with its deeper channel will provide better performance than the less expensive plan of using a broad-crested spillway.

(g) Dillon Dam will be a rolled earth-fill structure with an uncontrolled spillway located in the left abutment. Controlled flow regulation will be provided by an outlet works located in the right abutment. The outlet works, with a capacity of 7,000 cfs at conservation pool level, will consist of a three-gated intake (each gate 7 feet wide by 15 feet high), a 551-foot horseshoe-shaped conduit, and a stilling basin. A 1:50-scale model reproduces 1000 feet of the approach area and 1800 feet of exit channel, the full width of the dam and spillway area, and the controlling conduit with gates and stilling basin.

(h) All tests have been completed; preparation of final report is in progress.

(210) MODEL STUDY OF INTAKE STRUCTURES, GARRISON AND FORT RANDALL DAMS, MISSOURI RIVER, NORTH DAKOTA.

(b) The District Engineer, Garrison District, Corps of Engineers, Bismarck, N. D.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of intake structures.

(f) To develop the most suitable intake and control design for 10-foot by 20-foot rectangular conduits by (1) vacuum tests to determine location of critical areas which might be subjected to cavitation pressures; and (2) tests under atmospheric pressures to determine head losses, gate vibrations, and gate downpull.

(g) Garrison and Fort Randall Dams are two of the flood-control and hydroelectric power projects to be built on the Missouri River. The study is being conducted on a 1:30-scale model reproducing a portion of the intake structure and one sluice including the intake throat; trash-rack, bulkhead, emergency and service gate slots; one service gate; air vent; and transition section.

(h) Testing is in progress.

(211) MODEL STUDY OF OUTLET STRUCTURES, GARRISON DAM, MISSOURI RIVER, NORTH DAKOTA.

(b) The District Engineer, Garrison District, Corps of Engineers, Bismarck, N. D.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of outlet structures.

(f) To develop a stilling device for the power conduits, which will be used for diversion during construction of the dam, that can later be incorporated into the powerhouse substructure; and to develop a sluiceway stilling basin.

(g) Garrison Dam will consist of an earth embankment rising approximately 185 feet above the valley of the Missouri River upstream from Bismarck, N. D. The present plan calls for eight power conduits and five flood-control conduits located in the right abutment and a chute-type spillway designed to pass 600,000 cfs located in the left abutment. The study is being conducted upon a model, scale of 1:45, reproducing about 300 feet of the lower portion of the power conduits and sluiceways, the entire tailrace area and stilling basin below the sluiceways, and about 1000 feet of the exit area below the stilling basin.

(h) Study inactive; testing indefinitely postponed.

(213) MODEL STUDY OF CONTROL STRUCTURE, MORGANZA FLOODWAY, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of control structure.

(f) To determine discharge coefficients and to investigate head-discharge relationships, effect of stilling basin design on the hydraulic jump, and effect of crest shape on hydraulic efficiency.

(g) Morganza Floodway Control Structure will consist of an ogee-type spillway and a stilling basin, the design of which will be governed by results of model tests; 191 gate bays, each 23 feet wide, will control flood flows through the floodway. The 1:16-scale model reproduces about 300 feet of approach area and 400 feet of exit area, five gate bays, and a portion of the levee on the right end of the structure. A supplementary model of the weir, built to a scale of 1:30 and installed in a glass-sided flume, is also being used for this study.

(h) Testing is in progress.

(214) MODEL STUDY OF SPILLWAY AND STILLING BASIN, OSCEOLA DAM, OSAGE RIVER, MISSOURI.

(b) The District Engineer, Kansas City District, Corps of Engineers, Kansas City, Mo.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of spillway and stilling basin.

(f) To confirm design assumptions and to arrive at the most feasible and economical stilling basin design.

(g) The dam consists of a rolled-fill earth embankment section and a gravity-type concrete overflow structure including the gate-controlled spillway, the flood-control and navigation conduits, bulkhead sections to effect connection with the earth embankment, and provision for future power installation. The spillway is 760 feet in width and is controlled by 16 crest gates (each 30 feet high and 40 feet wide). The spillway structure includes 15 sluices (each 5 feet wide and 8 feet high). The 1:60-scale model reproduces about 900 feet of approach channel, the spillway, the sluices, the stilling basin, and about 1500 feet of the exit channel.

(h) All tests have been completed; preparation of final report is in progress.

(216) MODEL STUDY OF IRRIGATION TUNNEL, ST. MARY DAM, SASKATCHEWAN, CANADA.

(b) The Chief Engineer, Prairie Farm Rehabilitation, Dept. of Agriculture, Saskatchewan, Canada.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To check the hydraulic characteristics of the irrigation tunnel, and to develop means for correcting any uneconomic, unsafe, or undesirable conditions which are found to exist in the proposed design.

(g) St. Mary Dam is to be a unit of the St. Mary - Milk Rivers Project, by which it is proposed to develop some 345,000 acres of irrigated land in addition to providing a better water supply for existing irrigation districts comprising some 120,000 acres. A rolled-fill dam with a crest length of about 2,400 feet will rise 190 feet above the valley floor. A cut through the summit of a ridge will serve as a spillway and will conduct flood flows to a coulee roughly paralleling the river to the north. A tunnel through the hill to the south of the dam will conduct irrigation water from the reservoir. This tunnel has been designed to pass a maximum discharge of 3,200 cfs with the head varying from a minimum of 25 feet to a maximum of 81 feet. A 1:25-scale model reproduced approximately 200 feet of approach channel, the intake structure, including the service gates, transition from the intake to tunnel, the tunnel, the outlet transition, and about 300 feet of exit channel.

(h) All tests have been completed; preparation of final report is in progress.

(217) SECTION MODEL STUDY OF SPILLWAY AND BUCKET, WHITNEY DAM, BRAZOS RIVER, TEXAS.

(b) The District Engineer, Galveston District, Corps of Engineers, Galveston, Tex.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of spillway and stilling basin.

(f) To analyze the hydraulic characteristics of the spillway and stilling basin, and to develop means of correcting any uneconomic, unsafe, or otherwise undesirable conditions which may exist in the proposed design.

(g) The dam as proposed consists of an 824-foot ogee-type spillway near the center portion of the 1680-foot concrete structure, designed to pass a maximum flow of 660,000 cfs at a head of 40 feet. The spillway contains 17 tainter gates (each 38 feet high by 40 feet wide) and 16 flood-control conduits (each 9 feet high by 5 feet wide). Either a 200-foot horizontal stilling basin with baffle piers and end sill or a 50-foot radius bucket will be used to dissipate the energy contained in spillway flow. A 1:30-scale section model reproduces one entire bay of the spillway and two adjacent half bays, a portion of the approach channel, the bucket or horizontal apron, three sluices, and a portion of the exit channel.

(h) All tests have been completed; preparation of final report is in progress.

(218) MODEL STUDY OF CONDUIT ENTRANCES.

(b) Office, Chief of Engineers, Dept. of the Army, Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of conduit entrances.

(f) To collect experimental data on which to base the hydraulic design of conduit entrances for conduit alignments at various angles to the upstream face of a dam.

(g) 1:20-scale models of nine intakes for a 5-foot 8-inch by 10-foot 0-inch conduit were fabricated of plastic and attached to a steel pressure tank for testing. The intakes tested were for conduit alignments normal to the face of the dam and at angles of 10, 20, 30, and 40 degrees from the normal to the face of the dam.

(h) Testing is in progress.

(219) SLUICE GATE SLOTS, GENERAL TESTS.

(b) The Chief of Engineers, Dept. of the Army, Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for general information.

(f) To study effect of sluice gate slot shape on cavitation tendencies.

(g) A 1:6-scale model of the gate slots was constructed which reproduced one pair of gate slots plus adjoining portions of the conduit upstream and downstream therefrom.

(h) Testing is in progress.

(221) PROTOTYPE CONFIRMATION OF MODEL STUDIES.

(b) The Director, Waterways Experiment Station, Vicksburg, Miss.

(c) Personnel of the Waterways Experiment Station.

(e) General information.

(f) To obtain, from already accumulated data and from future prototype observations, material to be analyzed and tabulated for subsequent interpretations. The ultimate aim of the investigation is to aid the engineer in evaluating results obtained from small-size studies, as well as to advance the science of model investigations.

(g) Inquiries have been addressed to departmental offices enlisting their cooperation in furnishing background material, such as plans and specifications, construction progress photographs, construction status, changes in design, and any measured prototype performance data. In the case of projects in the final stages of construction and for which no means of obtaining hydraulic data have been provided, plans have been made for procuring such data as is possible. For projects which have been recently initiated, the feasibility for prototype measurements will be determined, and plans formulated for the installation of equipment for making hydraulic observations.

(h) Prototype data are being obtained.

(222) MODEL STUDY OF PONTONS FOR MILITARY BRIDGES.

(b) The Executive Officer, the Engineer Board, Fort Belvoir, Va.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To study the effect of adding the rectangular center section to the M4 pontons in military bridges; to secure data on the M4 pontons with this arrangement; and, if possible, to improve the freeboard in high velocity flow by testing several new type bow shapes.

(g) The M4 ponton is 6 feet 10-1/2 inches wide and 29 feet 7-5/8 inches long, with a curved streamlined bow and rectangular-shaped stern. When used in an M4 type bridge, two pontons are fastened stern to stern and adjacent pairs of pontons placed at 15-foot centers. In the present tests, however, a rectangular-shaped center section was added to the two pontons forming an overall length of about

81 feet. The 81-foot overall sections were spaced at 7.5 feet center to center. The models of the pontons and the bridge were constructed to the linear scale ratio of 1:15. The deck of the bridge was reproduced by a wooden frame of such construction as to reproduce the deflection characteristics of the prototype bridge under load.

(h) All tests have been completed; preparation of the final report is in progress.

(224) HYDROLOGICAL RESEARCH PROJECT, EXPERIMENT STATION LAKE WATERSHED, MISSISSIPPI.

(b) Office, Chief of Engineers, Dept. of the Army, Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) General information.

(f) To augment pertinent data and to advance the knowledge of the hydrological characteristics of any drainage basin through a comprehensive study of the hydrology of a typical small watershed -- that of the Experiment Station Lake.

(g) The Experiment Station dam forms a small lake whose elevation is controlled by a chute-type spillway. Pertinent facts concerning the watershed are: shape, oval; area, 3,521 acres; terrain, rough and hilly; soil, loess; vegetation, pasture, cultivated land, woods; habitation, scattered. Two investigations were included in the project: (1) a study of the rainfall-runoff relation, using the unit-hydrograph method; and (2) a study of evaporation. The apparatus and structures used in the project consisted of 29 non-recording and 5 recording rain-gaging stations located at approximately half-mile intervals over the watershed, 6 inflow stream-gaging stations, 2 land and 1 floating evaporation stations, 6 groundwater wells, and 2 type F and 2 type FA infiltrometers.

(h) Study discontinued; preparation of final report is in progress.

(226) POTAMOLOGY INVESTIGATIONS.

Formerly entitled "Model Study of Investigations for the Control of Bank Caving and Meandering of Alluvial Streams."

(b) The President, Mississippi River Commission, Vicksburg, Miss.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for developing model techniques.

(f) To develop a type of hydraulic model which can be used to obtain reliable predictions as to future changes in the meander course of the Mississippi River, such as predictions to serve as a guide to the placing of bank revetment; and to determine the nature and causes of failures in Mississippi River revetment with a view to improving the design and prolonging the life of revetments.

(g) The project consists of three phases: (1) Development of a suitable material and model operating technique to obtain an erodible-bank, movable-bed type model which will respond to the laws of channel meandering in the same degree as its counterpart in nature, and which can be used to predict 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 with a view to 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 to determine the erodibility characteristics of various natural and synthetic erodible materials is being conducted in two small sheet-metal flumes. These flumes are each 1 foot wide and 1 foot deep with a 6-foot straight section at the upstream end and a 1-foot straight section at the lower end; between the straight sections is a 90° circular-arc section of 5-foot radius. On the concave side of the circular-arc section provisions are made for modeling of sections of the erodible materials to be tested. A large flume is being designed which will permit the modeling of a specific reach of the Mississippi River to linear scale ratios, model-to-prototype, of 1:100 vertically and 1:400 horizontally, for use

in adapting these erodible materials in modeled bends of unstable reaches of the river. For the study of revetment failures on erodible banks, a flume 8 feet wide by 3 feet deep by 60 feet long is being used. In this flume is reproduced a section of a typical bend of the Mississippi River to an undistorted linear 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. Another flume approximately 125 feet wide, 600 feet long, and 3-1/2 feet deep is being designed for the revetment study and will contain a complete typical bend of the Mississippi River to an undistorted scale of 1:50.

(h) Testing is in progress.

(227) MODEL STUDY OF FLOOD-CONTROL PROJECT, BRADY CREEK, BRADY, TEXAS.

(b) The District Engineer, Galveston District, Corps of Engineers, Galveston, Tex.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for channel improvements.

(f) To study, verify, or modify the design assumptions on the capacity of the project or improved channel, water-surface elevations, slopes, and velocities.

(g) The city of Brady, Tex., is located on Brady Creek 29 miles above the mouth, 173 miles southwest of Fort Worth, Tex., and 154 miles northwest of Austin, Tex. The major portion of the city of Brady, including the industrial or business district, is located on the south bank of the creek. This south bank is comparatively low and is subject to inundation by major floods. Protection of this area from floods by improving the channel and constructing a high levee along the south bank is under consideration. The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:150; vertical dimensions, 1:100. Reproduced in the model are 11,000 feet of the improved channel, approximately 600 feet of unimproved channel adjacent to the upstream end of the improved channel, and approximately 5,700 feet of unimproved channel at the lower end.

(h) All tests have been completed; preparation of final report is in progress.

(229) MODEL STUDY OF THE MISSISSIPPI RIVER, CAIRO, ILLINOIS, TO COTTONWOOD POINT, MISSOURI.

(b) The President, Mississippi River Commission, Vicksburg, Miss.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for flood control improvements.

(f) To determine the effect of certain proposed plans for controlling floods on the Mississippi River.

(g) The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:2000; vertical dimensions, 1:100. Reproduced in the model are the main channel and overbank area of the Mississippi River from Grand Tower, Ill., (80 miles above Cairo, Ill.) to Cottonwood Point (134 miles below Cairo, Ill.); the Ohio River from Dam 50 (110 miles above Cairo, Ill.) to the mouth; the Cumberland River from the vicinity of Kuttawa, Ky., (42 miles above the mouth) to the mouth; the Tennessee River from the foot of Gilbertsville Dam (25 miles above the mouth) to the mouth; the Cache River Basin; and the Birds Point-New Madrid Floodway.

(h) All tests thus far assigned have been completed. The model is used intermittently as new problems arise.

(230) MODEL STUDY FOR FLOOD CONTROL, CUMBERLAND, MARYLAND.

(b) The District Engineer, Washington District, Corps of Engineers, Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To study and develop proposed plans for the protection of Cumberland, Md., from floods.

(g) Cumberland, Md., is situated approximately 120 miles northwest of Washington, D. C., at the confluence of Wills Creek and the North Branch of the Potomac River. These two streams produce a severe flood problem in the vicinity of the confluence and along Wills Creek, the smaller of the two streams. The business district of Cumberland parallels Wills Creek closely and is subject to overflow from this stream. Channel improvement of Wills Creek by excavation and paving is under consideration, but the extent of such improvement is to some degree limited by the backwater of the North Branch of the Potomac River. This can be improved by downstream channel excavation and removal of some of the present obstructions. The model is of the fixed-bed type with an undistorted linear scale ratio of 1:60. Reproduced in the model are approximately 1.5 miles of Wills Creek, from its confluence with the North Branch of the Potomac River to above the city limits of Cumberland, Md., and 4 miles of the North Branch of the Potomac River (approximately 1 mile above and 3 miles below its confluence with Wills Creek).

(h) All authorized tests have been completed; future tests indefinite.

(232) MODEL STUDY FOR ELIMINATION OF SHOALING, VICINITY OF HEAD OF PASSES, MISSISSIPPI RIVER, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for channel improvements.

(f) To study and develop plans for the improvement and maintenance of the deep-water channel from the Head of Passes to the Gulf of Mexico through Southwest Pass.

(g) The Mississippi River flows into the Gulf of Mexico through several natural outlets, of which only South and Southwest Passes are suitable for deep-water navigation. South Pass, the shorter of the two, offers a satisfactory, self-maintained navigation channel; the greatest difficulties of navigation by this route are found at the head and foot of the pass during high water. The entrance channel at the head of Southwest Pass, however, requires annual maintenance dredging. Tentative plans for the elimination of maintenance dredging in this pass were studied. The model was of the movable-bed type with scale ratios: horizontal dimensions, 1:500; vertical dimensions, 1:150. Reproduced were 7 miles of the Mississippi River above the Head of Passes, all of South and Southwest Passes, and the upper 2 miles of Pas a Loutre and of Cubits Gap. Cubits Gap and Pas a Loutre could be regulated to discharge any desired percentage of flow, while South and Southwest Passes were controlled by maintaining the water-surface elevation at mean Gulf level at their lower ends. These water-surface elevations were controlled by electrically-operated automatic valves which replaced tailgates in this model.

(h) All tests have been completed; preparation of final report has been suspended.

(233) MODEL STUDY OF CHANNEL IMPROVEMENTS, JOHNSTOWN, PENNSYLVANIA.

(b) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh, Pa.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of channel improvements.

(f) 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, in the vicinity of Johnstown, Pa., so that floods of the magnitude of that of March 17-18, 1936, would be carried within banks.

(g) The project involves the widening, deepening, and realigning of the channels, and the construction of retaining walls where necessary to confine flood flows within the channels. The model was of the fixed-bed type with scale ratios: horizontal dimensions, 1:200; vertical dimensions, 1:80; and reproduced 5.8 miles of Stony Creek, 2.6 miles of Little Conemaugh River, and 4.7 miles of Conemaugh River, with sufficient overbank to include all areas considered in danger of possible flooding.

(h) All tests have been completed; preparation of final report is in progress.

(234) MODEL STUDY OF MEMPHIS HARBOR, MEMPHIS, TENNESSEE.

(b) The District Engineer, Memphis District, Corps of Engineers, Memphis, Tenn.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for general information.

(f) To determine the effects which the proposed closure of Tennessee Chute would have upon flood heights and channel configurations.

(g) The principal feature of the proposed improvement plan for Memphis Harbor is the construction of a closure dam at the head of Tennessee Chute. The model will be a combination movable-bed fixed-bed type with scale ratios: horizontal dimensions, 1:600; vertical dimensions, 1:150. Reproduced in the model will be the channel and overbank area of the Mississippi River from Redman Point (740 miles above the Head of Passes) to Cow Island (717.5 miles above Head of Passes).

(h) Testing is in progress.

(235) MODEL STUDY OF SECTIONS OF THE MIDDLE MISSISSIPPI RIVER.

(b) The District Engineer, St. Louis District, Corps of Engineers, St. Louis, Mo.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for channel stabilization.

(f) To determine the effects of certain proposed plans for the maintenance of navigable depths in the low-water channel of the middle Mississippi River.

(g) The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:2000; vertical dimensions, 1:100. Reproduced in the model are the main channel and overbank area of the Mississippi River from Grand Tower, Ill., (80 miles above Cairo) to Cottonwood Point (134 miles below Cairo); the Ohio River from Dam 50 (110 miles above Cairo) to the mouth; the Cumberland River from the vicinity of Kuttawa, Ky., (42 miles above the mouth) to the mouth; the Tennessee River from the foot of Gilbertsville Dam (25 miles above the mouth) to the mouth; the Cache River Basin; and the Birds Point-New Madrid Floodway. This model is the same as that used in Project No. 229, "Model Study of the Mississippi River, Cairo, Illinois, to Cottonwood Point, Missouri", page 105.

(h) All tests have been completed; preparation of final report is in progress.

(236) MISSISSIPPI BASIN MODEL.

(b) Office, Chief of Engineers, Dept. of the Army, Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for flood-control improvements.

(f) To study the coordination of releases from reservoirs, investigate the effect of reservoir operation on flood stages, check the routing of project and other floods, establish and check levee grades, predict stages, and determine the effect of floodways on stage reduction.

(g) The project provides for construction and operation of a model of the Mississippi River watershed, including the Ohio, Missouri, White, Arkansas, and Red Rivers, and their principal tributaries. All existing and proposed flood-control reservoirs as well as levees, dikes, floodwalls, and other pertinent works will be reproduced. The model will be built to a horizontal scale of 1:2000, and a vertical scale of 1:100. The model area will be approximately 200 acres, measuring 4,500 feet east and west, and 3,900 feet north and south. Water-surface elevations will be recorded at control points by electrical gages located over the model. Stream flow will be controlled by mechanical measuring equipment electrically operated from the same central control points.

(h) Design and construction of the model are in progress.

(237) MISSISSIPPI RIVER FLOOD-CONTROL MODEL.

(b) The President, Mississippi River Commission, Vicksburg, Miss.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for flood-control improvements.

(f) To determine the effects of certain combinations of existing and proposed plans for controlling floods on the Lower Mississippi River.

(g) The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:2000; vertical dimensions, 1:100. Reproduced in the model are the main channel of the Mississippi River from Helena, Ark., (300 miles below Cairo, Ill.) to Donaldsonville, La., (900 miles below Cairo, Ill.); the entire Atchafalaya Basin as far south as the Gulf of Mexico; and the backwater areas of the Arkansas, White, Yazoo, Ouachita, and Red Rivers.

(h) The model is used intermittently as new problems arise.

(239) MODEL STUDY OF HIGH-LEVEL CROSSINGS, MORGANZA AND WEST ATCHAFALAYA FLOODWAYS, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To determine flow conditions through and below trestles of proposed high-level crossings of the floodways, the possibility of improvements in design, and the effects on stages upstream from the embankments of the high-level crossings.

(g) Two models will be required for the tests. They will be of the fixed-bed type, with scale ratios, model-to-prototype, of 1:600 horizontally and 1:50 vertically. One model will reproduce the Morganza Floodway from its entrance (at latitude 30°50' N) to latitude 30°35' N; the other model will reproduce the West Atchafalaya between latitudes 30°41' N and 30°26' N. The models will be constructed and tested successively. Prior to testing the proposed high-level crossings, the models will be adjusted to computed flow lines furnished by the Office of the President, Mississippi River Commission.

(h) Construction and adjustment of the Morganza model are completed, and testing is in progress. Construction of the West Atchafalaya model will be undertaken upon completion of testing in the Morganza model.

(241) MODEL STUDY OF FLOOD-CONTROL PLANS, YAZOO BACKWATER AND HEADWATER AREAS.

(b) The District Engineer, Vicksburg District, Corps of Engineers, Vicksburg, Miss.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of flood-control project.

(f) To determine the effect of Yazoo Backwater and Headwater Plans.

(g) The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:2000; vertical dimensions, 1:100. Reproduced in the model are the main channel of the Mississippi River from Helena, Ark., (300 miles below Cairo, Ill.) to Donaldson, La., (900 miles below Cairo, Ill.); the entire Atchafalaya Basin as far south as the Gulf of Mexico; and the backwater areas of the Arkansas, White, Yazoo, Ouachita, and Red Rivers. This model is the same as that used in Project No. 237, "Mississippi River Flood-Control Model", listed above.

(h) Study is completed.

(242) MODEL STUDY OF WAVE AND SURGE ACTION, ANAHEIM BAY, CALIFORNIA.

(b) The Chief, Bureau of Yards and Docks, Navy Dept., Washington, D. C.; The District Engineer, Los Angeles District, Corps of Engineers, Los Angeles, Calif.; and the Long Beach Harbor Dept., City of Long Beach, Calif.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To determine the best location and alignment for the proposed extension of the San Pedro Bay detached breakwater system. Other aspects of the investigation concerned the determination of the relative effects of the alignment and location of the shore connecting elements of the breakwater system on the stability of Sunset Beach, and the characteristics of the current patterns within the breakwater enclosure relative to pollution in the enclosed harbor.

(g) Anaheim Bay is located between Seal Beach and Sunset Beach about 7 miles downcoast from the Los Angeles River. The Anaheim Bay entrance lies downcoast from the present terminus of the San Pedro Bay detached breakwater system. To provide protection from wave and surge action for the Naval magazine and net depot harbor in Anaheim Bay, the Navy constructed converging jetties at the harbor entrance. The general plan involves the completion of the partially constructed east-west detached breakwater to, or near, the shore line some distance below Anaheim Bay. In conjunction with this general plan, the removal of the Navy jetties is contemplated. The model was of the fixed-bed type, except for Sunset Beach, which was reproduced on a movable bed, with linear scale ratios of 1:300 horizontal, and 1:60 vertical. The model reproduced all of the San Pedro Bay coast line southward from a point about 8,000 feet coastwise and northeast of the mouth of the San Gabriel River to Bolsa Bay, and the offshore hydrography of San Pedro Bay to about the 40-foot-depth contour. The reproduced shore-line elements included Seal Beach, Anaheim Bay, and its harbor facilities, and Sunset Beach. The model was equipped with adjustable wave machines for reproducing prototype wave characteristics. Wave heights were measured and recorded by electrical devices. Sunset Beach was molded to recent survey contours, and erosion and accretion were determined by soundings. Pollution characteristics were determined by plotting the paths of surface floats.

(h) All tests have been completed; preparation of the final report is in progress.

(243) MODEL STUDY OF SALT WATER INTRUSION, CALCASIEU RIVER, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for navigation improvements.

(f) To determine the 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.

(g) The project provides for deepening the present Calcasieu River channel from Lake Charles, La., to the Gulf of Mexico from 30 feet to 34 feet. The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:1000; vertical dimensions, 1:50. All of the Calcasieu River and Lake, from the head of tide above Lake Charles to Calcasieu Pass in the Gulf of Mexico, is reproduced in the model, and approximately 10 miles of the Calcasieu River-Sabine River section and 10 miles of the Calcasieu River-Mermentau River section of the Gulf Intracoastal Waterway. The model was equipped with automatic tide controls in order to reproduce observed prototype tides in the Gulf of Mexico and in the east and west sections of the Intracoastal Waterway. Salt water of the correct density was introduced into the ocean water-supply system, and fresh water in the correct volume was introduced at the upper end of the model.

(h) All tests have been completed; preparation of final report is in progress.

(245) MODEL STUDY FOR THE ELIMINATION OF SHOALING IN NEW CASTLE AND FINNS POINT RANGES, DELAWARE RIVER, PENNSYLVANIA.

(b) The District Engineer, Philadelphia District, Corps of Engineers, Philadelphia, Pa.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for channel improvement.

(f) To test plans proposed for reducing shoaling in New Castle and Finns Point Ranges, Delaware River.

(g) The project provides for a channel about 96 miles long and of various specified dimensions extending from Philadelphia to deep water in Delaware Bay, including construction of dikes and training walls, for regulation and control of tidal flow, and dredging to provide adequate anchorages at several points. New Castle and Finns Point Ranges (sections of the main river channel) are located between Kilcohook disposal area and the Chesapeake and Delaware Canal entrance. The ranges together shoal at an average annual rate of 2,000,000 cu yd. The Chesapeake and Delaware model as revised for the Wilmington Harbor study was used for the tests. The model is of the fixed-bed, silt-injection type with scale ratios: horizontal dimensions, 1:800; vertical dimensions, 1:80. Tides and currents were reproduced in the model by automatic tide gates.

(h) All tests have been completed; preparation of final report is in progress.

(246) MODEL STUDY OF LYNNHAVEN BAY, VIRGINIA.

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for navigation improvements.

(f) 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.

(g) The project consists of plans for the development and maintenance of inlet and interior channels through the shoals that now retard tidal flow through the inlet and into the waters of the bays tributary to the inlet, and for the development of jetties to prevent reshoaling of the inlet channels. The model is of the fixed-bed type, reproducing all of Lynnhaven Bay and Inlet and a portion of Chesapeake Bay adjacent to the inlet sufficiently large for accurate reproduction of observed prototype tides and currents. Scale ratios are: horizontal dimensions, 1:800; vertical dimensions, 1:80. Provision is made for reproducing prototype tides and tidal currents throughout the model, and for varying the widths and depths of the inlet and interior channels to determine the optimum channel cross-sections required to provide the desired tidal flow into and out of Lynnhaven Bay.

(h) Testing is in progress.

(247) MODEL STUDY OF ENTRANCE CHANNEL CURRENTS, MIDWAY ISLANDS.

(b) The Chief, Bureau of Yards and Docks, Navy Dept., Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To determine the best plan for reduction of the entrance channel currents. These currents are caused by the rising of the lagoon waters above the surrounding ocean area. This phenomenon is caused by wave action coupled with the peculiar physical features of the atoll.

(g) The small atoll, known as Midway Islands, is located about 1300 statute miles northwest of Honolulu, Territory of Hawaii. This atoll has been developed as a naval operating base with harbor facilities for submarines, tankers, and cruisers. An entrance channel on the south side of the atoll leads from the Pacific Ocean into the submarine basin and lagoon mooring area. Wave action raises the level of the lagoon sometimes as much as 2 feet above the surrounding ocean area, which is accompanied by very strong currents in the entrance channel. The currents, coupled with the action of wind and waves, make navigation conditions very difficult in the entrance channel, especially at the channel mouth. The improvement plans proposed various schemes such as widening the channel mouth, widening the channel from 400 to 1000 feet in 200-foot increments, in combination with various lengths of breakwaters on the west side of the channel, and enclosing the deep-water area of the central lagoon by an impervious breakwater.

The model was of the fixed-bed type with linear scale ratios of 1:500 horizontal

and 1:100 vertical. The model reproduced the entire atoll and the Pacific Ocean to about the 120-foot-depth contour. The model was equipped with adjustable wave machines for reproducing to scale the prototype wave characteristics. A circulating system attached to the model supplied the proper amount of water to maintain a constant ocean level at the channel mouth. The current magnitudes were measured with floats and a miniature current meter. Wave heights were measured and recorded by electrical devices.

(h) All tests have been completed; preparation of the final report is in progress.

(248) MODEL STUDY OF LYNNHAVEN INLET, VIRGINIA.

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for navigation improvements.

(f) To determine the effectiveness of jetties in preventing reshoaling of the inlet channel as developed from tests on the Lynnhaven Bay fixed-bed model, and to determine the effects of jetties on the beaches adjacent to the inlet.

(g) The project consists of plans for the development and maintenance of inlet and interior channels through the shoals that now retard tidal flow through the inlet and into the waters of the bays tributary to the inlet, and for the development of jetties to prevent reshoaling of the inlet channel. The model is of the movable-bed type, reproducing Lynnhaven Inlet and adjacent beaches for a distance of about 10,000 feet to the east and west of the inlet, and off-shore areas to about the minus 25-foot contour of depth in Chesapeake Bay. Scale ratios are: horizontal dimensions, 1:400; vertical dimensions, 1:80. Provisions are made for reproducing waves from any direction between northeast and northwest and tides of any type. The littoral and tidal currents that flow along the southern shore line of Chesapeake Bay in the vicinity of Lynnhaven Inlet are also simulated in the model.

(h) Testing 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.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for the design of harbor improvements.

(f) To determine the most effective location for the proposed companion breakwater and project breakwater extension which will afford maximum protection against wave and surge action.

(g) Proposed improvements for Monterey Harbor comprise a 2000-foot extension of the existing breakwater and construction of a companion breakwater approximately 1500 feet long extending from shore so as to afford an enclosed harbor with a navigation entrance having a minimum width of 175 feet. The model is of the fixed-bed type, with a linear scale ratio of 1:100, model to prototype. Its limits include all of Monterey Harbor and a sufficient area of Monterey Bay to the northwest, north, and east to permit reproduction of wave action from critical directions. Wave action is simulated by plunger-type wave machines. Wave heights are measured throughout the problem area by electrical wave-height measuring rods and recorded by an oscillograph. The model covers 6,000 square feet representing a prototype area of 2.15 square miles.

(h) All tests have been completed; preparation of final report is in progress.

(251) MODEL STUDY OF SAVANNAH RIVER HARBOR, GEORGIA.

(b) The District Engineer, Savannah District, Corps of Engineers, Savannah, Ga.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for harbor improvements.

(f) To study means of improving and maintaining the ship channel from Savannah, Ga., to deep water in the Atlantic Ocean, consideration being given to the effect of proposed improvements on adjacent recreation beaches.

(g) The project for the improvement of Savannah Harbor includes the revision of existing jetties at the mouth of the Savannah River, the relocation of the inland waterway through the harbor, and the enlargement of the ship channel at various points. The model was of the fixed-bed type with scale ratios: horizontal dimensions, 1:1000; vertical dimensions, 1:150. Reproduced in the model were the Savannah River from the head of tidewater to the mouth, and all areas in the vicinity of the mouth which are subject to tidal flow. Two automatic tide controls were used for tidal reproduction. Salt water of the correct specific gravity was introduced through the ocean supply valve, and was colored with potassium permanganate to permit visual observation of salinity currents.

(h) All tests have been completed; preparation of final report is in progress.

(252) PILOT MODEL STUDY OF SOUTHWEST PASS, MISSISSIPPI RIVER, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for navigation improvements.

(f) To develop special model appurtenances and operating technique required to reproduce prototype density currents in Southwest Pass by the simultaneous removal 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 a later comprehensive model study of Southwest Pass.

(g) The project for Southwest Pass provides for development of plans for elimination or reduction of shoaling in the Southwest Pass Bar Channel. The model will be of the movable-bed type, and will include Southwest Pass from mile 5 below Head of Passes to the ends of the jetties, and a 2.25 square mile area of the Gulf of Mexico adjacent to the jetties. Scale ratios will be: horizontal dimensions, 1:500; vertical dimensions, 1:100. Provisions will be made for reproducing prototype tides and tidal currents in the Gulf of Mexico, density flow and freshwater river flow in Southwest Pass, and the movement of bed-load material in lower Southwest Pass and the bar channel. The model will be so designed and constructed that it can be enlarged for the later comprehensive study of Southwest Pass at minimum cost and time.

(h) Construction of the model is in progress.

(253) MODEL STUDY FOR CHANNEL IMPROVEMENT, ST. JOHNS RIVER, FLORIDA.

(b) The District Engineer, Jacksonville District, Corps of Engineers, Jacksonville, Fla.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for navigation improvements.

(f) To determine the best location and alignment of the cutoff and the effect on navigation of the cutoff and the deepening of the present channel to 34 feet.

(g) The project provides for a cutoff in the St. Johns River below Jacksonville, Fla., which will extend from Dames Point to Fulton, in connection with deepening of the present channel from Jacksonville to the Atlantic Ocean to a depth of 34 feet. The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:1000; vertical dimensions, 1:100. The model includes the St. Johns River from Welaka, Fla., to the Atlantic Ocean, as well as approximately six miles of the Intracoastal Waterway to the north and south of the St. Johns River. The model is equipped with automatic tide controls in order to reproduce the observed prototype tides in the St. Johns River and in the north and south sections of the Intracoastal Waterway. Salt water of the correct density is introduced into the ocean water-supply system, and fresh water is introduced at the upper end of the model.

(h) All tests have been completed; preparation of final report is in progress.

(255) MODEL STUDY OF SHOALING IN THE BAR CHANNEL, UMPQUA RIVER, OREGON.

(b) The District Engineer, Portland District, Corps of Engineers, Portland, Ore.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for navigation improvements.

(f) To determine whether or not the relocation or improvement of the South Jetty will effect an appreciable decrease in the present heavy rate of shoaling in the entrance channel.

(g) The project for the improvement of the Umpqua River consists of plans for the relocation or improvement of the South Jetty and maintenance of an entrance channel 26 feet deep and of suitable width. The model is of the movable-bed type, the movable-bed reach extending 10,000 feet north of and 10,000 feet south of the mouth of Umpqua River and offshore to about the 80-foot contour of depth in the ocean. The river is reproduced from the mouth to a point above Winchester Bay. Scale ratios are: horizontal dimensions, 1:400; vertical dimensions, 1:80. Provisions are made for reproducing waves from any direction from northwest to southwest, tides of any type, and littoral currents either up or cown the coast.

(h) Adjustment of the model is in progress.

(257) MODEL STUDY OF STABILITY OF RUBBLE-MOUND BREAKWATERS.

(b) The Chief, Bureau of Yards and Docks, Navy Dept., Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) The primary purpose of the model study is to determine the most efficient design of a composite rubble-mound breakwater, and to determine the effect of the dynamic forces of wave action on the breakwater during different phases of construction.

(g) The rubble-mound breakwater stability study is being conducted in a 5-foot by 18-foot by 117-foot concrete tank equipped with a plunger-type wave machine. A hypothetical prototype breakwater is reproduced in the model using scale ratios of 1:30, 1:45, and 1:60. The rubble-mound breakwater structure consists of three types of materials: class-C fine core material, class-B enrockment for the class-C material, and class-A rock used to form the cap of the breakwater. Each class of material makes up a section of the breakwater structure, which is subjected to storm waves of 15 feet by 270 feet and 21 feet by 300 feet until stabilization of the breakwater section is reached. The model breakwater reproduces to scale (linear, weight, and volume) the prototype breakwater designs and specifications.

(h) Testing is in progress.

(416) MODEL STUDY OF STILLING BASIN, BUGGS ISLAND DAM, ROANOKE RIVER, VIRGINIA.

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of stilling basin.

(f) 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 bucket lip.

(g) Buggs Island Dam will be a concrete gravity structure 2797 feet long, excluding earth wings and saddle dikes. The ogee-type spillway has a gross length of 1092 feet and is designed to pass a maximum flow of 770,000 cfs under a 37-foot head. The spillway flow will be controlled by 22 tainter gates, each 42 feet by 32 feet. The energy dissipator is of the bucket type. An existing 1:30-scale section model has been utilized to test the Buggs Island bucket. The drop from

crest to basin on this model was adjusted to simulate the crest-to-basin drop of Buggs Island Dam, and the bucket of Buggs Island Dam was installed at the toe of this model on a 1:35 scale. The portion of the Buggs Island spillway reproduced represents a 171.0-foot section of the prototype.

(h) Testing is in progress.

(417) MODEL STUDY OF ALGIERS LOCK, INTRACOASTAL WATERWAY, NEW ORLEANS, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To study the feasibility of filling the lock through the sector gates and gate recesses, thus eliminating the need for a culvert system.

(g) Algiers Lock, connecting the Intracoastal Waterway from the west with the Mississippi River at New Orleans, will be located downstream from the present Harvey Lock and will permit traffic along the waterway to cross the Mississippi River without passing through the main anchorage and dock area of the Port of New Orleans. The lock chamber will have a usable length of 800 feet, width of 75 feet, and a minimum depth of 12 feet over the sills. The lock is designed to operate under a maximum head of 18.5 feet. Since the head on the gates will be reversible, sector gates are required. A 1:20-scale model reproduces a portion of the approaches to the lock and the lock chamber, including the sector gates and gate recesses.

(h) Testing is in progress.

(418) CALIBRATION OF SPILLWAY TAINTER GATES.

(b) The Chief of Engineers, Dept. of the Army, Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for general information.

(f) To calibrate tainter gates with special attention to the critical region wherein the spillway nappe just touches the gate lip.

(g) Tests are being conducted on a 1:30-scale section model of Whitney Dam. The spillway has an ogee-crest shape; tainter gates are 40 feet by 38 feet and have a radius of 38 feet. The gate seats are 10.75 feet downstream from the spillway crest. Two complete gate bays plus adjacent half gates are reproduced. The gates were carefully machined of brass and accurately set for each opening with calipers and then locked in position with set screws.

(h) Testing is in progress.

(419) SLIDE GATE TESTS.

(b) The District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.

(c) Personnel of the Waterways Experiment Station and Little Rock District.

(e) Experimental, for general information on shape of gate lips.

(f) To determine the most desirable shape of the bottom of slide gates to minimize vibration, negative pressures, and disturbance of flow. Also to determine the downpull on the gate leaf and the amount of air drawn through the air vents.

(g) Tests are being conducted on models of slide gates at the Waterways Experiment Station and on prototype gates at Norfork Dam, on North Fork River, Ark., to obtain general data on the optimum shape for gate lips. Norfork Dam has eleven 4-foot by 6-foot conduits with hydraulically operated slide gates designed to operate in the fully open position. The bottom of the gate is parallel to the floor of the conduit. Four types of gates have been tested with plastic models, scale 1:6, using piezometers to measure pressures. The models reproduced the gate slots, sluice-gate portion of conduit upstream and downstream from the gate section, and the air vent.

(h) Testing is in progress.

(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.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To determine discharge coefficients of the Howell-Bunger valves and to study stilling basin action below the valves with special emphasis on pressures at the end sill.

(g) Narrows Dam will be a dual-purpose flood-control and hydroelectric power dam. The structure will be of the concrete-gravity type, containing a centrally located uncontrolled overflow spillway section (designed to discharge 41,000 cfs), powerhouse intake, and adjacent non-overflow sections. Normal flow will pass through two 8.5-foot diameter conduits and will be controlled by 84-inch diameter Howell-Bunger valves on the downstream end of each conduit. A 1:16-ecale model will reproduce the two conduits, the Howell-Bunger valves, the stilling basin, and a portion of the exit channel. The reservoir area will be represented by a steel pressure tank.

(h) Testing is in progress.

(421) MODEL STUDY OF SLUICES, HULAH DAM, CANEY RIVER, OKLAHOMA.

(b) The District Engineer, Tulsa District, Corps of Engineers, Tulsa, Okla.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of sluices.

(f) To examine the hydraulic performance of the sluices.

(g) Hulah Dam, a flood-control project, will be an earth and rock-fill embankment about 5,200 feet in length. The valley section of the dam will have an average height of 61 feet. The spillway structure, combining the spillway and control works, will consist of a concrete-gravity overflow weir about 50 feet high, on which will be mounted ten 40 feet wide by 25 feet high tainter gates. Nine 5 feet wide by 6.5 feet high sluices through the spillway section will regulate normal outflow. The spillway is designed to pass a flow of 285,000 cfs under a head of 33.7 feet. A 1:20-scale model reproduces a 256-foot wide section of the spillway, stilling basin, and exit channel. The section reproduced is through the center of the spillway and includes three sluices. The approach area is represented by a reinforced concrete tank properly baffled to permit smooth flow into the sluices.

(h) All tests have been completed; preparation of final report is in progress.

(422) MODEL TESTS OF ROLLER-TYPE SPILLWAY BUCKET.

(b) Office, Chief of Engineers, Dept. of the Army, Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of roller-type spillway buckets.

(f) To study spillway bucket performance under varying conditions of head, discharge, and tailwater.

(g) Existing models of various dams are being used with a bucket installed at the downstream toe. The bucket has a radius of 50 feet and a lip slope of 1 on 1. Scale ratios of models vary from about 1:30 to 1:50.

(h) Testing is in progress.

(423) MODEL STUDY OF SPILLWAY, BENBROOK DAM, TRINITY RIVER, TEXAS.

(b) The District Engineer, Galveston District, Corps of Engineers, Galveston, Tex.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of spillway.

(f) To investigate and correct any objectionable flow characteristics that 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.

(g) Benbrook Dam will be constructed for flood control and water conservation. The reservoir will have a storage capacity of 258,630 acre-feet. The earth embankment will be about 9,200 feet long, including the spillway section, and will have a maximum height of 130 feet above the river bed. An uncontrolled ogee spillway (500 feet wide, including a 100-foot notch 14 feet below the main spillway crest) will have a total capacity of 172,000 cfs at the design water-surface elevation. The outlet works will consist of a gated intake structure and a 13-foot diameter conduit having a discharge capacity of 7,270 cfs at apillway-notch crest elevation. A 1:60-scale model will reproduce 900 feet of the approach area, the spillway, and 2,000 feet of exit channel.

(h) Testing is in progress.

(424) MODEL STUDY OF OUTLET WORKS, ALLATOONA DAM, ETOWAH RIVER, GEORGIA.

(b) The District Engineer, Mobile District, Corps of Engineers, Mobile, Ala.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of outlet works.

(f) To examine the hydraulic performance of the sluices, and to determine the capacity provided by several schemes for passing diversion flows through one of the spillway monoliths.

(g) Allatoona Dam will be a concrete-gravity structure for flood-control and the generation of power. Flow regulation will be afforded by manipulation of 9 spillway gates, operation of the turbines, and operation of the four 5-foot-8-inch by 10-foot sluices. The spillway is designed to pass a flow of 297,000 cfs under a head of 33.8 feet. A 1:20-scale section model reproduces the left half of the spillway below elevation 721, two sluices, one-half of the stilling basin, and the left training wall, and a portion of the exit channel. The approach channel is represented by a pressure tank to which the intake sections of the sluices are attached. A 1:25-scale model reproduces portions of the cofferdam and spillway, including the monolith through which diversion flows will be passed.

(h) All tests have been completed; preparation of final report is in progress.

(425) COMPREHENSIVE MODEL STUDY, DELAWARE RIVER, PENNSYLVANIA.

(b) The District Engineer, Philadelphia District, Corps of Engineers, Philadelphia, Pa.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for reduction in shoaling.

(f) To develop and test plans for reduction of shoaling in several ranges of the navigation channel.

(g) The project provides for a navigation channel about 96 miles long, extending from Philadelphia to deep water in Delaware Bay, having depths of 37 and 40 feet, and of various specified widths (800 feet or greater), and a channel from Philadelphia to Trenton, having depths of 28 and 25 feet, with a width of 300 feet. Included in the project are provisions for construction of dikes and training walls for regulation and control of tidal flows, and dredging to provide turning basins and adequate anchorage at several points. The model will be of the fixed-bed, silt-injection type with linear scale ratios of 1:1000 horizontally and 1:100 vertically, and will reproduce the entire tidal portion of Delaware River and Bay from the

Capes to Trenton, including tidal portions of major tributaries. Tides and tidal currents will be reproduced by automatic tide control mechanisms, and fresh-water discharges of the Delaware River and significant tributaries will be introduced by means of Van Leer weirs. Observed prototype salinities will be reproduced in the Delaware Bay portion of the model, and provisions made for the injection of silt into the model, and for measuring silt deposits on the bed of the model.

(h) Design of the model is in progress.

(426) MODEL STUDIES OF EACH BRANCH RESERVOIR, CLARION RIVER BASIN, PENNSYLVANIA.

(b) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh, Pa.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To investigate the adequacy of the spillway relative to the head-discharge relationship, 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.

(g) East Branch Dam will be a rolled-filled structure with top embankment 179.5 feet above stream bed. An uncontrolled spillway of the side-channel type, located in the left abutment, will consist of a weir 260 feet long and a longitudinal channel. Spillway capacity will be 69,500 cfs with a maximum head of 17.5 feet. The outlet facilities, to be located in the right abutment, will consist of a 10-foot diameter conduit with intake, control tower, and stilling basin. Maximum conduit discharge will be 5,000 cfs at spillway-crest elevation. Two models are involved in the study: (1) a 1:50-scale model of the spillway, including the overflow section, the chute, the dispersion bucket, and a portion of the exit channel; (2) a 1:25-scale model of the outlet works, including the approach channel, the intake, the control tower, 1269 feet of tunnel, and the stilling basin and exit channel.

(h) Design of the model is in progress.

(427) COMPREHENSIVE MODEL STUDY, FORT RANDALL DAM, MISSOURI RIVER, SOUTH DAKOTA.

(b) The District Engineer, Omaha District, Corps of Engineers, Omaha, Nebr.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To determine the effects on velocities of depth and curvature of the approach channel; to study flow over the spillway crest and in the chute, with special attention to wave action, position of the gate structures, and pier design; to measure velocities and observe eddy action in the spillway stilling basin and in the combined tailrace and sluice discharge channels; to study the magnitude and direction of velocities in the river channel downstream from the embankment to determine the need for special protection of the chalk berm and embankment; and to observe the effects of advanced retrogression upon performance of stilling basin and discharge channel.

(g) This project is one of a system of multiple-purpose reservoirs to be used for flood-control, irrigation, navigation, power, etc. The dam will consist of a 27,000,000 cu yd rolled-earth-fill embankment almost 2 miles long, with a maximum height of 160 feet above the river channel. A reinforced concrete chute spillway controlled by tainter gates will be located in the left abutment. The spillway is designed to discharge 1,085,000 cfs. Flows up to 125,000 cfs will be passed through four 22-foot diameter conduits discharging into a common stilling basin. Eight 22-foot diameter penstocks are provided for power generation. A 1:100-scale comprehensive model will reproduce 7,400 feet of approach channel, the spillway, a 4,900-foot section of the dam, the flood-control conduits and power penstocks, and 3,100 feet of exit channel.

(h) Design and construction of the model are 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.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of breakwater.

(f) To study effects of wave action in the harbor during periods of northerly storms, and to determine a plan of adequate breakwater arrangement to provide the maximum amount of protection to terminals, wharves, docks, and the shore area within the harbor limits.

(g) The project comprises a breakwater-enclosed outer harbor with an outer west breakwater 4,478 feet long; a 2,700-foot west arrowhead breakwater, and a 2,200-foot east arrowhead breakwater; a depth of 21 feet in the outer harbor east of Lackawanna coal dock and between harbor lines in Oswego River north of the north line of Seneca Street, and a depth of 21 feet in soft material and 22 feet in hard material in the remainder of the outer harbor west of the Lackawanna coal dock. The model, to be constructed on a scale of 1:100, will include all of the existing outer harbor, the proposed east outer harbor, the Oswego River to the south harbor line, and a portion of Lake Ontario northerly of the existing and proposed breakwaters. A 60-foot wave machine will be used.

(h) Design and construction of the model are in progress.

(429) MODEL STUDY OF WAVE AND SURGE ACTION, LONG BEACH HARBOR, CALIFORNIA.

(b) The City of Long Beach, California.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for development of harbor facilities.

(f) 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 to assist in the selection of pier alignment and location of navigation opening which would be most suitable for shipping.

(g) The City of Long Beach proposes to construct additional piers in and to dredge the Long Beach portion of the present Navy-Long Beach Harbor (plan A), and to construct an additional basin designated the Southeast Basin. This basin, to be enclosed by a hydraulically-filled mole, will be adjacent to and southeast of the existing Long Beach breakwater. Three different shapes for the basin have been proposed, with an alternate location of the navigation opening for one of the shapes (this shape and its alternate are designated plans 1 and 1A).

The fixed-bed type model was constructed to the scale ratios of 1:300 horizontally and 1:60 vertically. Reproduced in the model were the coast line from Point Fermin to Anaheim Bay, Calif., the Los Angeles inner and outer harbors, Long Beach inner and outer harbors, all of San Pedro Bay, the San Pedro breakwater, the east or detached breakwater, and a large area of the Pacific Ocean south of the detached breakwater. The Long Beach Harbor developments were constructed in the model to scale. Adjustable wave machines are installed on the model so that test waves of the desired dimensions can be reproduced from the south-southwest to southeast directions. Data obtained from the model consist principally of wave heights which are measured and recorded by electrical devices. This model is the same as that used in Project No. 242, "Model Study of Wave and Surge Action, Anaheim Bay, California", page 108.

(h) Testing is in progress.

(i) See also Projects Nos. 242, "Model Study of Wave and Surge Action, Anaheim Bay, California", page 108; 249, "Model Study of Wave and Surge Action, Monterey Harbor, California", page 111; 258, "Model Study of Wave and Surge Action, Naval Operating Base, Terminal Island, San Pedro, California", page 160; and 259, "Model Study of Breakwater Location, U. S. Naval Air Station, Alameda, California", page 161.

(430) MODEL STUDY OF BREAKWATER LOCATION, EAST BEAVER BAY HARBOR, LAKE SUPERIOR, MINNESOTA.

(b) Oglebay Norton & Company, Cleveland, Ohio.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of protective breakwater.

(f) To determine the type breakwaters (pervious or impervious) and the most effective location for the navigation opening which will afford maximum protection against short-period wave action existent in Lake Superior. The existing test program calls for investigation of two plans; in one plan the navigation opening is on the east side of the harbor area, while in the alternate plan the opening is located on the south side.

(g) Proposed improvements for Beaver Bay involve construction of protective breakwater sections extending from shore to form an enclosed anchorage having a navigation opening width of approximately 1000 feet. Use is to be made of a small island in the bay in conjunction with two breakwater sections to complete the east arm of the project. The model is of the fixed-bed type with linear scale ratio of 1:150, model to prototype. Its limits include a section of east Beaver Bay and sufficient area of Lake Superior to the east, south, and southwest to permit reproduction of waves from critical directions. Wave action is simulated by plunger-type wave machines. Wave heights are measured throughout the problem area by electrical wave-height measuring rods and recorded by an oscillograph. The model covers 6000 square feet, representing a prototype area of 4.84 square miles.

(h) Construction of the model is in progress.

U. S. DEPT. OF COMMERCE, NATIONAL BUREAU OF STANDARDS, National Hydraulic Laboratory, Washington, D. C.

Inquiries concerning Projects Nos. 154, 155, 159 to 163, incl., 166, and 431 to 434, incl., should be addressed to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C.

(154) AGING TESTS ON PIPES.

(b) U. S. Treasury Dept. (c) K. H. Beij.

(e) Experimental, design.

(f) To determine the effects of long-continued service on the hydraulic friction of pipes.

(g) Specimens of 1-1/2-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.

(h) Tests before aging started were made in 1936; observation tests were made in 1937, 1938, and 1940. The tests scheduled for 1942 were postponed and are now planned for 1948.

(155) MATHEMATICAL THEORY OF FLOOD WAVES.

(b) U. S. Weather Bureau. (c) G. H. Keulegan.

(e) General theoretical research.

(f) To review and supplement American and foreign literature on the mathematical theory of waves which is applicable to the theory of flood waves.

(g) The results of the review are being coordinated and extended by new proofs and additional material to form an integrated series of papers giving a complete

picture of present knowledge useful in the study of flood waves.

(h) The third paper will be published in 1948.

(159) MODEL LAWS FOR DENSITY CURRENTS.

(b) Office of the Chief of Engineers, Dept. of the Army.

(c) G. H. Keulegan.

(e) A theoretical study, supplemented by experimental research.

(f) To determine model laws.

(g) A theoretical analysis of available experimental data has been made to determine the nature and scope of experimental research required. Initial tests are under way in a small glass flume 70 feet long. A larger flume is being designed.

(h) Date of completion is indefinite.

(160) EFFECT OF STORM WINDS ON LAKE LEVELS.

(b) Laboratory project. (c) G. H. Keulegan. (e) Theoretical.

(f) To determine surface frictional forces of wind on lake surfaces.

(g) Data on storms over Lake Erie are being analyzed.

(h) A publication during 1948 is contemplated.

(161) EXTINCTION OF SOLITARY WAVES.

(b) Laboratory project. (c) G. H. Keulegan. (e) Theoretical.

(f) To study dissipation of energy.

(g) The theoretical determination of dissipation has been compared with the experimental results of Russell.

(h) Work has been completed, and a paper will be published early in 1948.

(162) FLOW PATTERNS AT PUMP INTAKES.

(b) Laboratory project. (c) G. H. Keulegan. (e) Theoretical.

(f) To determine flow patterns.

(g) Patterns are obtained theoretically by superposition of fields of circular vortices and sources and sinks.

(h) A publication during 1948 is contemplated.

(163) SHORT PIPES AND INTAKES.

(b) Laboratory project. (c) G. H. Keulegan.

(e) Theoretical and experimental.

(f) To determine methods of computing energy losses.

(g) A theoretical analysis has been made of the variation of the friction coefficient in the portion of a pipe in which the boundary layer develops, and the results have been applied to concrete and to corrugated steel pipe.

(h) Time of completion is indefinite.

(i) "Theory of flow through a short tube with square-edged entrance with smooth or corrugated surface", by G. H. Keulegan, a summary of the analysis, will be published shortly by the Highway Research Board, National Research Council. A more complete paper, "Friction losses in short pipes and culverts flowing full", by G. H. Keulegan, is nearly ready for publication.

(166) WET VENTING, STACK VENTING, AND SELF-SIPHONAGE TESTS OF PLUMBING SYSTEMS.

(b) Housing and Home Finance Agency.

(c) J. L. French, R. S. Wyly, A. L. Lembeck, E. J. Norcome.

(e) Experimental; to furnish data for use in preparing a Uniform Plumbing Code.

(f) To investigate the merits of stack and wet venting of plumbing fixtures and to investigate the effect of various factors on fixture self-siphonage.

(g) One two-story and two one-story house sanitary drainage systems with complete kitchen and bathroom fixture installations and with the drainage system constructed of transparent plastic pipe and fittings were installed. Motion-picture records of the various flow and pressure phenomena have been made.

(h) The tests have been completed, and a report is being prepared. A motion-picture incorporating the more important test results is being assembled by the Motion Picture Service of the Department of Agriculture.

(431) GREASE DEPOSITION IN PLUMBING FIXTURE DRAINS.

(b) Housing and Home Finance Agency.

(c) J. L. French, R. S. Wyly, J. L. Johnson, Jr.

(e) Experimental; to furnish information to code-making authorities.

(f) To investigate the effect of the length and slope of fixture drains and the type of vent fitting on deposition of grease in sink drains.

(g) Charges of grease-laden hot water will be periodically discharged through a conventional kitchen sink and drain, and the location and amount of grease deposited on the walls of the drain, trap, and vent fitting will be observed.

(h) The installation of apparatus has been completed, and preliminary tests are now being made.

(432) FROST CLOSURE ON THE STACK VENT OF PLUMBING SYSTEMS.

(b) Housing and Home Finance Agency.

(c) J. L. French, R. S. Wyly, J. L. Johnson, Jr.

(e) Experimental; to furnish information to code-making authorities.

(f) To determine the factors affecting deposition of frost in the portion of a plumbing system vent above the roof of a building.

(g) A three-inch, typical, one-story plumbing stack has been erected. Provision has been made to vary the temperature of the air surrounding the highest 18 inches of the stack vent from -30°F to room temperature. The rate of flow of air up the stack and its humidity will be varied to simulate service conditions. The depth of frost deposition inside the stack vent will be observed.

(h) Installation of apparatus is approaching completion.

(433) CAPACITIES OF PLUMBING STACKS.

(b) Housing and Home Finance Agency.

(c) J. L. French, R. S. Wyly, A. L. Lembeck. (e) Experimental.

(f) To determine stack capacities.

(g) Vertical stacks approximately 60 feet in height and varying in diameter from 2 to 5 inches will be tested. Various rates of discharge will be introduced to the stacks through fittings located approximately 8 feet apart along the stack. The capacity under different types of flow will be determined.

(h) Design of test apparatus and procedure is under way.

(434) PLUMBING VENTS.

(b) Laboratory project.

(c) J. L. French, R. S. Wyly, A. L. Lembeck. (e) Experimental.

(f) To determine loads on and capacities of main plumbing vents.

(g) Conventional venting systems will be attached to the plumbing stacks described in Project No. 433, "Capacities of Plumbing Stacks", page 121. The demand on the vents for different sizes of soil stacks and for different loadings on the soil stack will be observed, as well as the ability of the venting system to deliver the required volumes of air.

(h) Design of test apparatus and procedure is under way.

(435) RESEARCH ON FLOW NOZZLES.

(b) Cooperative research sponsored by the A.S.M.E. Special Research Committee on Fluid Meters.

(c) H. S. Bean, F. C. Morey.

(d) H. S. Bean, National Bureau of Standards, Washington 25, D. C.

(e) Experimental.

(f) To determine the most satisfactory location for pressure holes.

(g) At the meeting of the Fluid Meters Committee on December 4, 1947, it was decided to repeat tests on flow nozzles described under Project 496, "Determination of the Discharge Coefficients of Flow Nozzles", page 117 of Volume XI of this bulletin. These tests will be made at the University of California, Berkeley, Calif., under instructions from Mr. Bean.

(h) Active.

(i) "Research on flow nozzles and discharge coefficients of flow nozzles when used with corner taps." H. S. Bean and S. R. Beitler. Bulletin of the Engineering Experiment Station of the Ohio State University. January 1948.

U. S. DEPT. OF COMMERCE, WEATHER BUREAU, Washington, D. C.

Inquiries concerning Projects Nos. 167 and 168 should be addressed to the Chief, U. S. Weather Bureau, Washington 25, D. C.

(167) DEVELOPMENT OF RIVER FORECASTING TECHNIQUES.

(b) U. S. Weather Bureau. (c) M. Bernard, R. K. Linsley, Jr., M. A. Kohler.

(e) Experimental project under the Bureau's program of procedure development.

(f) To develop procedures which will permit more accurate and more timely river forecasts, or will increase the operating efficiency of existing forecasting staffs.

(g) The project involves a combination of basic theoretical hydrology and statistics to make maximum use of available data. New instruments and procedures are reviewed to determine whether they may be used directly or by adaptation. Original ideas presented by the staff are reviewed, techniques developed and tested by actual trial in comparison with existing methods. Investigations are aimed at the following problems: (1) Forecasting the runoff from rainfall; (2) distributing runoff in time to predict the outflow from a basin; and (3) routing and combining flows from tributaries to predict flood-wave movement downstream.

(h) This is a continuing project and no phase can be reported as complete. Developments under (1) and (3) above are well advanced, and techniques are now undergoing exhaustive tests to determine possibility of and need for further refinement. A pilot project under (2) above has been completed, and plans for comparative

testing of three original ideas are being formulated.

(168) SEASONAL WATER SUPPLY FORECASTING INVESTIGATIONS.

(b) U. S. Weather Bureau. (c) M. Bernard, R. K. Linsley, Jr., M. A. Kohler.

(e) Experimental project under the Bureau's program of procedure development.

(f) For development of forecasting procedures.

(g) The project is intended to (1) develop by statistical means a relation between precipitation, other meteorological factors, and runoff for forecasting total seasonal runoff volume; and (2) develop the relations between meteorological data and time distribution of runoff for predicting increments of runoff for various time intervals. The project requires as a part of the solution the determination of the most effective statistical treatments, both graphical and analytical; the establishment of criteria for selection of representative meteorological stations, and the development of methods of adjusting old records for differences in measurement technique and other effects which introduce a time trend into the record.

(h) A technique under item (g-1) is complete and under test to determine if further refinement is justified. Investigations under item (g-2) were begun in 1946 and are now being continued.

FEDERAL WORKS AGENCY, PUBLIC ROADS ADMINISTRATION, Washington, D. C.

(296) INVESTIGATION OF STORM DRAINS FOR EXPRESS HIGHWAYS.

(b) University of Illinois, Illinois Division of Highways, and U. S. Public Roads Administration.

For a complete report on this project, refer to Project No. 296 listed under University of Illinois, page 26.

(99) HYDRAULICS OF CULVERTS.

(b) Minnesota Department of Highways, in cooperation with U. S. Public Roads Administration.

For a complete report on this project, refer to Project No. 99 listed under St. Anthony Falls Hydraulic Laboratory, page 47.

U. S. DEPT. OF THE INTERIOR, GEOLOGICAL SURVEY, Washington, D. C.

(64) THE BACKWATER PROFILE FOR STEADY FLOW IN OPEN CHANNELS.

(b) Cooperative project, University of Illinois and U. S. Geological Survey.

For a complete report on this project, refer to Project No. 64 listed under University of Illinois, page 25.

(169) UNSATURATED FLOW OF WATER IN RELATION TO GROUND-WATER RECHARGE.

(b) U. S. Geological Survey, Water Resources Branch. (c) W. O. Smith.

(d) Chief Hydraulic Engineer, U. S. Geological Survey, Washington 25, D. C.

(e) Experimental and theoretical.

(f) Mechanics of nonsaturated flow of water in porous bodies.

(h) Measurements are in progress.

(170) THE SPECIFIC YIELD OF ROCKS FOR WATER.

(b) U. S. Geological Survey, Water Resources Branch. (c) W. O. Smith.

(d) Chief Hydraulic Engineer, U. S. Geological Survey, Washington 25, D. C.

(e) Experimental and theoretical.

(f) Mechanics involved in the determination of specific yield of porous media.

(g) A theoretical analysis of the problem has given the factors determining the specific yield of rocks, and a theoretical relation from which the specific yield may be found, has been developed for uniform sands. It has been checked with field data. Experiments are in progress to develop rapid methods of determining this quantity.

(h) A preliminary paper has been prepared.

(194) A STUDY OF METHODS USED IN THE MEASUREMENT AND ANALYSIS OF SEDIMENT LOADS IN STREAMS.

(b) Federal Inter-Agency River Basin Committee, Sub-committee on Sedimentation.

For a complete report on this project, refer to Project No. 194, listed under Corps of Engineers, St. Paul District, page 95.

(436) SEDIMENTATION STUDIES IN INLAND WATERS.

(b) U. S. Geological Survey, Water Resources Branch.

(d) Chief Hydraulic Engineer, U. S. Geological Survey, Washington 25, D. C.

(f) (1) To investigate the factors which govern the deposition and distribution of bottom sediments; (2) to determine their physical properties; (3) to develop accurate techniques for determined storage, and to ascertain what factors govern changes in storage.

(g) Lake Mead Investigations: Extensive studies for Lake Mead, which is the storage reservoir behind Hoover Dam, have begun. Complete determination of bottom contours with echo sounding methods, determination of thermal and of 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.

(h) Work begun December 1, 1947.

(437) THE BACKWATER PROFILE FOR STEADY FLOW IN UNIFORM CHANNELS, AND ITS SIGNIFICANCE IN THE STAGE-FALL-DISCHARGE RELATION.

(b) U. S. Geological Survey, Water Resources Branch. (c) W. D. Mitchell.

(d) Water Resources Branch, U. S. Geological Survey, Urbana, Ill.

(e) Analytical.

(f) To search for improvements in the technique of stage-fall-discharge analyses.

(g) Data collected under Project No. 64, "The Backwater Profile for Steady Flow in Open Channels", (University of Illinois, page 25) applied to the further study of stage-fall-discharge relations.

(h) Study now being started.

(438) TORQUE TESTING WATER-STAGE RECORDERS AND CLOCKS UNDER LOW TEMPERATURE CONDITIONS.

(b) U. S. Geological Survey, Water Resources Branch.

(c) F. F. LeFever, C. W. Reck.

(d) F. F. LeFever, U. S. Geological Survey, Ellenville, N. Y.

(e) Laboratory tests of torque (1) delivered by water-stage recorders and (2) required by their respective clocks, under a range of sub-freezing temperatures.

(f) To ascertain quantitatively the effect of low temperatures on the margin between the amount of torque developed by certain types and makes of water-stage recorders and the amount of torque required by their respective clocks.

(g) Tests made in a cold room at the Texas Company Research Laboratory at Beacon, N. Y. Observations made on three instruments representing some of the makes and types in most general use, throughout a range of artificially produced temperatures from $+32^{\circ}$F to -20°F.

(h) Two series of observations completed. Work on project held up pending development of additional testing equipment.

(439) EFFECT OF REFORESTATION ON STREAM FLOW.

(b) U. S. Geological Survey and New York State Department of Conservation.

(c) A. W. Harrington.

(d) W. B. Langbein, U. S. Geological Survey, Washington 25, D. C.

(e) Basic research.

(f) To study effect on stream flow of growing trees on abandoned farm lands.

(g) Observations of stream flow, precipitation, ground-water levels, and evaporation of three small reforested drainage basins were begun in 1934.

(h) Progress reports are prepared.

(440) MULTIPLE-STEP DRAWDOWN TEST.

(b) U. S. Geological Survey. (c) A. N. Sayre.

(d) Chief, Division of Ground Water, U. S. Geological Survey, Washington 25, D. C.

(e) Applied research in ground-water hydraulics.

(f) Interpretation of several multiple-step drawdown tests of water wells to determine head loss through screen and in well. Development of concepts, clarification theory, and application of new formulas.

(441) GEOLOGY OF CACHE VALLEY.

(b) U. S. Geological Survey. (c) A. N. Sayre.

(d) Chief, Division of Ground Water, U. S. Geological Survey, Washington 25, D. C.

(e) Basic research.

(f) Study of ground-water geology of the Tertrary and Quaternary sequence in Cache Valley, Utah.

(g) Detailed analysis is being made of the portion of the geologic column which is most important to the ground-water hydrology in the Basin and Range province.

(442) SURFACE RESISTIVITY STUDIES.

(b) U. S. Geological Survey. (c) A. N. Sayre.

(d) Chief, Division of Ground Water, U. S. Geological Survey, Washington 25, D. C.

(e) Basic research.

(g) Investigations of ground-water conditions by means of resistivity measurements made at land surface, and correlation with known hydrologic and geologic conditions.

(443) GEOCHEMISTRY OF GROUND WATER.

(b) U. S. Geological Survey. (c) S. K. Love, A. N. Sayre.

(d) Chief, Division of Quality of Water, U. S. Geological Survey, Washington 25, D. C.

(e) Basic research.

(f) Study of mineral constituents of ground water and causes thereof.

(444) EXTENDING STREAM-FLOW RECORDS.

(b) U. S. Geological Survey. (c) W. B. Langbein.

(d) W. B. Langbein, U. S. Geological Survey, Washington 25, D. C.

(e) Applied research.

(f) To analyze and develop methods for extending a stream-flow record.

(g) Correlations are being made of the flow at nearby gaging stations, and between rainfall and runoff.

(h) Report in preparation.

(445) SMALL RESERVOIRS IN ARID REGIONS.

(b) Office of Land Utilization, U. S. Dept. of the Interior.

(c) H. V. Peterson and staff.

(d) W. B. Langbein, U. S. Geological Survey, Washington 25, D. C.

(e) Applied research.

(f) To determine runoff, evaporation, seepage, and sedimentation.

(g) Installation of staff gages on a number of representative stock-watering reservoirs in Western States, supplemented by periodic resurvey of reservoir to determine capacity.

(h) Reports will be prepared.

(446) STORAGE RESERVOIRS IN THE UNITED STATES.

(b) U. S. Geological Survey. (c) G. E. Harbeck, Jr.

(d) W. B. Langbein, U. S. Geological Survey, Washington 25, D. C.

(e) Applied research.

(f) Analysis of water-storage development by dates and types of use.

(g) Compilation of technical data on all reservoirs in the United States with 5,000 acre-feet or more of capacity.

(h) Report in preparation.

(447) THERMO-TRANSFER AND ELECTRO-TRANSFER PHENOMENA IN SOILS AND SEDIMENTS AND THEIR RELATION TO GROUND-WATER RECHARGE.

(b) U. S. Geological Survey, Water Resources Branch. (c) W. O. Smith.

(d) Chief Hydraulic Engineer, U. S. Geological Survey, Washington 25, D. C.

(e) Experimental and theoretical.

(f) Relation of the phenomena to flow of liquids in porous bodies.

(h) Preliminary experimental work in progress.

(448) UNDERWATER PHOTOGRAPHY IN INLAND WATERS.

(b) U. S. Geological Survey, Water Resources Branch.

(c) W. O. Smith, R. L. Taylor.

(d) Chief Hydraulic Engineer, U. S. Geological Survey, Washington 25, D. C.

(e) Experimental and theoretical.

(f) Development of techniques of underwater photography and their use in identifying rock structures. An extensive investigation has been made at Lake Butter in Pinellas County, Florida. Detailed development of the necessary echo sounding techniques for mapping bottom contours of lakes has been made as a prerequisite to underwater photography.

(h) A paper has been prepared.

(449) SONIC PROPERTIES OF SOILS AND SEDIMENTS.

(b) U. S. Geological Survey, Water Resources Branch. (c) W. O. Smith.

(d) Chief Hydraulic Engineer, U. S. Geological Survey, Washington 25, D. C.

(e) Experimental and theoretical.

(f) Development of techniques for determining sonic properties of soils and sediments and their application to problems of fluid flow.

(h) Some preliminary work has been done.

(450) ELECTROLYTIC POTENTIAL MODELS FOR THE SOLUTION OF PROBLEMS IN GROUND-WATER HYDRAULICS.

(b) U. S. Geological Survey, Water Resources Branch. (c) W. O. Smith.

(d) Chief Hydraulic Engineer, U. S. Geological Survey, Washington 25, D. C.

(e) Experimental and theoretical.

(f) Development of electrolytic potential techniques for model studies.

(h) An electrolytic tank and a suitable bridge have been built. It is not yet in operation.

(451) ELECTRIC AND MAGNETIC PROPERTIES OF SOILS AND SEDIMENTS.

(b) U. S. Geological Survey, Water Resources Branch. (c) W. O. Smith.

(d) Chief Hydraulic Engineer, U. S. Geological Survey, Washington 25, D. C.

(e) Experimental and theoretical.

(f) (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.

(h) Preliminary experimental work is in progress.

U. S. DEPT. OF THE INTERIOR, BUREAU OF RECLAMATION, Denver, Colorado.

Inquiries concerning Projects Nos. 452 to 465, incl., should be addressed to The Chief Engineer, Bureau of Reclamation, Denver, Colo.

(452) WELDED HOLLOW-JET VALVE.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To develop a control valve for low-head outlets capable of being fabricated from rolled flat-steel stock, yet retaining favorable operating characteristics of conventional cast-steel hollow-jet valve.

(g) Model tests on 12-inch model.

(h) Suspended for work of higher priority.

(453) HOOVER DAM INTAKE CYLINDER GATE.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental investigation.

(f) To check the adequacy of cylinder-gate suspension under severe adverse conditions.

(g) Hydraulic tests performed on a 1:24 model of the intake tower and cylinder gate assembly. Drawdown pull and hydrostatic pressures were measured for various operating heads, gate openings, and rates of opening or closure.

(h) Suspended for work of higher priority.

(454) CHERRY CREEK OUTLET WORKS.

(b) U. S. Engineer Office, Denver, Colo.

(c) Hydraulic laboratory, Bureau of Reclamation.

(e) Experimental, for design.

(f) To check the adequacy of the proposed outlet works for Cherry Creek Dam for releasing normal flow from reservoir.

(g) Tests are being made on a 1:28-scale model of the tunnels and stilling pool; two outside tunnels are controlled with slide gates; middle tunnel is controlled with a hollow-jet valve.

(h) Laboratory investigations are under way.

(455) ENDERS DAM OUTLET WORKS.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the adequacy of proposed outlet works for Enders Dam, Missouri Basin.

(g) Tests were made on 1:20-scale model of river outlet works, utilizing two hollow-jet control valves. Stilling pool was shortened by use of deep, covered pool into which the valves discharged.

(h) Tests completed; report to be written.

(456) ENDERS DAM SPILLWAY.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the adequacy of the proposed design for the Enders Dam Spillway and to prepare gate operating schedules.

(g) A 1:72-scale model of the spillway and outlet works was used.

(h) Investigations have been completed; report has not been written.

(457) SOLDIER CANYON OUTLET WORKS.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the adequacy of stilling basin for high-head outlet works for Soldier Canyon Dam.

(g) A 1:4 model of basin and valve is being used. Various types of valves and modifications of stilling basins are being investigated.

(h) Studies are incomplete, and report has not been prepared.

(458) OLYMPUS (CONCRETE GRAVITY) DAM SPILLWAY.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To study the proposed design of the spillway, and to make necessary changes to assure safe and economical operation.

(g) A 1:36 model of the overflow section, outlet section, and stilling pool was used.

(h) Testing is in progress.

(459) SURGE TANK ORIFICE STUDIES.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) General design, experimental.

(f) To develop a surge tank orifice having a relatively low coefficient of discharge with flow in one direction and a relatively high coefficient with flow in the other.

(g) A series of 1:50-scale model orifice pieces and mouthpieces were tested in a system simulating surge tank operation.

(h) Studies in progress.

(460) HEART BUTTE DAM SPILLWAY AND OUTLET WORKS.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To investigate the adequacy and efficiency of the hydraulic design of the combination structure, spillway, and river outlet.

(g) A 1:21.5-scale model largely of transparent plastic is being used to study the critical features of the uncontrolled morning glory spillway combined with outlet gates and tunnel. The chief subjects of investigation are prevention of vortices and required aeration for smooth operation.

(h) Studies in progress.

(461) BOYSEN DAM SPILLWAY.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To check the hydraulic design of the proposed spillway for the Boysen earth-fill dam.

(g) A 1:48-scale model is being used for gate, chute, and stilling basin studies.

(h) Investigations are in progress.

(462) BOYSEN DAM OUTLET WORKS.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To investigate the adequacy of the hydraulic design of the outlet works for the Boysen earth-fill dam.

(g) A 1:16-scale model is being used to conduct the hydraulic laboratory investigations.

(h) Tests are in progress.

(463) DAVIS DAM SPILLWAY.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the most effective and economical design of stilling basin for Davis Dam spillway.

(g) A 1:72-scale model is being used in the investigation of roller buckets, sloping aprons, and stilling basin as possible means of handling floodwaters with possible retrogression of stream bed in the future. Model is used to test diversion scheme for construction purposes.

(h) Testing is in progress.

(464) MEDICINE CREEK DAM SPILLWAY.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the adequacy of the proposed design of spillway for the earth-fill dam and make recommendations of necessary changes in design.

(g) A 1:60-scale hydraulic model is being used for the investigations.

(h) Studies incomplete.

(465) FRIANT-KERN CANAL TURNOUT.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To procure design data for prevention of collection of debris at turnouts; to determine best proportions for various features of turnouts.

(g) A 1:24-scale model of a section of the canal is being used to study various alternate designs.

(h) Tests are in progress.

U. S. NAVY DEPT., DAVID TAYLOR MODEL BASIN, Washington, D. C.

Inquiries concerning Projects Nos. 174, 175, 177, and 466 to 470, incl., should be addressed to The Director, David W. Taylor Model Basin, Washington 7, D. C.

(174) CIRCULATING WATER CHANNEL.

(b) Laboratory project. (c) C. E. Bowers, C. A. Lee.

(e) The design, construction, and calibration of a circulating water channel to be used as a test facility.

(f) The purpose of the facility is to provide a stream of water with an essentially flat surface free from waves and having a uniform velocity throughout the test section.

(g) Three 1:22-scale models of the full-scale circulating water channel have been designed, constructed, and tested. A full-scale water channel has been constructed and partially calibrated. The full-scale water channel test section is 22 feet wide, 9 feet deep, and 60 feet long. The water channel structure is a vertical closed loop with the test section situated in the upper horizontal leg. The facility is powered by two 1000-hp motors driving two vertically-set adjustable-blade propeller type pumps. The pump blades are adjusted for speed control which can be maintained to ±0.01 of a knot.

(h) Studies are being continued in the 1:22-scale model on alterations to the full-scale water channel. The full-scale channel has been in operation as a test facility for the past two and one-half years. A manual for operation is in preparation.

(i) Reports and papers on all known attempts to construct a facility of similar nature have been collected, and will be furnished to interested parties upon request.

(175) VARIABLE PRESSURE WATER TUNNEL - 60-INCH.

(b) Laboratory project. (c) W. F. Brownell, C. A. Lee.

(e) The design of a variable-pressure water tunnel to be used as a test facility.

(f) To provide a jet of water approximately 60 inches in diameter and traveling at a speed of 50 knots. Provisions will be made to vary the pressure of the jet from pressures approaching vapor pressure to at least 4 atmospheres.

(g) A search of literature on all existing water tunnels has been made. Many of the existing tunnels have been visited by the Director and members of the Taylor Model Basin staff. A search of literature has been made on the component parts of the tunnel such as contraction, diffuser, guide vanes, and elbows at the St. Anthony Falls Hydraulic Laboratory, University of Minnesota. A 1:10-scale model is under construction at St. Anthony Falls and will be completed and ready for test in the near future. The Iowa Institute of Hydraulic Research is conducting tests on the degree of turbulence produced by screens and grids and the effect of model size on the jet of a water tunnel. The Taylor Model Basin is designing a 1:4-scale model which will have an operating speed of 50 knots and have the same variation in pressure as the full-scale water tunnel. Special attention is being directed toward the design of a test section which will be readily removable.

(h) A three volume bibliography of existing water tunnels and a five volume hydraulic design study have been completed. Work is being discontinued on this project. Upon completion of the 24-inch water tunnel project, work may be resumed.

(i) Reports and papers on all known water tunnels as mentioned in (h) are available for study and will be furnished to interested parties upon request.

See Projects No. 105, "Water Tunnel Design Studies", St. Anthony Falls Hydraulic Laboratory, page 49; and No. 73, "Measurement of Turbulence in Flowing Water", and No. 80, "Turbulence Behind Screens", State University of Iowa, pages 28 and 30, respectively.

(466) VARIABLE PRESSURE WATER TUNNEL - 24-INCH.

(b) Laboratory project. (c) W. F. Brownell, C. A. Lee.

(e) The redesign, construction, and calibration of a 24-inch variable-pressure water tunnel.

(f) To provide a jet of water approximately 24 inches in diameter and traveling at a speed of 35 knots. Provisions will be made to vary the pressure of the jet from pressures approaching vapor pressure to at least 1-1/2 atmospheres.

(g) Improvements to the present 24-inch water tunnel are to be made. A search of literature on all existing water tunnels was previously made in connection with the 60-inch variable-pressure water tunnel. A 1:4-scale model study of the proposed redesign of the 24-inch variable pressure water tunnel will be made at the St. Anthony Falls Hydraulic Laboratory, University of Minnesota. The test section of the tunnel will be provided with proper fittings so that the tunnel may be

operated as an open or closed jet. Dynamometer shafts for propellers will be provided both upstream and downstream from the test section. Special attention is being given the test section elements in order that the test section jet will not change its characteristics as the water speed is increased.

(h) Preliminary plans and specifications for the mechanical, structural, and electrical designs of the 1:4-scale model and the full-scale tunnel are being made.

(i) Reports and papers on all known water tunnels are available in three volumes for study, and will be furnished to interested parties upon request.

See Project No. 105, "Water Tunnel Design Studies", St. Anthony Falls Hydraulic Laboratory, page 49.

(177) BENTONITE CHANNEL.

(b) Laboratory project. (c) B. Rosenberg, C. A. Lee.

(e) Experimental research.

(f) To develop a new means for quantitative and qualitative studies of flow around underwater bodies.

(g) By utilizing the double refraction properties of flowing colloidal solutions of Bentonite clay, photographs showing the viscous shear pattern around an underwater body can be obtained. A technique using polarized light to obtain the shear pattern in the flowing colloidal solution will be used. The shear patterns will be studied and by numerical or graphical integration the velocity distribution may be obtained. Preliminary investigations will be two-dimensional in character, but later it is planned to extend the scope of the investigations to three-dimensional bodies.

(h) The Bentonite channel is under construction, and a preliminary report of the technique to be used is being completed.

(467) STATISTICAL ANALYSIS OF TURBULENT FLOW IN PIPES.

(b) U. S. Navy Dept.

(c) M. S. Macovsky, W. L. Stracke, A. Borden, P. Eisenberg, J. V. Wehausen.

(e) Experimental and theoretical investigations for general information.

(f) To investigate methods of describing turbulent flow of water in pipes and to correlate the description with the boundary conditions.

(g) After suitable methods have been devised for describing and measuring the turbulent flow of water in pipes, the dependence of the fundamental descriptive parameters upon Reynolds number of the flow, roughness parameters, etc., will be investigated. It is expected to investigate the deviation from isotropy and to compare the results obtained from water flow with the results of air flow.

(h) Present work is concentrated upon devising methods for measuring the turbulent velocity fluctuations. A method of observing a part of the turbulent spectrum by high-speed photography of oil particles ejected from a hypodermic needle has proved successful but tedious. A hot-wire measuring instrument is being developed, as is also an electromagnetic method.

(i) "Progress on the development of hot-wire methods for velocity measurements in water." M. S. Macovsky. Taylor Model Basin Report 592. October 1947.

"Methode zur elektrischen Geschwindigkeitsmessung von Flüssigkeiten." B. Thurlemann. Helv. Phys. Acta 14: 383-419. 1941.

"An alternating field induction flow meter of high sensitivity." A. Kolin. Review of Scientific Instruments, 16: 109-116. 1945.

(468) FRICTIONAL RESISTANCE RESEARCH.

(b) U. S. Navy Dept. (c) J. P. Breslin.

(e) Both theoretical and experimental investigation of frictional resistance of hull

forms.

(f) To discover more precise relationships between frictional resistance of ship model and prototype.

(g) It is expected to obtain more accurate estimates of that part of the resistance of a towed model which is due to frictional resistance by taking into account the transition from a laminar to turbulent boundary layer and the separation of the flow which may arise with blunt forms.

(h) Work at present is concentrated upon developing a method which can become both easy and routine for detecting the region of transition for a towed ship form.

(469) PANAMA CANAL, RESTRICTED CHANNEL TESTS.

(b) Special Engineering Division, The Panama Canal.

(c) R. S. Garthune, C. A. Lee.

(e) Experimental, for design and for general information.

(f) To obtain information, from model tests, which will be of assistance in the selection of the cross-sectional dimensions and the design of bends for modernization of the Panama Canal.

(g) The model tests were conducted at scale ratios of 1:45 and 1:86, and they included an investigation of the effects of varying the cross-sectional dimensions of the channel for both one-way and two-way traffic; an investigation of the comparative handling characteristics of several different types of ships under various conditions; an investigation of the effect of current in the channel upon the handling characteristics of the ships; a comparison of model ship performance in several types of channel bends; an investigation of the change of level or sinkage of a ship underway in a restricted channel. The tests were of two main types, the observational tests and the force-measurement tests. In the observational tests, the self-propelled models were steered by means of a remote-control rudder system. Runs were made at various off-center positions in the channel, and the performance of the model ships was studied directly and also by analysis of photographic records. In the observational tests, the ship models were unrestrained, and they moved through the canal in either still water or in ahead or following currents. In the force-measurement tests, the self-propelled ship models remained stationary at various off-center positions in the canal and water moved past the model. The resulting forces and moments acting on the ship were measured, and the rudder angle and the angle of yaw required to produce equilibrium were determined.

(h) The test program is complete. Several status reports have been written, and a final report is in preparation.

(i) "Speed and power of ships." D. W. Taylor. 3rd edition (second revision), U. S. Govt. Printing Office. 1943. 301 pp.

"Steering of ships in shallow water and canals." G. S. Baker. Trans. Institution of Naval Architects, Vol. 66: 319-340. 1924.

"Maneuvering of ships: Semi-balanced rudders of twin screw ships." G. H. Bottomley. Trans. Northeast Coast Institution of Engineers and Shipbuilders, Vol. 49: 97-114, Discussion, p. D49-62. 1932/33.

"Some important phases of canal navigation, illustrated by recent experiments in Germany." Elnathan Sweet. Proc. A.S.C.E., Vol. 27: 1084-1094. 1901.

"Surges in Panama Canal reproduced in model". F. W. Edwards and Edward Soucek. Proc. A.S.C.E., Vol. 70(1): 3-13. January 1944.

"Some model experiments on suction of vessels." D. W. Taylor. Trans. Society of Naval Architects and Marine Engineers, Vol. 17: 1-21. 1909.

"Interaction between vessels." R. B. Bodilly. Van Nostran Co. 1924.

"The effect of size of towing tank on model resistance." John P. Comstock and C. H. Hancock. Trans. Society of Naval Architects and Marine Engineers, Vol. 50: 149-197. 1942.

(470) ELECTROLYTIC TANK FOR STUDYING FLUID FLOW.

(b) U. S. Navy Dept. (c) A. Borden, W. L. Stracke.

(e) Experimental investigation.

(f) To study the flow and pressure distribution about hydrodynamic bodies, using the method of electric analogy.

(g) Provision has been made for using either conducting or non-conducting cylinders in the tank. The lines of equipotential may be mapped with a searching probe and pantograph, or the velocity dietribution may be obtained directly, using a double electrode probe.

(h) Equipment ie being built.

U. S. NAVAL ENGINEERING EXPERIMENT STATION, Annapolis, Md.

Inquiries concerning Projects Nos. 471 to 473, incl., should be addressed to the Director, U. S. Naval Engineering Experiment Station, Annapolis, Md.

(471) FLANGES AND FITTINGS, SILVER BRAZED, STANDARD AND MODIFIED, FOR USE IN SALT WATER PIPING SYSTEMS.

(b) Bureau of Ships, U. S. Navy Dept.

(c) W. C. Stewart, Supt. of Metallurgical Laboratory; W. G. Schreitz, J. L. Basil.

(e) Design and experimental.

(f) To determine the advantagee of pipe fittings of modified design as compared with standard fittings for decreasing turbulence and thus prolonging the life of piping systems.

(g) In this test, Severn River water, a brackish estuary water, was pumped through a piping system consisting of red brass (85:15 copper-zinc) pipe and silver brazed bronze fittings of standard and modified designs. The branch pipes ranged from 1 inch to 4 inches IPS. The teet was made at a water velocity of 915 fps in the branches. The firet failuree occurred after approximately four months' test. Failure wae characterized by erosion and penetration of the pipe wall on the downstream side of fittings and branches. Red brass pipe was used to accelerate corrosive action.

(h) Test Report C-2369-B is in preparation for submittal to the Bureau of Ships. Results of this test have not been published, but it is the intention to do so after the Bureau of Ships has had opportunity to study the report.

(472) TESTING OF CONDENSER TUBES AT THE MARINE TESTING STATION, KURE BEACH, N. C.

(b) Bureau of Ships, U. S. Navy Dept.

(c) W. C. Stewart, Supt. of Metallurgical Laboratory; W. G. Schreitz, J. L. Basil.

(e) Design and experimental.

(f) To compare the relative corrosion resistance of various condenser tube alloys in natural sea water, as affected by condeneer head design for introducing the cooling water.

(g) Five experimental condensers, each containing 20 tubes approximately 4 feet long, are to be installed at Kure Beach, N. C., for test. Condenser tubes of several different alloys and in two wall thicknesses are to be installed. Different condeneer head designs are to be employed for introducing the cooling water at different anglee with respect to the tube sheet. Sea water is to be pumped through the condensers arranged in parallel. Flow characteristics are to be determined by means of components made of transparent plaetic.

(h) Arrangements for procuring the materials have been made.

(473) INVESTIGATION OF MATERIALS AND DESIGN FEATURES FOR SALT WATER PIPING SYSTEMS IN CONNECTION WITH DEVELOPMENT PROGRAM.

(b) Bureau of Ships, U. S. Navy Dept.

(c) W. C. Stewart, Supt. of Metallurgical Laboratory; W. G. Schreitz, J. L. Basil.

(e) Design and experimental.

(f) To determine the most suitable material for thin-wall piping carrying sea water.

(g) Three piping systems containing copper-nickel alloy pipe ranging from 3/8-inch to 3 inches IPS are being fabricated for test in natural sea water at Kure Beach, N. C. Two of the systems are to contain fabricated fittings of the same composition as the pipe material and are to be assembled by welding. The material of these systems is 70:30 copper-nickel alloy with the addition of other constituents to improve corrosion resistance. The third system contains pipe of these compositions assembled with bronze fittings by silver brazing. Sea water is to be pumped through the systems at 15 fps. The design of joints and fittings, including special means for protecting the pipe adjacent to the downstream side of fittings, forms a part of the investigation.

(h) Fabrication of the piping systems is in progress.

THE PANAMA CANAL, Special Engineering Division, Diablo Heights, Canal Zone.

(180) HYDRAULIC MODEL OF PANAMA CANAL AT SEA LEVEL.

(b) Special Engineering Division, Department of Operation and Maintenance, The Panama Canal (laboratory project).

(c) Hydraulic Section personnel under the supervision of J. S. Meyers.

(d) The Supervising Engineer, Special Engineering Division, The Panama Canal, Diablo Heights, Canal Zone.

(e) Project is part of the Isthmian Canal Studies, 1947, authorized by Public Law 280, 79th Congress, to investigate means for increasing the security and capacity of the Panama Canal.

(f) To obtain the best possible check on the computed values for tidal currents that would be produced in both an open and a regulated sea-level canal, and to investigate the hydraulic flow problems that would arise in the design and operation of such a canal.

(g) Investigations are being conducted on a hydraulic model with undistorted scale ratio, model to prototype, of 1:100. The half-mile long model reproduces the Atlantic and Pacific entrances and harbors to deep water, with connecting channel at sea level. Initially constructed to reproduce a channel 500 feet wide and 50 feet deep, following the alignment of the present Canal, the model was subsequently revised to reproduce a 60-foot by 600-foot relocated channel. Various combinations of tides are reproduced in miniature at both entrances by electro-mechanical tide machines. Observations have been made of the current velocities and other flow characteristics in both an open and regulated sea-level canal. Several alternate designs of tidal-regulating structures have been investigated, and gate-operating schedules developed for various tolerances of current velocity. Prototype measurements of hydraulic roughness in Gaillard Cut and of current velocities in the Pacific entrance have been checked in the model in verification tests. Other tests involved comparison of canal velocities for tidal flows and steady flows under equivalent heads, observation of currents in bends, and determination of effects of tributary flood flows on tidal flow in the canal.

(h) Tests are being continued.

(i) Following completion of the investigations directly concerned with the Panama Sea-Level Canal, a brief series of surge tests in the nature of general research will be undertaken.

ECOLE POLYTECHNIQUE DE MONTREAL, Hydraulic Laboratory, Montreal, Canada.

Inquiries concerning Projects Nos. 266 to 268, incl., should be addressed to Prof. Raymond Boucher, Ecole Polytechnique de Montreal, 1430 St. Denis Street, Montreal 18, Canada.

(266) HYDRAULIC MODEL STUDIES OF DIFFERENT SPILLWAY PROFILES.

(b) Laboratory project. (c) Prof. Raymond Boucher and assistants.

(e) General experimental research.

(f) To establish a comparison between the discharge capacities of different spillway designs.

(g) Studies are made on concrete models of existing and recommended spillway profiles. Pressure distribution on spillway faces and coefficients of discharge are determined for various heads up to the designed head. The effect of gate piers of various designs is also investigated.

(h) Seven different profiles have been studied, including two modifications of Creager-Justin profile upstream of crest line. The experimental work has been proceeding very irregularly during the last three years, and has just been resumed.

(267) MODEL TESTS OF A LOG FLUME CONTROL SECTION.

(b) The Shawinigan Engineering Company, Ltd., Montreal.

(c) Prof. Raymond Boucher and assistants.

(e) Experimental project for design information.

(f) To determine the efficiency of a control section for open channels consisting of a laterally tapering section of channel with bottom sloping in the direction of flow.

(g) The model, to a scale of 1:7.5, was installed in the 30-inch glass-sided flume, preceded by a short length of rectangular channel. Tests were made for heads up to the designed head to determine discharge coefficients. Profiles of the nappe were also obtained to complete observation of flow conditions.

(h) Tests have been completed; preparation of final report is in progress.

(268) CALIBRATION TESTS OF A SHARP-CRESTED PARABOLIC WEIR.

(b) Laboratory project. (c) Prof. Raymond Boucher and assistants.

(e) Experimental project for general information.

(f) 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 will measure flows to a new 18-inch by 30-inch glass-sided steel flume to be used for model testing and open channel studies.

(g) The brass weir plate was attached to the face of its stilling basin and the tests conducted on the whole set-up to be used with the flume. Heads were determined in a stilling pot with a point gage and discharges were measured by volume for larger flows and by weight for small flows.

(h) Testing has been completed. Preparation of report is in progress.

NATIONAL RESEARCH COUNCIL, Division of Mechanical Engineering, Ottawa, Canada.

Inquiries concerning Projects Nos. 474 and 475 should be addressed to Mr. J. H. Parkin, National Research Council, Ottawa, Ontario, Canada.

(474) STUDIES OF PROPOSED CHANNEL IMPROVEMENTS IN THE FRASER RIVER AT NEW WESTMINSTER, BRITISH COLUMBIA.

(b) Department of Public Works, Canada. (c) E. S. Turner, J. A. D. Marion.

(e) Experimental, for design of channel improvements.

(f) To determine the best methods of removing a sand bar from the navigation channel of the Fraser River near New Westminster, B. C.

(g) The model represents 5 miles of the Fraser River to a horizontal scale of 1:400 and a vertical scale of 1:100. Bituminous coal is used for the movable bed material. Tide and freshet control mechanisms are provided.

(h) Testing is in progress.

(475) DESIGN OF TERMINAL DIFFUSERS.

(b) Laboratory project. (c) E. S. Turner, L. S. Breen.

(e) Experimental, for general information.

(f) To obtain data for the design of a compact and efficient terminal diffuser.

(g) It was desired to install diffusers on the ends of the pipes supplying the laboratory flume to reduce turbulence and increase the capacity of the pipes. Experiments were performed, prior to the war, using wide angle cones with vanes to induce rotation and with cones of various shapes. The results appeared of general interest, and the study is being continued to include several designs of vanes.

(h) Experiments are in progress.

COMPLETED PROJECTS

THE BALDWIN LOCOMOTIVE WORKS, I. P. Morris Department, Eddystone, Pa.

Inquiries concerning Projects Nos. 476 to 479, incl., should be addressed to Mr. H. J. Davis, Supervisor of Hydraulic Laboratory, I. P. Morris Department, The Baldwin Locomotive Works, Eddystone, Pa.

(476) FRANCIS TYPE TURBINE MODEL - EFFICIENCY, HORSEPOWER, CAVITATION, AND RUNAWAY SPEED TESTS.

(b) U. S. Bureau of Reclamation, Davis Dam Project.

(c) R. B. Willi, Supervising Engineer; H. J. Davis, Supervisor of Hydraulic Laboratory.

(e) Experimental research to improve runner design.

(f) To develop a runner of improved design for application to a set of specific conditions (Davis Dam Project).

(g) On a large project such as this, it is often desirable to design a runner model to meet specific requirements, and to test new design by means of model tests. Improvements over the drawing board design are sometimes possible by making certain modifications to the scale model.

(h) Tests are completed, and the prototype units are being manufactured.

(477) ADJUSTABLE SIX-BLADE PROPELLER TYPE TURBINE MODEL FOR HIGH HEAD APPLICATION - EFFICIENCY, HORSEPOWER, CAVITATION, BLADE TORQUE, AND RUNAWAY SPEED TESTS.

(b) Laboratory project.

(c) R. B. Willi, Supervising Engineer; H. J. Davis, Supervisor of Hydraulic Laboratory.

(e) Experimental research in connection with future design of product.

(f) To obtain propeller turbine design applicable to heads as high as 100 feet.

(g) Turbine was tested in a closed flume, the hydraulic gradient of which may be raised or lowered to simulate the operating conditions of a commercial prototype. All parts of the turbine were made homologous to the proposed field unit, the runner having a throat diameter of 11 inches. Numerous tests were made to obtain complete efficiency, horsepower, cavitation, blade torque, and runaway speed data for all ranges of speeds, heads, and plant sigmas.

(h) Tests have been successfully completed.

(478) ADJUSTABLE FOUR-BLADE PROPELLER TYPE TURBINE MODEL FOR LOW HEAD APPLICATION - EFFICIENCY, HORSEPOWER, CAVITATION, BLADE TORQUE, AND RUNAWAY SPEED TESTS.

(b) Laboratory project.

(c) R. B. Willi, Supervising Engineer; H. J. Davis, Supervisor of Hydraulic Laboratory.

(e) Experimental research in connection with future design of product.

(f) To obtain propeller turbine design applicable to low heads.

(g) Turbine was tested in a closed flume, the hydraulic gradient of which may be raised or lowered to simulate the operating conditions of a commercial prototype. All parts of the turbine were made homologous to the proposed field unit, the runner having a throat diameter of 11 inches. Numerous tests were made to obtain complete efficiency, horsepower, cavitation, blade torque, and runaway speed data for all ranges of speeds, heads, and plant sigmas.

(h) Tests have been successfully completed.

(479) BUCKET-SHAPE STUDIES FOR IMPULSE TYPE TURBINE - FLOW PATTERN ANALYSIS ON STATIONARY MODEL BUCKETS.

(b) Laboratory project.

(c) R. P. Willi, Supervising Engineer; Dr. R. Lowy, Engineer.

(e) Experimental research in connection with future design of product.

(f) To improve bucket design for impulse type turbines.

(g) Model bucket was held in test stand in a static position, but which allowed manual adjustment of bucket in a vertical arc tangent to a high velocity nozzle jet. By studying jet pattern as it emerged from bucket and passed through a reference grid, it was possible to make modifications in bucket face and obtain a bucket design which should prove itself under regular horsepower efficiency tests.

(h) This phase of testing is completed. Horsepower-efficiency tests are needed to confirm design.

CALIFORNIA INSTITUTE OF TECHNOLOGY, Pasadena, Calif.

(9) HYDRAULIC DESIGN OF EROSION CONTROL STRUCTURES BY MEANS OF MODEL TESTS.

(b) Research Division, Soil Conservation Service, U. S. Dept. of Agriculture.

(c) V. A. Vanoni, H. A. Einstein, J. T. Rostron.

(d) Prof. Robert T. Knapp or Dr. Vito A. Vanoni, California Institute of Technology, Pasadena 4, Calif.

(e) Experimental studies to obtain design information.

(f) To obtain design information for typical and specific structures.

(g) This project includes a number of investigations conducted by the Laboratory on Hydraulic Structures. Some of these are particular structures and lead to findings and recommendations of interest only to one structure. Other tests cover more general investigation leading to results of more widespread interest. The procedures followed are those normally used in the hydraulic model laboratory.

(h) The project was completed in June 1947.

(i) "Hydraulic design of durable structures for gully control." Brooks T. Morris and D. C. Johnson. Trans. A.S.C.E., Vol. 108: 887-890. 1943.

"Scour control and scour resistant design for hydraulic structures." Brooks T. Morris. Trans. American Geophysical Union, Pt. I: 60-67. 1942.

"Baffle type energy dissipator for pipe outlets." Vito A. Vanoni and James T. Rostron, Agricultural Engineering, Vol. 25, No. 8: 301-304, and No. 9: 341-348. August and September 1944.

(10) STABILITY OF NATURAL SEDIMENTS UNDER LOCALLY CONCENTRATED ATTACK ON FLOWING WATER.

(b) Research Division, Soil Conservation Service, U. S. Dept. of Agriculture.

(c) H. A. Einstein, V. A. Vanoni.

(d) Prof. Robert T. Knapp or Dr. Vito A. Vanoni, California Institute of Technology, Pasadena 4, Calif.

(e) Basic experimental research.

(f) To establish a rational basis for predicting the rate of scour of sediments and pavements at the foot of drop structures, overfall dams, and at other places where several erosion forces are active.

(g) The work has included both laboratory studies and field studies, and it is

contemplated that future studies will continue along both of these lines. The laboratory studies included measurements of erosion due to jets, as well as in model stilling basins of various designs, using the normal laboratory technique.

(h) This project is discontinued, due to lack of staff.

(13) STUDY OF PRE-ROTATION AND REVERSE FLOW AT THE EYE OF A CENTRIFUGAL PUMP.

(b) Laboratory project. (c) R. T. Knapp, R. L. Daugherty.

(d) Prof. Robert T. Knapp, or Prof. R. L. Daugherty, California Institute of Technology, Pasadena 4, Calif.

(e) Experimental project for student thesis.

(f) Experimental verification of the flow characteristics within a centrifugal pump, especially in the region near the impeller eye.

(h) The first series of investigations has been completed.

(i) The results are included in a report on the Bureau of Reclamation research program.

(14) GRAND COULEE PUMP MODEL TESTS.

(b) Byron Jackson Company.

(c) R. T. Knapp, R. L. Daugherty, A. Hollander, E. Lindros.

(d) Prof. Robert T. Knapp, California Institute of Technology, Pasadena 4, Calif.

(e) Experimental program to obtain design information.

(f) To determine the best pump unit for the specified varying conditions.

(g) A number of impellers and diffusers were tested to show the effect of minimum changes in design upon the sizes of the unit for a minimum specified efficiency, and on the change of maximum efficiency by these variations. The principal changes in design were in the impeller and diffuser angles.

(h) The program has been completed.

(i) Reports have been submitted to the Bureau of Reclamation. These cover the performance of the final unit only.

UNIVERSITY OF CALIFORNIA, Department of Engineering, Fluid Mechanics Laboratory, Berkeley, Calif.

Inquiries concerning Projects Nos. 30, 33, and 34 should be addressed to the Chairman, Department of Engineering, University of California, Berkeley 4, Calif.

(30) ARTIFICIAL ROUGHNESS IN OPEN CHANNELS.

(b) Laboratory project. (c) J. W. Johnson.

(e) Experimental investigation.

(f) Investigation of methods to measure roughness.

(g) Experimental investigations in water channel containing various types of artificial roughness.

(h) Work completed.

(i) "Friction losses in artificially roughened channels." A. C. Smith and C. Warren. B.S. thesis. 1943.

"Rectangular artificial roughness in open channels." J. W. Johnson. Trans. American Geophysical Union, Pt. V: 906. April 1945.

"Flow in a channel of definite roughness." Discussion by J. W. Johnson and E. A. LeRoux. Proc. A.S.C.E., Vol. 71, No. 6: 948. June 1945.

(33) FLOW-DURATION CURVES.

(b) Laboratory project. (c) E. Maltzman. (e) Undergraduate thesis.

(f) To prepare flow-duration curves for certain stream in Southern California.

(g) Curves prepared from stream flow data published by the U. S. Geological Survey.

(h) Work completed.

(i) "Flow duration curves for stream in Southern California." E. Maltzman. B. S. thesis. 1943.

This investigation was made to determine the similarity of flow-duration curves for a number of streams in Southern California. To place the curves on a comparable basis and eliminate the effect of drainage area, the ratio of discharge to mean discharge was plotted against percent of time. The streams for which analyses were made were Arroyo Seco, Fish Creek, Little Dalton Creek, Little Santa Anita Creek, Little Tujunga Creek, Santa Anita Creek, and Tujunga Creek.

(34) MODEL STUDY OF BREAKWATERS AT HUNTERS POINT, CALIFORNIA.

(b) Bureau of Yards and Docks, U. S. Navy Dept.

(c) J. A. Putnam, K. J. Bermel, J. W. Johnson.

(e) A theoretical and experimental investigation.

(f) To provide information for locating breakwaters to give maximum protection at this Navy Base against wave action from local winds, and then to determine relative effects of silting and scouring should breakwaters be constructed.

(g) Analysis of wind data in the vicinity of Hunters Point from 1929 to 1945, inclusive. Preliminary study of wave patterns by means of a ripple tank. A model study, using a prototype to model scale ratio of 40:1, was made to verify a theory of wave diffraction in the lee of breakwaters with the breakwaters at various angles to the incident waves. Extent and orientation of breakwaters based on above data. Current observations, approximately a 92-hour period, April 14 to 18, 1945, in the vicinity of Hunters Point. A second model, prototype to model scale ratio of 600:1 in the horizontal and 100:1 in the vertical, adjusted to reproduce currents as per above survey, was made of the south half of San Francisco Bay to investigate silting and scouring tendencies due to the various breakwaters considered.

(h) Project completed.

(i) Interior Report No. 1, "Breakwater model studies, U. S. Navy drydock, Hunters Point, Calif." J. A. Putnam. August 20, 1945.

Interior Report No. 2, "Breakwater model studies, U. S. Navy drydock, Hunters Point, Calif." J. A. Putnam and K. J. Bermel. July 1946.

Final Report, "Breakwater model studies, U. S. Naval drydocks, Hunters Point, Calif." J. A. Putnam and K. J. Bermel. February 1947.

"Estimating storm-wave conditions in San Francisco Bay." J. A. Putnam. Trans. American Geophysical Union, Vol. 28, No. 2: 271. April 1947.

An adaptation of wave-forecasting procedures as developed for wind generated waves in the open sea.

Knowing the fetch, wind velocity, and duration, it is possible to obtain from the charts presented, values of average wave height and period of the highest 30 percent of the waves present at the end of the fetch. Presentation of curves of constant fetch and constant duration as parameters in these figures makes it possible to determine whether wave height and period at the end of the generating area are controlled by fetch or duration. A specific example relating to construction work at the United States Naval Drydocks, Hunters

Point, Calif., is used to illustrate the method used.

"Suspended-matter sampling and current observation in the vicinity of Hunters Point, San Francisco Bay." J. A. Putnam, K. J. Bermel, and J. W. Johnson. Trans. American Geophysical Union, Vol. 28, No. 5: 742. October 1947.

A summary of suspended-matter concentration, in the vicinity of Hunters Point in San Francisco Bay, including analysis of bottom samples and accompanied by selected data of current velocities and directions. Suspended-matter data based on approximately 250 samples, taken at approximately six-hour intervals, over a 92-hour period, April 14 to 18, 1945. Samples were obtained from each of the nine stations, at corresponding tide phases, and for depths of one foot off the bottom, one-fourth and one-third of the depth, and one foot below the surface.

MISCELLANEOUS ABSTRACTS

"The propulsion of amphibious craft." R. G. Folsom and E. D. Howe. Presented before the Northern California Section of the Society of Naval Architects and Marine Engineers in San Francisco, April 29, 1947.

The paper presents the operational requirements of amphibious vehicles for water, surf, and land performance. The characteristics of the surf depend upon the bottom contours and breaker heights and periods. The propulsion of amphibious craft in the water depends upon the time rate of change of momentum of the water passing through the propulsion system. Analytical methods are presented to determine propeller and jet propulsion performance. Grouser propulsion as used with LVT's requires supplemental investigation. Models were tested at the University of California towing tank in order to determine the maximum performance of emerged and submerged tracks and slip between water and tracks. Experimental data indicated no correlation existed between the static pull or drawbar thrust with respect to speed or horsepower characteristics of the self-propelled model.

"Notes on the design of current meters." M. P. O'Brien and R. G. Folsom. Presented at the meeting of the American Geophysical Union at Pasadena, February 1, 1947.

A perfect current meter is defined, and a general discussion of departures of real current meters from the ideal is presented. The Price current meter has been shown to over-register, due to turbulence and angularity of the fluid stream. The propeller type of meter shows less sensitivity, due to flow stream characteristics when it is properly designed. The effects on accuracy of turbulence, Reynolds number, and meter inertia are included. Methods of rating current meters are discussed, with some indication of the deficiencies of present standard procedures. The work results in a series of recommendations and design specifications for an improved propeller type of current meter.

CARNEGIE INSTITUTE OF TECHNOLOGY, Department of Civil Engineering, Pittsburgh, Pa.

(480) EFFECT OF SUBMERGENCE ON A FOUR-FIFTHS DEGREE CUSPIDATE WEIR.

(b) Laboratory project. (c) F. W. Edwards, L. M. Laushey, C. L. Dick.

(d) Prof. F. T. Mavis, Head, Dept. of Civil Engineering, Carnegie Institute of Technology, Pittsburgh 13, Pa.

(e) Undergraduate thesis.

(f) Tests made on a 4/5 degree parabolic weir to determine the discharge coefficient as a function of head, and also the effects of submergence.

(g) Tests were conducted for both free and submerged discharge.

(h) Completed.

COLORADO A & M COLLEGE, Fort Collins, Colo.

(481) SEEPAGE LOSSES FROM IRRIGATION CHANNELS.

(b) Soil Conservation Service, U. S. Dept. of Agriculture, and Colorado A & M College.

(c) C. H. Rohwer.

(d) Carl H. Rohwer, Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(e) Experimental, for design and general information.

(f) To devise methods of measuring seepage losses from irrigation channels, and to measure the losses from lined and unlined channels in different soils and under various conditions of flow.

(g) Seepage determinations were made by means of permeameters, inflow and outflow measurements, with current meters and by noting the rate of drop in pools. Where possible, seepage losses were measured by two methods for comparison. In most cases, seepage losses determined by the inflow and outflow measurement with current meters, were computed on the basis of the rate of flow at a particular time and also the volume of flow over a period of time. This period was chosen so that the canal stages at the beginning and end of the period would be the same. In this manner differences in channel storage were eliminated. Ground-water profiles at right angles to the canal were determined when needed, in order to find out where the losses were occurring.

(h) Project completed.

(i) "Seepage losses from irrigation channels." Carl H. Rohwer. Colorado Agr. Exp. Station, Technical Series Bulletin No. 38.

GEORGIA SCHOOL OF TECHNOLOGY, Civil Engineering Department, Atlanta, Ga.

(482) PORTABLE V-NOTCH WEIR PLATES FOR FIELD APPLICATIONS.

(b) Cooperative project, Georgia School of Technology and Atlanta District, Surface Water Division, Water Resources Branch, U. S. Geological Survey.

(c) J. E. Heatherly.

(d) Prof. C. E. Kindsvater, Civil Engineering Dept., Georgia School of Technology, Atlanta, Ga.

(e) Experimental calibration, for flow metering.

(f) To develop and calibrate a portable V-notch weir for field measurements of flows below the range of the standard U. S. Geological Survey "Pygmy" current meter.

(g) Identical 90° V-notch weir plates were cut from stainless steel plate, filed to a sharp edge by hand, and mounted on planks. Several of these plates were gravimetrically calibrated for various conditions of upstream channel configuration. A folding rule was used to measure heads below a designated point on the upstream face of the plate. Results from the several plates tested were remarkably consistent and agreed reasonably well with the standard discharge formulas.

(i) An inter-office report has been submitted for publication in the Water Resources Bulletin, U. S. Geological Survey.

UNIVERSITY OF IDAHO, College of Engineering, Moscow, Idaho.

(483) HYDRAULIC TURBINE INSTALLATION AND TESTING.

(b) Laboratory project. (c) W. W. Tinniswood.

(d) Allen S. Janssen, Dean, College of Engineering, University of Idaho, Moscow, Ida.

(e) Experimental laboratory study as thesis for B.S. degree in civil engineering.

(f) To provide a laboratory installation of a model reaction type turbine, and to obtain data concerning its operating characteristics and efficiency.

(g) A reaction type Brook water wheel manufactured by the Rodney Hunt Machine Company was installed with a complete model hydroelectric system, including a General Electric generator with necessary controls. Tests of efficiency and performance were made at various heads and gate openings to determine and check characteristic performance.

(h) Thesis completed in August 1947.

STATE UNIVERSITY OF IOWA, Iowa Institute of Hydraulic Research, Iowa City, Ia.

(70) SUPERCRITICAL FLOW IN OPEN-CHANNEL TRANSITIONS.

(b) Project conducted by Iowa Institute of Hydraulic Research in cooperation with the Committee on Hydraulic Research, Hydraulics Division, A.S.C.E., and The Research Foundation.

(c) E. Y. Hsu.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Analytical and experimental project.

(f) To determine principles of design for divergent channel sections carrying high-velocity flow.

(g) Studies of channel design were carried out in three phases: surface configuration at abrupt expansions; efficient curvature of expanding boundaries; and elimination of disturbances at the ends of transitions. Studies were conducted on a table of adjustable slope, using nozzles yielding rectangular jets of different dimensions and flows such that the Froude number varied from 1 to 6.

(h) Project completed.

(i) A paper entitled "Design of channel enlargements for supercritical flow", by Hunter Rouse, B. V. Bhoota, and E. Y. Hsu, has been submitted to the American Society of Civil Engineers for publication as part of a four-paper symposium on "High-velocity flow in open channels".

(71) FIRE-MONITOR INVESTIGATION.

(b) Bureau of Ships, U. S. Navy Dept., and U. S. Coast Guard.

(c) J. W. Howe, D. E. Metzler.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Experimental, for design information.

(f) To increase the range and concentration of jets from fixed and portable fire monitors.

(h) Project completed.

(i) Preliminary report, "Characteristics of high-velocity jets", by J. W. Howe and C. J. Posey. Proc. Third Hydraulics Conference, University of Iowa Bulletin 31: 315. 1946.

(74) DESIGN AND PROCUREMENT OF HYDRAULIC LABORATORY EQUIPMENT.

(b) National University of Colombia at Bogota.

(c) Staff of Iowa Institute of Hydraulic Research.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Design and consulting project.

(f) Provision of up-to-date equipment for student instruction in fluid motion and applied research in hydraulic engineering.

(h) All equipment has been designed. Approximately 90 percent of the equipment has been ordered by the National University, and several shipments to Colombia have been made.

(77) STUDIES IN EVAPORATION.

(b) Laboratory project. (c) M. L. Albertson.

(d) Prof. Hunter Rouse, State University of Iowa, Iowa City, Ia.

(e) Experimental, for doctoral thesis.

(f) To determine the effect of turbulence upon the transfer of vapor through the boundary layer.

(g) Above a porous porcelain evaporating surface set into a smooth boundary, the velocity, turbulence, and vapor profiles were measured to determine the thickness of the boundary layer and the laminar sub-layer, and the distribution of diffusivity and vapor immediately above the liquid surface. The velocity and turbulence were measured by a hot-wire anemometer, and the vapor concentration determined by very fine wet and dry thermocouples. The free-stream turbulence was created by a lattice screen of variable geometry placed upstream at different distances from the evaporating surface.

(h) Work completed.

(i) Results reported in doctoral thesis, "The effects of turbulence on evaporation", by M. L. Albertson, State University of Iowa, 1947.

This study was the experimental continuation indicated in the discussion by M. L. Albertson of the paper, "Evaporation from a free water surface", by G. H. Hickox. Trans. A.S.C.E., Vol. 11: 55, 1946.

(83) DETERMINATION OF PRESSURE DISTRIBUTION CAUSED BY FLOW OF AIR OVER A SERIES OF TWO-DIMENSIONAL ROOF FORMS.

(b) Laboratory project. (c) G. A. Austin.

(d) Prof. J. W. Howe, State University of Iowa, Iowa City, Ia.

(e) Experimental, for master's thesis.

(f) To determine pressure distribution on two-dimensional roofs of various proportions and slopes.

(g) Experiments in small air tunnel; maximum wind velocities approximately 70 fps; models about 3 inches in height.

(h) Work completed.

(i) Results reported in master's thesis, "A study of the pressure distribution on a series of two-dimensional roof forms", by George A. Austin, Jr., State University of Iowa, June 1947.

(85) SYNTHESIS OF THE FLOOD HYDROGRAPH ON RALSTON CREEK, IOWA.

(b) Laboratory project. (c) M. R. Carstens.

(d) Prof. J. W. Howe, State University of Iowa, Iowa City, Ia.

(e) Theoretical, for master's thesis.

(f) Determination of elements of rainfall contributing to runoff in selected storms on Ralston Creek.

(g) Runoff divided according to distance of contributing area from control of stream

gaging station on Ralston Creek; assumptions made as to rates of travel and storage; integration of various elements of flow made to produce synthetic hydrograph which was compared with actual hydrograph.

(h) Work completed.

(i) Results reported in master's thesis, "Synthesis of the runoff hydrograph on Ralston Creek", by M. R. Carstens, State University of Iowa, June 1947.

For information on project from which these data were obtained, see Current Project No. 66, "Hydrologic studies - Ralston Creek watershed", page 26.

(86) UNSTEADY FLOW PROBLEMS FROM MASSAU'S LINE OF ATTACK.

(b) Laboratory project. (c) P. N. Lin.

(d) Prof. C. J. Posey, State University of Iowa, Iowa City, Ia.

(e) Theoretical, for master's thesis.

(f) To develop a step method for computing unsteady flow problems, taking into account the theoretical considerations pointed out by J. Massau.

(g) A computation method was devised and tested on actual problems in comparison with methods proposed by Thomas and others.

(h) Work completed.

(i) Results reported in master's thesis, "Unsteady flow problems from Massau's line of attack", by P. N. Lin, State University of Iowa, June 1947.

The graphical step method as developed under this project did not fully eliminate trial and error computations. It is hoped that further study can be undertaken to improve the methods still more.

(87) VORTEX OVER OUTLET.

(b) Laboratory project. (c) H. C. Hsu.

(d) Prof. C. J. Posey, State University of Iowa, Iowa City, Ia.

(e) Experimental, for master's thesis.

(f) To study the effect of the vortices that form over outlets in decreasing the discharge through the outlet.

(g) Water was introduced tangentially and radially, in controlled proportions, into a 6-foot diameter tank having a 4-inch standard orifice at the center of the smooth level bottom. Heads were varied up to a maximum of about 2 feet.

(h) Work completed.

(i) Results reported in master's thesis, "Vortex over outlet", by H. C. Hsu, State University of Iowa, June 1947.

Contrary to popular belief, it was found that tangential inflow is essential to the formation of a persistent vortex capable of decreasing the discharge. An empirical relationship between the strength of the vortex and the discharge deficiency was obtained.

(88) A LENGTH CRITERION FOR THE HYDRAULIC JUMP.

(b) Laboratory project. (c) B. Behera, A. A. Qureshy.

(d) Prof. C. J. Posey, State University of Iowa, Iowa City, Ia.

(e) Experimental, for master's thesis.

(f) To develop a criterion for the length of the hydraulic jump that is closely related to bottom scour, but easy to perform, and which will give results that are not much affected by the judgment of the observer.

(g) Tests were made of hydraulic jumps in the one-foot and three-foot flumes at the Iowa Institute of Hydraulic Research laboratory, with the potential scour intensity indicated by the point at which right circular cylinders of different

densities, placed on the horizontal floor of the flume, would just topple.

(h) Work completed.

(i) Results reported in master's thesis, "A length criterion for the hydraulic jump", by B.Behera, State University of Iowa, February 1947. Appendix containing additional experimental data submitted for master's thesis by A. A. Qureshy, June 1947.

The results of this investigation are of a preliminary nature, but indicate that the method is likely to be useful if cylinders of sufficient density (much heavier than lead) can be utilized.

LEHIGH UNIVERSITY, Department of Civil Engineering, Bethlehem, Pa.

Inquiries concerning Projects Nos. 58 and 92 should be addressed to Prof. W. J. Eney, Head, Dept. of Civil Engineering, Lehigh University, Bethlehem, Pa.

(58) THE EFFECT OF LATERAL CONTRACTIONS ON SUPERCRITICAL FLOW IN OPEN CHANNELS.

(i) Master's thesis, John Howard Dawson, Lehigh University, 1943.

Theoretical and experimental study; shows advantages of abrupt corners in such transitions for particular velocities.

(92) TRANSPORTATION OF SEDIMENT IN PIPE LINES.

(i) Master's thesis, Amnuay Phoonphiphutana, Lehigh University 1947.

This project was listed in Volume XI as "Friction Factor for Coal Suspension".

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Department of Mechanical Engineering, Cambridge, Mass.

(96) FRICTION COEFFICIENTS IN THE INLET LENGTH OF SMOOTH, ROUND TUBES.

(b) National Advisory Committee for Aeronautics. (c) A. H. Shapiro.

(d) Prof. A. H. Shapiro, Dept. of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.

(e) Experimental project, to yield both design information and fundamental concepts.

(f) To measure friction coefficients in the entrance region of a pipe, where the velocity profile is changing, and to determine the effect of Reynolds number and of turbulence.

(g) Static pressure measurements were made at various points along the walls of smooth, round tubes through which water was flowing. From these data were inferred resistance coefficients.

(h) Project concluded.

(i) Report submitted to National Advisory Committee for Aeronautics, entitled "Friction coefficients in the inlet length of smooth, round tubes", by A. H. Shapiro and R. D. Smith, July 1947. Copies may be borrowed from the National Advisory Committee for Aeronautics, Washington, D. C.

(484) CAVITATION TESTS OF VARIOUS BEARING MATERIALS IN OIL.

(b) Wright Aeronautical Corporation.

(d) J. Palsulich, Project Engineer, Wright Aeronautical Corporation, Wood-Ridge, N. J.

(i) "Report on vibratory cavitation tests of various bearing materials in oil", by B. G. Rightmire, submitted to Wright Aeronautical Corporation.

UNIVERSITY OF MICHIGAN, College of Engineering, Ann Arbor, Mich.

(485) RESISTANCE OF BARGES AND FLOTILLAS.

(c) L. A. Baier.

(d) Prof. L. A. Baier, Room 326 West Engineering Bldg., University of Michigan, Ann Arbor, Mich.

(h) Project completed and report published in Transactions of the Society of Naval Architects and Marine Engineers, 1947.

THE PENNSYLVANIA STATE COLLEGE, School of Engineering, State College, Pa.

(130) WATER TUNNEL VANED TURNS STUDIES.

(b) Ordnance Research Laboratory at The Pennsylvania State College.

(c) J. M. Robertson, A. J. Turchetti.

(d) Prof. J. M. Robertson, Hydraulics Laboratory, School of Engineering, The Pennsylvania State College, State College, Pa.

(e) Experimental study for design purposes; M.S. thesis.

(f) To determine the best contour and proportions of the turning vanes to be used in the four turns of the water tunnel.

(g) Library and analytical research, together with experiments on 1.5-inch chord vanes in the experimental water tunnel (Project No. 129, "Water Tunnel Model Studies", page 43).

(h) Research completed. Thesis and report have been written. Paper has been submitted to an engineering society for possible publication.

(i) "A study of vaned elbows for a large water tunnel." A. J. Turchetti. M.S. thesis, Dept. of Mechanical Engineering, The Pennsylvania State College, August 1947.

"Water tunnel vaned-turns studies." Ordnance Research Laboratory, Report No. 7958-64. September 10, 1947.

A study of vaned turns was made as a part of the research program for the design of the 48-inch water tunnel to be constructed at The Pennsylvania State College. Miter turns with guide vanes were the logical choice because of their compactness and small disturbance to the flow. The proportions of the vanes were based on the work of others, and the number of vanes was based on wind tunnel practice. Structural analysis of the design indicated that the vanes are strong enough, that their deflection is negligible, and that they should not be liable to excessive vibration. Studies of the flow around a 10-inch diameter turn with 18 vanes were made in the experimental water tunnel to determine the cavitation susceptibility and the energy losses and to serve as a final check on the design. It was found that the loss coefficient of the bend is about 0.15, the vanes are safe from cavitation as their critical cavitation index is about 1.1, and that the vanes should be set at an angle of attack of one degree.

ST. ANTHONY FALLS HYDRAULIC LABORATORY, University of Minnesota, Minneapolis, Minn.

Inquiries concerning Projects Nos. 101, 102, 106, 107, and 486 should be addressed to Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

(101) VELOCITY DISTRIBUTION AT A SECTION IN A 90° TRIANGULAR CHANNEL.

(b) Master's thesis, University of Minnesota. (c) H. D. Purdy, Jr.

(e) Experimental and analytical student thesis.

(f) To determine longitudinal velocity distribution in a triangular open channel.

(g) To determine longitudinal velocity distribution in a 6-inch, 90° triangular channel, using kerosene as a fluid. Experiments were conducted in both the laminar and turbulent range, using a Pitot tube. Results were correlated with modern concepts of flow.

(h) Study completed.

(i) Thesis is available for interlibrary loan from the University of Minnesota Library.

(102) VELOCITY DISTRIBUTION AND BOUNDARY SHEAR IN OPEN CHANNELS.

(b) Master's thesis, University of Minnesota. (c) J. S. Holdhusen.

(e) Experimental and analytical student thesis.

(f) To determine the effect of boundary shear on velocity distribution.

(g) Velocity patterns were determined over discharge area of a rectangular steel channel 3 feet wide and 15 inches deep at slopes greater than critical. Boundary shear was determined by the Kármán theory after computing the value of "K" (the universal constant of turbulence) by two methods. Secondary currents were plotted and their effects were analyzed.

(h) Study completed.

(i) Thesis is available for interlibrary loan from the University of Minnesota Library.

(106) INVESTIGATION OF A MODEL SEDIMENTATION BASIN.

(b) Master's thesis, University of Minnesota. (c) B. K. Banerjee.

(e) Experimental investigation.

(f) To determine the governing model law and efficiency of operation of a sedimentation basin.

(g) To determine the distribution and sizes of sediment deposited in various parts of the basin for different conditions of operation. Glass spheres from 10 to 60 microns in diameter were used for sediment.

(h) Study completed.

(i) Thesis is available for interlibrary loan from the University of Minnesota Library.

(107) CHIPPEWA RESERVOIR SPILLWAY MODEL.

(b) Northern States Power Company. (c) L. G. Straub, W. W. DeLapp.

(e) Experimental model study.

(f) To establish optimum design of changes in existing structure for the purpose of decreasing downstream erosion.

(g) Flow and erosion patterns studied for various designs in a three-dimensional model constructed to a scale of 1:24 for a complete range of discharges.

(h) Study completed.

(486) FLOW THROUGH GUTTER INLETS.

(b) Minnesota Department of Highways. (c) C. L. Larson.

(e) Experimental investigation for design information.

(f) To develop grate inlets of higher capacity and greater ability to pass debris than present inlets provide.

(g) Experiments were conducted with several full-scale standard and experimental grate inlets mounted in an artificial gutter variable in slope over a range corresponding to field slopes of one to six percent. Both variation of capacity with total flow and variation of capacity with slope were determined. Standardized debris tests were made with simulated debris in order to obtain a quantitative basis for comparison of self-cleaning qualities.

(h) Study completed.

(i) "Experiments on flow through inlet gratings for street gutters." Curtis L. Larson. Presented at annual meeting, Highway Research Board, December 1947; paper will be published in the Proceedings of the Highway Research Board, 1947.

S. MORGAN SMITH COMPANY, York, Pa.

Inquiries concerning Projects Nos. 143 and 487 should be addressed to Mr. George A. Jessop, Chief Engineer, S. Morgan Smith Company, York, Pa.

(143) STUDY OF PRESSURE CONDITIONS IN A SPECIAL DESIGN RIGHT-ANGLE ELBOW WITH GUIDE VANES AND SPECIAL DESIGN ROTOVALVE INSTALLED IN A HIGH VELOCITY PIPE LINE.

(b) Board of Water Supply, City of New York, Kensico Hill View Station.

(c) John Haupt, New York Board of Water Supply; R. Sahle and laboratory personnel, S. Morgan Smith Company.

(e) Experimental research.

(f) The object of these tests is to determine, primarily, the low pressure area where cavitation may occur and means of reduction or elimination. To determine the low pressure area by means of observation through Lucite windows, piezometer connections, and by Pitot tube measurements.

(g) A complete model of the pipe line, which included a bell mouth intake, right-angle elbow with special design guide vanes, rotovalve with a special design plug, and a discharge nozzle, was installed in the laboratory. A section of the pipe line is made of Lucite in order to observe the flow condition in the elbow at the guide vane section and in the entrance and discharge end of the valve plug. Three designs of special guide vanes in the elbow were tested. Pressure distribution in the section between two of the guide vanes in the elbow was determined by means of piezometers. Pitot tube traverses were made to determine the velocity distribution and angle of flow at the discharge end of the guide vane section. Pressure readings were taken at various locations in the rotovalve plug and body. Pressure readings were also taken when the plug was located at several angles of valve opening. A number of changes were made to the valve plug to obtain the best pressure condition. The model was tested under field head conditions.

(h) Tests were completed in May 1947.

(i) A report was prepared, giving details of tests and decisions for best design. The studies were enlarged to include mechanical vibration and pressure fluctuations caused by cavitation. A piezo-electric inertia-type pickup was used for the former, and a wheatstone bridge-type pressure pickup for the latter. Following suitable electronic amplification, traces were exhibited on the screen of a 5-inch cathode ray oscillograph. Photographs of the trace for various operating

conditions are included in the report, with tabulations of amplitudes and frequencies. The frequencies were related to the calculated natural resonant frequencies of the model.

(487) CENTRIFUGAL PUMP FOR DREDGE - EFFICIENCY AND HORSEPOWER TESTS ON MODEL.

(b) Arundel Corporation, Baltimore, Md.

(c) R. Sahle, J. Thorell, and laboratory personnel.

(e) Experimental research.

(f) To determine the discharge, efficiency, and cavitation limits of three designs of model impellers.

(g) The complete pump model was installed in a closed system pump stand. The pump has no guide vanes in the spiral discharge casing or suction bell intake. This type of pump is especially designed for pumping water-bearing gravel, sand, and silt. Tests indicated the best impeller design.

(h) Tests were completed in April 1947.

STEVENS INSTITUTE OF TECHNOLOGY, Experimental Towing Tank, Hoboken, N. J.

(488) SCALE EFFECT OF THE MAIN SPRAY OF FLYING BOAT HULLS (Project CB-882).

(b) Bureau of Aeronautics, U. S. Navy Dept. (c) W. C. Hugli, Jr., W. C. Axt.

(d) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

(e) Experimental investigation for design information.

(f) To determine whether or not the main spray characteristics of flying boats were subject to a scale effect.

(g) Three models of one design were tested, the smallest model being a 1/4-scale model of the largest. The intermediate model is a 1/2-scale model of the largest hull.

(h) Completed.

(i) This work is reported in Technical Note No. 59, Experimental Towing Tank. Restricted project.

(489) REDUCTION OF FLYING BOAT LANDING RUNS (Project 794).

(b) Bureau of Aeronautics, U. S. Navy Dept. (c) W. C. Hugli, Jr., W. C. Axt.

(d) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

(e) Experimental investigation.

(f) To determine the effectiveness of various braking devices in reducing the landing run of flying boats.

(g) A number of braking devices, including side steps, flaps, and water scoops, have been tested with varying results.

(h) Completed.

(i) Experimental Towing Tank Technical Note No. 66 contains the results of this project. Restricted project.

(490) INTERNATIONAL FLYING BOAT COMPARISON (Project 752).

(b) Bureau of Aeronautics, U. S. Navy Dept.

(c) W. C. Hugli, Jr., Albert Strumpf.

(d) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

(e) Experimental project for design and general information.

(f) To determine the various hydrodynamic characteristics of the best German, British, and American flying boat designs in order that they may be compared.

(g) The tests were conducted with models of the American Martin JRM-1, the British Short Shetland, and the German BV-222 flying boats.

(h) Completed.

(i) Experimental Towing Tank Report No. 327 covers the results of this project. Restricted project.

(491) IMPACT STUDIES ON HIGH SPEED MOTOR BOATS (Project 961).

(b) Sparkman and Stephens, New York, N. Y. (c) R. R. Williamson.

(d) R. R. Williamson, Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

(e) Experimental investigation for design purposes.

(f) To determine the magnitude of impact loads on the structure of high speed motor boats travelling in rough water.

(g) Two motor boat hulls with two different dead rise angles were tested for comparison, and the accelerations of the hulls measured while pitching in a head sea.

(h) Completed.

(492) INVESTIGATION OF THE EFFECT OF HULL PROPORTIONS AND STEP DEPTH ON THE HYDRODYNAMIC CHARACTERISTICS OF FLYING BOAT HULL MODELS WITH VARYING LENGTH BEAM RATIO (Project 821).

(b) National Advisory Committee for Aeronautics.

(c) W. C. Hugli, Jr., W. C. Axt, Albert Strumpf.

(d) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

(e) Experimental investigation for design information.

(f) To determine the effect of hull proportion and step depth on the hydrodynamic characteristics of flying boat hull models with varying length beam ratios.

(g) A series of flying boat hull models with length beam ratios varying from 6 to 10, 3 step depths and 3 forebody, afterbody length ratios were tested, using as a parent model a lengthened forebody version of the PB2Y-4. Twenty-one models in all were built and tested for overall hydrodynamic characteristics, including spray, resistance, and longitudinal stability.

(h) Completed.

(i) Experimental Towing Tank Report No. 312 covers the results of this project.

(493) LONG AFTERBODY STUDIES OF A FLYING BOAT HULL (Project CB-869).

(b) Bureau of Aeronautics, U. S. Navy Dept. (c) W. C. Hugli, Jr., W. C. Axt.

(d) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

(e) Design.

(f) To determine whether lengthening the afterbody of a small flying boat would impair the spray and resistance characteristics.

(g) Four variations of stern post angle were investigated to establish optimum spray conditions. Spray and resistanoe were made in the displacement speed range.

(h) Completed.

(i) Experimental Towing Tank Technical Report No. 331 covers the work conducted under this project. Restricted project.

(494) STANDARD SERIES OF FLYING BOAT HULLS (Project CD-1012).

(b) Bureau of Aeronautics, U. S. Navy Dept. (c) W. C. Hugli, Jr., W. C. Axt.

(d) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

(e) An experimental study for design and general information.

(f) To determine the effect on overall performance of flying boat hulls of changes in dead rise angle, afterbody angle and length beam ratio, singly and in combination.

(g) A series of 38 models derived from a single parent have been tested at varying loads, speeds, and trims.

(h) Completed.

(i) Experimental Towing Tank Report No. 325 covers the work done on this project. Restricted project.

UNIVERSITY OF WASHINGTON, Department of Civil Engineering, Seattle, Wash.

(495) FLOW IN PIPES.

(b) Laboratory project. (c) C. W. Harris, Cameron Smith.

(d) Prof. C. W. Harris, Hydraulics Laboratory, Dept. of Civil Engineering, University of Washington, Seattle, Wash.

(e) Experimental study to obtain general information.

(f) To establish a means, conforming to modern concepts of flow, of identifying pipe surfaces in relation to their resistance to passage of water, and to introduce a practical method for applying a specific roughness coefficient, once found, to any size of pipe.

(g) Surfaces of random roughness were produced artificially by spraying sheet metal liners with stainless steel. Liners were then rolled to proper diameter and inserted in standard pipe. Pipe tests were run in the usual manner, covering an exceptionally wide range of velocities. Pipe diameters varied from 1/4 inch to 4 inches, including many intermediate sizes.

(h) Completed. Other aspects of this project are reported under Current Project No. 361, "Flow in Pipes and Channels", page 60.

(i) The results of this project were presented as a technical paper before the American Society of Civil Engineers in the summer of 1947 by Prof. C. W. Harris.

THE UNIVERSITY OF WISCONSIN, Hydraulic Laboratory, Madison, Wis.

Inquiries concerning Projects Nos. 147, 148, and 496 should be addressed to Dr. Arno T. Lenz, Hydraulic Laboratory, The University of Wisconsin, Madison 6, Wis.

(147) RAINFALL-RUNOFF RELATION, BIG EAU PLEINE RIVER.

(h) Project completed. M.S. thesis by C. C. Warnick available for loan.

University of Wisconsin
Worcester Polytechnic Institute
Corps of Engineers, Los Angeles District

(148) MODEL STUDY OF PROPOSED ENTRANCE STRUCTURES FOR GARY SLIP.

(h) Project completed. Report available for loan.

(496) SPILLWAY GATE OPERATION TO PREVENT EROSION BELOW DAMS.

(b) Laboratory project. (c) A. T. Lenz.

(e) Experimental study of models of spillways with crest gates.

(f) To determine gate operating procedure which would produce minimum velocities and scour downstream from the spillway.

(g) A paper on this subject appeared in the Proceedings of the Midwest Power Conference held at Chicago, April 3-5, 1946. This paper reports results of tests on four different model dams of scales varying from 1:30 to 1:50, with both fixed and movable beds, with and without baffle blocks, and with a varying number of gates and various openings of those gates.

(h) Project completed.

(i) Engineering Experiment Station Reprint No. 131 of this paper is available for distribution.

WORCESTER POLYTECHNIC INSTITUTE, Alden Hydraulic Laboratory, Worcester, Mass.

(370) SPILLWAY TEST OF CHITTENDEN DAM.

(b) Project conducted for Jackson & Moreland, Engineers.

(c) Laboratory staff.

(d) L. J. Hooper, Asst. Director, Alden Hydraulic Laboratory, Worcester Polytechnic Institute, Worcester, Mass.

(e) Test of the stilling pool below the dam.

(f) To determine an economical form of stilling pool below the Chittenden spillway.

(g) A 1:15 model of the spillway was installed in the 3-foot glass-sided flume with a movable gravel bed representing the spillway channel. Tests were also made to show the type of protection necessary at the side of the pool.

(h) Test work completed and report submitted.

DEPT. OF THE ARMY, CORPS OF ENGINEERS, Los Angeles District Hydraulic Laboratory, Los Angeles, Calif.

(187) HYDRAULIC MODEL STUDY, LOS ANGELES RIVER CHANNEL IMPROVEMENT, STEWART AND GRAY ROAD TO PACIFIC ELECTRIC RAILWAY.

(b) Dept. of the Army, Corps of Engineers, Los Angeles District.

(c) Hydraulic Design Unit, A. P. Gildea, Chief. (e) Design.

(d) The District Engineer, Los Angeles District, Corps of Engineers, 751 South Figueroa St., Los Angeles 14, Calif.

(f) To determine confluence losses and water surfaces for various types of bridge construction (clear span, multiple span, size and shape of piers).

(g) A 1:50-scale model of the entire channel improvement under consideration has been constructed and measurements made to determine water-surface profiles at the confluence with Rio Hondo and at the various bridges.

(h) Tests have been completed.

(i) Loan copy of report may be obtained from Waterways Experiment Station, Vicksburg, Miss.

DEPT. OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station, Vicksburg, Miss.

Inquiries concerning Projects Nos. 199, 200, 202, 203, 207, 208, 209, 212, 215, 220, 231, 238, 244, 254, 258, and 259 should be addressed to The Director, Waterways Experiment Station, P. O. Box 631, Vicksburg, Miss.

(199) MODEL STUDY OF STILLING BASIN, BLUESTONE DAM, NEW RIVER, WEST VIRGINIA.

(b) The District Engineer, Huntington District, Corps of Engineers, Huntington, W. Va.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of stilling basin.

(f) To determine the location of cavitation pockets around the baffle piers, and to develop moderate revisions in the present stilling basin design in an attempt to reduce cavitation action. (See Project No. 203, "Model Evaluation of Cavitation Action, Claytor Dam, New River, Virginia", page 156.)

(g) Bluestone Dam, on New River near Hinton, W. Va., will be a flood-control and hydroelectric power dam. Flow will be regulated by 16 sluices through the spillway; 21 vertical-lift gates surmounting the spillway will control extreme floods. The spillway is designed to pass 430,000 cfs under a head of 30 feet. A secondary or stilling weir will be placed 364 feet downstream from the axis of the dam to provide sufficient tailwater in the stilling basin for formation of a hydraulic jump. The basin will contain a 44-foot horizontal apron, two rows of baffle piers, and an end sill. The 1:36-scale section model reproduced a portion of the spillway chute, the stilling basin, and the secondary weir.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-243, "A laboratory development of cavitation-free baffle piers, Bluestone Dam, New River, West Virginia", available on loan.

(200) MODEL STUDIES OF CONDUITS AND STILLING BASIN, BULL SHOALS DAM, WHITE RIVER, ARKANSAS.

(b) The District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of conduits and stilling basin.

(f) To study (1) cavitation tendencies at the gate slots of the flood-control conduits; (2) dispersion of conduit flow as affected by alterations to the exit portal and stilling basin; and (3) dissipation of spillway discharges.

(g) Bull Shoals Dam (one of the principal units in the comprehensive plan for flood control in the White River Basin) will be a 2349-foot concrete-gravity structure with an overflow spillway section located on the right side of the valley and a nonoverflow section on the left side, which will contain intakes and penstocks for supplying water to the power generating units. The spillway will have 17 radial crest gates, 40 feet long and 28 feet high, and is designed to pass a discharge of 556,000 cfs. Sixteen gate-controlled conduits are provided through the base of the dam in the spillway section. Two models were used originally for the study: (1) a 1:6-scale model reproducing the gate slots and a portion of the conduit cross-section; and (2) a 1:25-scale model reproducing three of the conduits and a 288-foot wide section of the stilling basin. In order to determine the adequacy of the stilling basin developed on the sluice model for spillway flow, an additional 1:60-scale section model was constructed reproducing 180 feet of the spillway.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-234, "Model studies of conduits and stilling basin, Bull Shoals Dam, White River, Arkansas", available on loan.

(202) MODEL STUDY OF STILLING BASIN, CLARK HILL DAM, SAVANNAH RIVER, SOUTH CAROLINA AND GEORGIA.

(b) The Division Engineer, South Atlantic Division, Corps of Engineers, Atlanta, Ga.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of stilling basin.

(f) To examine the hydraulic performance of the bucket as originally designed. In this connection data were desired as to the effect of varying the tailwater from the theoretical depth required for a hydraulic jump over a horizontal apron to a depth 20 percent in excess of the theoretical jump depth.

(g) Clark Hill Dam will be a combined earth and concrete structure with a top elevation of 351 feet and a length of about 5,660 feet. An ogee-type spillway near the center portion of the concrete dam has a gross length of 1096 feet and is designed to pass a maximum flow of 1,058,000 cfs under a head of 46 feet. Flow over the spillway will be controlled by 23 tainter gates, each 40 feet wide and 35 feet high. The energy dissipator at the toe of the spillway will be of the bucket type with a radius of 50 feet and a lip height of 14.6 feet. Provisions also are being made for the release of flow through sluices located in the spillway section and for generation of hydraulic power. The 50-foot radius bucket of the Clark Hill Dam spillway was installed at the toe of the existing models of Stewarts Ferry Dam and Conemaugh Dam. This permitted comparison of results obtained from a 1:100-scale section model and from a 1:35-scale section model. No alterations were made to the existing crest shape and gates of the section models. The total discharge over the spillway and through the bucket was proportioned to scale in both models, and simulated the discharge per foot of width that would exist for the Clark Hill Dam conditions.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-229, "Model study of bucket-type energy dissipator, Clark Hill Dam, Savannah River, South Carolina and Georgia", available on loan.

(203) MODEL EVALUATION OF CAVITATION ACTION, CLAYTOR DAM, NEW RIVER, VIRGINIA.

(b) The District Engineer, Huntington District, Corps of Engineers, Huntington, W. Va.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of baffle piers of Bluestone Dam. (See Project No. 199, "Model Study of Stilling Basin, Bluestone Dam, New River, West Virginia", page 155.)

(f) To evaluate the pressure variations on the baffle piers of the Claytor Dam; the results of these tests are used as a basis for evaluating the possibility of dangerous erosion by cavitation of the Bluestone Dam baffle piers.

(g) Claytor Hydroelectric Project is located on New River near Allisonia, Va. In addition to the regulation of flow for power development, flow is passed through two outlets located in the spillway and controlled by 5-foot gate valves. Nine spillway gates are used to control extreme floods. Maximum flow over the spillway occurred during the flood of August 13-16, 1940, when a discharge of 200,000 cfs was passed over a head of 28.5 feet. The stilling arrangement below the spillway consists of a short apron with a row of baffle piers and an end sill. The 1:36-scale section model reproduced 5 central bays of the spillway and stilling basin.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-243, "A laboratory development of cavitation-free baffle piers, Bluestone Dam, New River, West Virginia", available on loan.

(207) MODEL STUDY OF SLUICES, FALL RIVER DAM, FALL RIVER, KANSAS.

(b) The District Engineer, Tulsa District, Corps of Engineers, Tulsa, Okla.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of sluices.

(f) To determine the adequacy of the present sluice design; to determine whether artificial means of spreading the flow as it emerges from the sluices is necessary; and to develop the most suitable design for the sluices.

(g) The dam consists of an earth-fill embankment spanning the valley with a concrete spillway structure in the river channel near the right abutment. The spillway is of the gravity, ogee-weir type with eight 50-foot by 25-foot high tainter crest gates. Normal flow regulation is afforded by seven 5-foot by 8-foot 6-inch sluices through the spillway weir, one along the center line of each of the spillway piers. A 1:20-scale sluice model reproduced a portion of the pool area, three sluices, a 256-foot wide section of the stilling basin, and 200 feet of the exit channel.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-230, "Model study of sluices for Fall River Dam, Fall River, Kansas", available on loan.

(208) MODEL STUDY OF SPILLWAY, ENID DAM, YOCONO RIVER, MISSISSIPPI.

(b) The District Engineer, Vicksburg District, Corps of Engineers, Vicksburg, Miss.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To examine the hydraulic performance of the proposed spillway structure with special reference to the capacity, hydraulic safety, and effect of the sloping side walls on the hydraulic performance of the stilling basin.

(g) Enid Reservoir, one of several flood-control works planned to furnish flood protection to the Yazoo River Basin above the head of the Mississippi River backwater area, will be located approximately 3 miles north of Enid, Miss. The dam will be an earth-fill structure with an uncontrolled chute-type spillway having a crest length of 200 feet, and designed to pass a flow of 49,700 cfs under a head of 16 feet. An unusual feature of the original design of the spillway was the flat slope of the side walls extending the full length of the spillway, which was proposed in order to reduce the quantity of reinforcing steel in the walls to a minimum. Flow regulation was to be afforded by conduits under the spillway section. The 1:30-scale model reproduced about 450 feet of approach channel, the spillway, the intake tower and conduits (schematically), and about 450 feet of exit channel.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-223, "Model study of spillway, Enid Dam, Yocona River, Mississippi", available on loan.

(209) MODEL STUDY OF SLUICES, FORT GIBSON DAM, GRAND (NEOSHO) RIVER, OKLAHOMA.

(b) The District Engineer, Tulsa District, Corps of Engineers, Tulsa, Okla.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of sluices.

(f) To determine the adequacy of the proposed sluice designs.

(g) Fort Gibson Reservoir will be used for the dual purpose of flood control and development of hydroelectric power. The dam will be a concrete-gravity type structure with an overall length of approximately 2850 feet. A 1490-foot concrete ogee-type spillway located within the dam section is designed to pass 919,000 cfs at a head of approximately 35 feet. The spillway discharge will be controlled by thirty 40-foot tainter gates surmounting the spillway crest. Normal flow regulation is afforded by ten 5-foot 8-inch by 7-foot sluices through

the spillway proper. A 1:20-scale model reproduced a portion of the pool area, five sluices, a 256-foot wide section of the stilling basin, and 200 feet of the exit channel.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-228, "Supplementary model study of stilling basin for spillway and sluices, Fort Gibson Dam, Grand River, Oklahoma", available on loan.

(212) MODEL STUDY OF HARLAN COUNTY DAM, REPUBLICAN RIVER, NEBRASKA.

(b) The District Engineer, Kansas City District, Corps of Engineers, Kansas City, Mo.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To study possible erosive currents along the left training wall, and eddy action along the toe of the dam.

(g) The dam consists of a rolled-fill embankment section and a gravity-type concrete overflow structure including the gate-controlled spillway, the flood-control outlet works, irrigation outlets, bulkhead section to effect connections with the earth embankment, and provision for future power installation. The spillway, 876 feet in width, is controlled by 18 crest gates, each 30 feet high by 40 feet wide. The spillway structure includes 10 sluices, each 5 feet wide and 8 feet high. The 1:80-scale model reproduced about 2,000 feet of approach channel, the spillway, the sluices, the stilling basin, and about 4,400 feet of the exit channel.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-236, "Model study of spillway and stilling basin, Harlan County Dam, Republican River, Nebraska", available on loan.

(215) MODEL STUDY OF SPILLWAY, STEWARTS FERRY DAM, STONES RIVER, TENNESSEE.

(b) The District Engineer, Nashville District, Corps of Engineers, Nashville, Tenn.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of spillway and stilling basin.

(f) To analyze the hydraulic characteristics of the spillway and the stilling basin and to develop means of correcting any uneconomic, unsafe, or otherwise undesirable conditions which may exist in the proposed design.

(g) The dam is a composite-type structure consisting of rolled-fill earth embankment sections and of a gravity-type concrete section containing the spillway and powerhouse intakes. The 328-foot spillway containing 7 crest gates (each 26 feet high and 40 feet wide) is designed to pass a maximum discharge of 199,000 cfs under a head of 32.5 feet. Low flows will be regulated by 5 sluices (each 10 feet high and 5 feet 8 inches wide) through the spillway section. A bucket-type stilling basin will dissipate the energy contained in the spillway flow. A 1:80-scale model reproduced about 1400 feet of approach channel, the spillway, the sluices, the bucket-type energy dissipator, a portion of the earth dam, and about 2200 feet of exit channel.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-239, "Model study of spillway and bucket, Stewarts Ferry Dam, Stones River, Tennessee", available on loan.

(220) MODEL STUDY OF SUCTION HEAD, DREDGE JADWIN.

(b) The District Engineer, Memphis District, Corps of Engineers, Memphis, Tenn.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of dredge suction heads.

(f) To investigate the performance of a newly-designed suction head, and to obtain data and information on the operation of both original and new-type heads constructive toward achieving a design of maximum efficiency.

(g) During the course of major field repairs and alterations, conversion of the suction line on the dredge JADWIN provided opportunity for the Memphis District Office to consider changes in the design of the suction head which would effect greater yardage output. A 16-foot by 10-foot by 4-foot flume with a sand bed spanned by a movable carriage supporting a suction head and pumps was used for these tests. The suction head was constructed to the scale ratio of 1:10 and was made of sheet metal and transparent pyralin. The suction pump discharged into a sump where the dredged material was trapped and subsequently measured. Water from the sump flowed back into the model over a 90-degree V-notch weir. Measurement of the dredged material, together with observation of pump discharge as measured over the weir, enabled a check on the percent solids being dredged. Manometers were used to measure suction vacuum and jet pressure. Action of the dredge was simulated by controlling the discharge through an orifice in the discharge line.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-232, "Model study of suction head, Dredge Jadwin", available on loan.

(231) MODEL STUDY OF NAVIGATION IMPROVEMENTS, GALOP RAPIDS SECTION, ST. LAWRENCE RIVER, NEW YORK.

(b) The District Engineer, New York District, Corps of Engineers, New York, N. Y.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for navigation improvements.

(f) To determine the suitability of two alternate plans for obtaining a deep-water channel through Galop Rapids, with particular reference to the provisions of satisfactory velocities and alignments and freedom from navigation hazards; to develop improvements in the proposed plans where necessary; and to determine the optimum order of construction of the plans and the proper location of spoil areas.

(g) The Galop Rapids Section of the International Rapids forms the control for water-surface elevations in Lake Ontario. Several alternate plans have been developed for the navigation project in this reach, some involving a dredged navigation channel through Galop Island, others involving a dredged navigation channel past Galop Island combined with a regulation channel through the island. A specified maximum velocity must not be exceeded in the navigation channel provided by the adopted plan; and Lake Ontario stages must not vary outside a certain range during construction nor after completion of the project. A fixed-bed model with scale ratios of 1:400 horizontally and 1:80 vertically was used for the study. The limits of the model extended from Ogdensburg, N. Y. (mile 65 below Lake Ontario) to the vicinity of Sparrowhawk Point (mile 74.5 below Lake Ontario). The problem area was molded in removable blocks to facilitate changing from one plan to another.

(h) Study completed.

(238) MODEL STUDY OF FLOOD-CONTROL PLANS BELOW THE LATITUDE OF MORGAN CITY, LOUISIANA.

(b) The President, Mississippi River Commission, Vicksburg, Miss.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design of flood-control project.

(f) To determine the most effective plan for flood protection in the latitude of Morgan City, La.

(g) The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:2000; vertical dimensions, 1:100. Reproduced in the model are the main channel of the Mississippi River from Helena, Ark., (300 miles below Cairo, Ill.) to Donaldsonville, La., (900 miles below Cairo, Ill.), the entire Atchafalaya Basin

as far south as the Gulf of Mexico; and the backwater areas of the Arkansas, White, Yazoo, Ouachita, and Red Rivers. This model was the same as that used in Project No. 237, "Mississippi River Flood-Control Model", page 108.

(h) Study completed.

(i) Final repirt, "Memorandum report on model study of approved plan for flood control below Morgan City, Louisiana", available on loan.

(244) MODEL STUDY FOR ELIMINATION OF SHOALING, DEEPWATER POINT RANGE, DELAWARE RIVER, PENNSYLVANIA.

(b) The District Engineer, Philadelphia District, Corps of Engineers, Philadelphia, Pa.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for navigation improvement.

(f) To investigate proposed plans for reducing shoaling in Deepwater Point Range.

(g) The project provides for a channel about 96 miles long and of various specified dimensions extending from Philadelphia to deep water in Delaware Bay. Included in the project are construction of dikes and training walls for regulation and control of tidal flow, and dredging to provide adequate anchorages at several points. Deepwater Point Range is located between Deepwater Point and Killcohook disposal area; the channel in this range shoaled at an average annual rate of nearly 2,800,000 cubic yards. The model was of the fixed-bed silt-injection type with scale ratios: horizontal dimensions, 1:800; vertical dimensions, 1:80. Reproduced in the model were the Delaware River from Artificial Island to a point 1 mile above Bellevue, the tidal portion of the Christina River and Brandywine Creek, and about 3 miles of the Chesapeake and Delaware Canal. Tides and currents were simulated in the model by automatic tide gates.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-231, "Model study of plans for elimination of shoaling in Deepwater Point Range, Delaware River", available on loan.

(254) MODEL STUDY OF POLLUTION, ST. JOHNS RIVER, FLORIDA.

(b) The City of Jacksonville, Fla.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for information.

(f) To devise a system of training walls which would prevent pollution by raw sewage along the west bank of the St. Johns River between the mouth of Ortega River and Winter Point.

(g) The study was conducted on the St. Johns River model previously used for a study of navigation improvement of St. Johns River. (See Project No. 253, "Model Study for Channel Improvement, St. Johns River, Florida", page 112.) The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1:1000; vertical dimensions, 1:100, and included the St. Johns River from Welaka, Fla., to the Atlantic Ocean, as well as approximately 6 miles of the Intracoastal Waterway to the north and south of the St. Johns River. The model was equipped with automatic tide controls in order to reproduce the observed prototype tides in the St. Johns River and in the north and south sections of the Intracoastal Waterway. Salt water of the correct density was introduced into the ocean water supply system, and fresh water was introduced at the upper end of the model.

(h) Study completed.

(i) Final report, "Model study of plans for prevention of pollution in the St. Johns River at Jacksonville, Florida", available on loan.

(258) MODEL STUDY OF WAVE AND SURGE ACTION, NAVAL OPERATING BASE, TERMINAL ISLAND, SAN PEDRO, CALIFORNIA.

(b) The Chief, Bureau of Yards and Docks, U. S. Navy Dept., Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To determine the best plan for protecting the Navy piers and drydocks at the Naval Operating Base, Terminal Island, San Pedro, Calif., from the effects of wave and surge action.

(g) The above-mentioned Navy piers and drydocks are located along an east-west marginal wall on the southern shore line of Terminal Island. Terminal Island is located about half way between the cities of San Pedro and Long Beach, Calif. Terminal Island and most of San Pedro Bay is protected, to a certain extent, by an outer breakwater system about 6.5 miles in length. However, at times this outer breakwater system allows a sufficient amount of wave energy to reach the pier area to cause troublesome conditions for moored ships. The improvement plan consisted of the construction of a mole which would surround the Navy piers and drydocks. This plan was devised to provide protection to the existing facilities and to provide an enlarged operating base. This model is the same as that used in Project No. 242, "Model Study of Wave and Surge Action, Anaheim Bay, California", page 108. The model was of the fixed-bed type with linear scale ratios of 1:300 horizontal, and 1:60 vertical. The model reproduced all of the coast line from Point Fermin to Anaheim Bay, Calif., the Los Angeles River and outer harbors, Long Beach River and outer harbors, all of San Pedro Bay, the San Pedro breakwater, the detached breakwater, and a large area of the Pacific Ocean south of the detached breakwater. The model was equipped with adjustable wave machines for reproducing to scale the prototype wave characteristics. Wave heights were measured and recorded by electrical devices.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-237, "Model study of wave and surge action, Naval Operating Base, Terminal Island, San Pedro, California", available on loan.

(259) MODEL STUDY OF BREAKWATER LOCATION, U. S. NAVAL AIR STATION, ALAMEDA, CALIFORNIA.

(b) The Chief, Bureau of Yards and Docks, U. S. Navy Dept., Washington, D. C.

(c) Personnel of the Waterways Experiment Station.

(e) Experimental, for design.

(f) To determine the best plan for reducing wave action at the carrier pier and in the seaplane lagoon, and for reducing shoaling in the dredged turning basin at the Naval Air Station, Alameda, Calif.

(g) The U. S. Naval Air Station, Alameda, Calif., has facilities for both land- and sea-type aircraft and naval ships of various types. These installations are located west of Alameda, Calif., along a section of exposed shore line of San Francisco Bay. The location of the Naval Air Station is such that the docking facilities are exposed to local storm waves, and the dredged turning basin is shoaled considerably by the deposition of silt transported in suspension by the ebb-tide currents from mud flats southeast of the turning basin. The proposed plans of improvement consisted of several breakwater plans so located as to follow the general alignment of the south line of the turning basin and entrance channel. The model was of the fixed-bed type with linear scale ratios of 1:200, horizontal and vertical. The model reproduced the shore line adjacent to the prototype, the seaplane lagoon, the carrier pier, the entrance channel and turning basin, and a part of the adjoining area of San Francisco Bay. The model was equipped with adjustable wave machines for reproducing the prototype wave characteristics. A circulating system attached to the model reproduced prototype ebb-tide currents. Gilsonite was used for silt material, and this material was introduced into the model through a system which consisted of a mixing tank, pipe lines, and perforated troughs. Wave heights were measured and recorded by electrical devices. The depths of model silt deposits were measured by sounding and the volumes of silt determined by graphical methods.

(h) Study completed.

(i) Final report, Tech. Memo. No. 2-242, "Breakwater location, U. S. Naval Air Station, Alameda, California -- Model investigation", available on loan.

U. S. DEPT. OF THE INTERIOR, BUREAU OF RECLAMATION, Denver, Colorado.

Inquiries concerning Projects Nos. 497 to 512, incl., should be addressed to The Chief Engineer, Bureau of Reclamation, Denver, Colo.

(497) GRAND COULEE POWERPLANT TURBINE.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Specific design investigation.

(f) To determine the most favorable design of features of turbine setting.

(g) The more important features of the turbine setting, such as draft-tubes and penstock conditions near the entrance to the scrollcase, were studied by means of a complete homologous model turbine built to a scale of 1:24. Three draft-tube designs selected by pilot tests in a smaller model were tested extensively. Several other features of turbine design, including scrollcase, speed ring, and fairwater cone, were also studied to determine the relative effect of certain design modifications on turbine efficiency.

(h) Testing has been completed and the report published.

(498) SHASTA (CONCRETE GRAVITY) DAM OUTLET CONTROL GATE.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To develop a high-pressure penstock in-the-line control gate.

(g) Beginning with a study of a 1:17 model of the conventional tube valve, practical control characteristics were attained in a totally new development utilizing a circular sharp-edged orifice and a slide leaf. The resulting gate has been adopted for several high-head penstock control installations.

(h) Testing has been completed and the report published.

(499) COACHELLA PIPELINE DISTRIBUTION SYSTEM.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the applicability of the orifice as a measurement device for the Coachella Distribution System.

(g) The study consisted of evaluating the head losses across various orifices for the applicable range of discharges, and determining the approximate differential gage readings for maximum and minimum flows. In addition, a 3-inch orifice was placed in a 6-inch pipe and tested with and without a deposit of sediment against the upstream orifice face.

(h) Testing has been completed and the report published.

(500) COACHELLA PROTECTIVE WORKS.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the adequacy of the Coachella Flood Protective Works - All American Canal.

(g) A distorted scale model (1:1200 for length, 1:750 for width, and 1:20 for depth) was tested to determine whether there was a tendency of the flood to overtop the dike during dispersal in the basin, and to determine the magnitude of the maximum velocities in the constricted sections.

(h) Initial investigations completed and interim report prepared.

(501) KORTES (CONCRETE GRAVITY) DAM SPILLWAY.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To check the design of the Kortes Dam Spillway, including an uncontrolled, circular, overflow crest spilling into a 30-foot diameter tunnel; to determine adequacy of river channel.

(g) A 1:60 model was used to study the approach conditions to the crest, closed chute flow conditions, tunnel flow, and flood flow conditions beyond the portal of the tunnel.

(h) Studies completed and report prepared.

(502) ROSS (CONCRETE ARCH) DAM SPILLWAY AND HOWELL-BUNGER VALVE HOODS.

(b) Seattle Light and Power Company. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To develop spillway and valve hoods for the Howell-Bunger valve for Ross Dam, City of Seattle, Wash.; to propose an ice-prevention system for Ross Dam.

(g) The following models were used in the hydraulic studies: A 1:30 model of spillway and deflector with one full gate on which spillway face and deflector pressures were measured; a second model to 1:80 scale of entire dam and spillways; a 1:12 model of Howell-Bunger valve and hood. The spillway was designed to discharge under a slight negative pressure, and valve hood was developed to control valve jet with no negative pressure areas.

(503) BHAKRA (CONCRETE GRAVITY) DAM SPILLWAY AND OUTLET WORKS AND APPURTENANCES.

(b) Province of Punjab, India. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the adequacy of drum-gate spillway section, including stilling basin and river outlets through the dam; the tunnel spillway with the left diversion tunnel and deflector at portal; tunnel outlet works in the right diversion tunnel.

(g) A total of six models was used. The composite model of the complete structure was on a scale of 1:80. Other models included a 1:17 river outlet; one 1:32 model of the downstream section of the tunnel outlet works, starting with the valves and extending to the tunnel portal; a 1:100 model of tunnel intake. In addition, an electric analogy model study of the tunnel spillway crest on a scale of 1:80 and a fluid polariscope model of drum-gate spillway section on a scale of 1:480.

(h) Studies completed and report finished.

(504) UNITY (EARTH-FILL) DAM SPILLWAY.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the adequacy of the spillway capacity.

(g) A 1:36 model was used to perform hydraulic laboratory studies to determine the capacity of the spillway and its safety. Stilling pool scour tests and crest and gate coefficients were taken.

(h) Studies completed and report published.

(505) GALINDO CREEK SIDE CHANNEL WASTEWAY, CONTRA COSTA CANAL.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the adequacy of the capacity of the spillway.

(g) A 1:6 model of the wasteway was tested.

(h) Studies completed and the report published.

(506) DEER CREEK DAM SPILLWAY AND OUTLET WORKS.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Design, experimental, operational.

(f) To determine the adequacy of the design of the spillway and outlet works.

(g) A 1:48 model of the spillway was constructed, including all pertinent features. A 1:20 model of the outlet works was tested. Special features studied were gate coefficients, chute flow, and stilling basin operation.

(h) Studies completed and report published.

(i) The report includes some comparative prototype data for the outlet works which uses tube valves.

(507) CONSTANT-HEAD ORIFICE CANAL TURNOUT.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To calibrate a constant-head orifice turnout.

(g) 1:2 models of various alternate designs of the constant-head orifice turnout were tested in the laboratory. The device employs two slide gates, the loss in head through one being measured as a function of the flow. The turnout is used extensively in canal diversions.

(h) Testing completed and report published.

(508) ANDERSON RANCH (ROCK EARTH-FILL) DAM SPILLWAY AND OUTLET WORKS.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the hydraulic characteristics of the spillway, stilling pool, and outlet works.

(g) Two models were used in the study, one a composite structure of both the spillway and outlet works on a 1:48 scale, and the other a model of the outlet works only on a 1:24 scale. The outlets and spillway utilize the same pool.

(h) Studies completed and report published.

(509) CAPILLANO (CONCRETE GRAVITY) DAM SPILLWAY.

(b) Vancouver, British Columbia. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the hydraulic characteristics of spillway, chute, and stilling basin, and the river outlets.

(g) A 1:60 hydraulic model was used. The approach conditions to the crest were investigated. Coefficient curves were determined for the crest. The aeration of nappe from drum gates was investigated for various positions. Stilling basin tests were conducted with and without the effect of river outlet discharge.

(h) Studies have been completed and report prepared.

(510) BOCA (EARTH EMBANKMENT) DAM SPILLWAY.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To insure proper entrance conditions to the gate section, proper flow conditions through the gates and down the chute, and adequate energy dissipation in the stilling basin.

(g) A 1:48 hydraulic model was used in the investigation.

(h) The investigation has been completed and the report prepared.

(511) GRASSY LAKE (EARTH- AND ROCK-FILL) DAM SPILLWAY AND OUTLET WORKS.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the hydraulic characteristics of the outlet works and spillway and insure adequate hydraulic design.

(g) A 1:12 model of the pertinent features of the riprapped pool of the outlet works. Model needle valve was used. A 1:20 model was used in the spillway investigations.

(h) Investigations have been completed and report prepared.

(512) GREEN MOUNTAIN (EARTH-FILL) DAM SPILLWAY AND TUBE VALVES.

(b) Bureau of Reclamation. (c) Hydraulic laboratory.

(e) Experimental, for design.

(f) To determine the hydraulic characteristics of the designed spillway and outlet tube valves to insure adequate design.

(g) A 1:40 model was used to determine the efficiency of the spillway crest and bridge piers, to obtain the most economical and effective design of the spillway chute, and to determine the extent of downstream erosion and possibility of employing some type of spillway stilling basin to prevent scour. A 1:8.33-scale model tube valve was used to procure data for the preparation of a head-discharge curve for the prototype valves.

(h) The investigations have been completed and report published.

QUEEN'S UNIVERSITY, Kingston, Ontario, Canada.

(513) THE UPWARD FLOW OF WATER THROUGH UNI-GRANULAR SAND.

(b) Laboratory project. (c) D. L. Seymour, J. D. Lee.

(d) Prof. J. D. Lee, Queen's University, Kingston, Ontario, Canada.

(e) Thesis study for M. S. degree.

(h) Completed. Thesis filed in University library.

UNIVERSITY OF TORONTO, Toronto, Canada.

Inquiries concerning Projects Nos. 514 and 515 should be addressed to G. Ross Lord, Associate Professor of Mechanical Engineering, University of Toronto, Toronto 5, Canada.

(514) THE VENTURI FLUME.

(b) Master's thesis. (c) V. Kalyanaraman.

(e) Experimental.

(f) To investigate the performance of the Venturi flume.

(g) The flume was set up in a steel channel having glass sides. The width of the channel was 18 inches. The width of the throat of the Venturi flume was varied. The case of free discharge was also investigated and flow with "drowned" discharge.

(h) Completed.

(i) The results indicated (1) in the region of free discharge, the Venturi flume will give accurate results; (2) the coefficient is a linear function of the Boussinesq number under free discharge conditions; and (3) the discharge coefficient increases in value as the throat width is increased under free discharge conditions.

(515) EFFECT OF CREST ON THE BEHAVIOR OF A SIPHON SPILLWAY.

(b) Master's thesis. (c) D. D. Sanwal.

(e) Experimental.

(f) To investigate the effect of changing the crest on the discharge coefficient of a siphon spillway.

(g) Five crests were investigated, namely, a cylindrical crest, cylindrical crest with 45-degree tangent, and three parabolic crests.

(h) Experimental work completed.

(i) The results seem to indicate that the discharge coefficient is not affected a great deal by varying the shape of crest.

FOREIGN PUBLICATIONS

Foreign publications have been received by the agencies listed below, and are available on loan. Requests should be directed to the agency indicated.

ROCKY MOUNTAIN HYDRAULIC LABORATORY, Allenspark, Colo.

Inquiries should be addressed to Prof. C. J. Posey, Director, University of Iowa, Iowa City, Ia.

"Hungarian Hydrographic Institute, Studies Nos. 1 and 2." Hungarian, with English and French abstracts.

DEPT. OF THE ARMY, OFFICE OF THE CHIEF OF ENGINEERS, Beach Erosion Board, Washington, D. C.

Inquiries should be addressed to The Resident Member, Beach Erosion Board, Little Falls Road, N.W., Washington 16, D. C.

Bagnold, R. A.	"Motion of waves in shallow water; interaction between waves and sand bottoms." Proc. Royal Society of London, Series A, Vol. 187: 1-18. October 8, 1946. (Photostatic copy.)
Bagnold, R. A.	"Sand movement by waves; some small-scale experiments with sand of very low density." Journal of Institution of Civil Engineers, London, No. 4, Vol. 27: 447-469. February 1947. (Photostatic copy.)
Betz, Albert	"Progress of the calculative methods." Great Britain Ministry of Supply, Reports and Translations, London, No. 231, 40 numb. 1946. (Photostatic copy.)
Burgers, J. M.	"On the influence of the concentration of a suspension upon the sedimentation velocity (in particular for a suspension of spherical particles)." Nederlandsch Akademie van Wetenschappen, Proceedings. Amsterdam. Vol. 44: 1045-1051, 1177-1184; Vol. 45: 9-16, 126-128. 1941-1942. (Mededeeling No. 42 uit het Laboratorium voor aero - en hydrodynamica der Technische hoogeschool te Delft.) (Photostatic copy.)
Crowther, E. M.	"The direct determination of distribution curves of particle size in suspensions." Journal of the Society of Chemical Industry, London, Vol. 46: 105T-107T. 1927. (Photostatic copy.)
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Guelke, R. W.	"The measurement of sea-water velocities by electromagnetic induction." Journal of the Institution of Electrical Engineers, London, Vol. 94, Pt. 2, Power Engineering, No. 37: 71-74. February 1947. (Photostatic copy.)
Hesseland, Ivar	"Zur wellen und strömungsdynamik." Bulletin of the Geological Institution, Upsala Univ., Vol. 31: 39-54. 1946. (Photo. copy.)
Le Grand, Yves	"La pénétration de la lumière dans la mer." Annales, Institut océanographique, Monaco. 17 October 1939. (Photostatic copy.)

Richardson, E. G. "The measurement of pressure on the sea bed." Philosophical Magazine, London, Ser. 7, No. 264: 25-32. January 1946. (Photostatic copy.)

Schou, Axel "Det marine forland, geografiske studier over danske flad-kystlandskabers dannelse og formudvikling samt traek af disse omraaders kulturgeografi. Med saerlig hensyntagen til Sjaelland." (With English summary.) Reprint from Folia geographica danica, Copenhagen, Tom. IV. 1945. 236 pages.

Side, E. A. "Motion of waves in shallow water; the modification of wave patterns in shallow water." Great Britain Ministry of Supply, Wave Report No. 15, Cambridge. 1946. 3 pages. (Photostatic copy.)

Steers, J. A. "The coastline of England and Wales." Cambridge, England. 1946. 644 pages.

Stockmann, W. B. "Horizontal circulation of water in the sea, as caused by non-uniform velocity distribution in a shoreward wind across its movement." Akademiia nauk, Doklady, Vol. 49, No. 2: 102-106. Moscow, 1945. (Photostatic copy.)

Timmermans, P. D. "Proeven over den invloed van golven op een strand, in verband met enkele vaarnemingen aan de Nederlandsche kust." Summary in English.) Leidsche geologische mededeelingen, deel VI, afl. 3, blz. 231-386. 1935.

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Ursell, F. "The wave-making properties of a submerged pulsating source." Great Britain. Admiralty Research Laboratory. 7 numb. l. 1946. (Photostatic copy.)

White, C. M. "The drag of cylinders in fluids at slow speeds." Proc. Royal Society of London, Vol. 186, No. 1007: 472-479. 1946. (Photostatic copy.)

U. S. DEPT. OF COMMERCE, NATIONAL BUREAU OF STANDARDS, National Hydraulic Laboratory, Washington, D. C.

Inquiries should be addressed to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C.

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Bonnet, L., and Lamoen, J. "Étude théorique et expérimentale des cours d'eau a marée." Annales des Travaux Publics de Belgique, June 1946.

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Lamoen, J. "Le coup de bélier d'Allievi, compte tenu des pertes de charge continues." Waterbouwkundig Laboratorium, Borgerhout-Antwerpen, Belgium. 1947.

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Bogardi, J. "Vizügyi Közlemények." (Hydraulic Proceedings.) Institut d'Hydrographie, Budapest, Hungary. Vol. XXVI, Nos. 1-4. 1944. (With English and French abstracts.)

Bogardi, J. "Vizügyi Közlemények." (Hydraulic Proceedings." Institut d'Hydrographie, Budapest, Hungary. Vol. XXVIII, Nos. 1-4. 1946. (With English and French abstracts.)

Bogardi, J. "A lefolyási tényező és a levezetendő belvizmennyiség." (The runoff coefficient and the quantity of drainage water.) Institut d'Hydrographie, Studies No. 1. 1944. (With English and French abstracts.)

Bogardi, J. "A Budapesti dunahidak roncsainak vizszinduzzasztása." (Backwater effect of the bridge ruins at Budapest.) Institut d'Hydrographie, Studies No. 2. 1946. (With English and French abstracts.)

ITALY

The following publications issued by the Istituto di Idraulica de la Universita di Pisa, Italy:

Rastrelli, A. "Sull'equazione di continuità." Istituto di Idraulica Agraria Pubblicazioni del Personale No. 69. Reprint from "Annali della Facoltà di Agraria", Vol. VII. 1946.

Rastrelli, A. "Sul calcolo delle sezioni bagnate per correnti a pelo libero in moto uniforme." Istituto di Idraulica Agraria Pubblicazioni del Personale No. 70. Reprint from "Annali della Facoltà di Agraria", Vol. VII. 1946.

Rastrelli, A. "Sulla determinazione della radici complesse conjugate di un'equazione algebrica a coefficienti reali di V grado." Istituto di Idraulica Agraria Pubblicazioni del Personale.

di Ricco, Guido "Sulla scala di portata $q = \alpha \omega^m J^{1/2}$ per il moto uniforme dell' acqua in un canale." Reprint from Bollettino del R. Istituto Superiore Agrario di Pisa, Vol. IX. 1933.

di Ricco, Guido "Sulla fognatura campestre." Reprint from "Annali dei Lavori Pubblici, già Giornale del Genio Civile", Fascicolo 11°. 1928.

di Ricco, Guido "Sul profilo pratico dei muri dritti di ritenuta d'acqua." Reprint from "Annali dei Lavori Pubblici, già Giornale del Genio Civile", Fascicolo 11°. 1929.

di Ricco, Guido "Pratica delle condotte forzate assegnazione dei diametri." Reprint from "Annali dei Lavori Pubblici, già Giornale del Genio Civile", Fascicolo IX°. 1926.

di Ricco, Guido "L'abbinamento delle condotte d'acqua nelle zone sismiche." Reprint from Bollettino del R. Istituto Superiore Agrario di Pisa, Vol. V. 1929.

di Ricco, Guido "Sul metodo turazza per la ricerca del coefficiente udometrico di un colatore." Reprint from Bollettino del R. Istituto Superiore Agrario di Pisa, Vol. IX. 1933.

di Ricco, Guido "Moto permanente lineare in alveo prismatico (determinazione approssimata del profilo di rigurgito)." Reprint from"L'Acqua",

Vol. XXII, 3-4. March-April 1944.

di Ricco, Guido — "Sul moto vario lineare." Reprint from "Giornale del Genio Civile", Fascicolo 1°. January-February 1946.

di Ricco, Guido — "Il problema economico degli acquedotti consorziali."

Teofilato, Stefano — "Misure di fenomeni d'urto in corrente veloce." Supplementi Teonici alle Monografie Scientifiche di Aeronautica, No. 1. January 1947.

Teofilato, Stefano — "Leggi del trasporto solido nei canali." Reprint from "Acta, Pontificia Academia Scientiarum", Vol. XI, No. 2. 1947.

Viti, Mario — "Metodi per il tracciamento del profilo di pelo libero delle correnti in moto permanente in alvei cilindrici." Reprint from "Giornale del Genio Civile", Fascicolo 3°-4°. March-April 1947.

The following publications issued by the Istituto di Idraulica e Costruzioni Idrauliche di Milano, Italy:

Citrini, Duilio — "Sul movimento di una corrente veloce in un canale in curva." No. 39. Reprint from "L'Energia Elettrica", Vol. XVII, Fascicolo IX. September 1940.

Citrini, Duilio — "Modellatori a risalto (Guida al progetto)." No. 44. Pubblicazione N. 5 del Centro Studi per le Applicazioni dell'Ingegneria all'Agricoltura. June 1941.

Citrini, Duilio — "Diffusione di una vena fluida effluente in campo di fluido in quiete (Premessa ad una ricerca sperimentale)." No. 61. Reprint from "L'Energia Elettrica", Vol. XXIII, Fascicolo IV. April 1946.

Citrini, Duilio — "Ricerca sperimentale sulla diffusione di una vena liquida effluente in un campo di liquido in quiete(Prima serie di prove)." No. 64. Reprint from "L'Energia Elettrica", Vol. XXIII, Fascicolo VIII. August 1946.

Citrini, Duilio — "Canali rettangolari con portata e larghezza gradualmente variabili." Reprint from "L'Energia Elettrica", Vol. XIX, Fascicolo V e VI. May-June 1942.

Contessini, Felice — "Ricerche sperimentali su modelli eseguite per una diga tracimabile (Ciglio sfiorante, pile, smorzatore)." No. 37. Reprint from "L'Energia Elettrica", Vol. XVII, Fascicolo III. March 1940.

Franzi, Giovanni — "Sul moto dei liquidi con materie solide in sospensione (Esame generale delle esperienze finora compiute e deduzioni pratiche)." No. 47. Reprint from "L'Energia Elettrica", Vol. XVIII, Fascicolo V. May 1941.

Gentilini, Bruno — "Esperienze sull'efflusso dai tubi addizionali cilindrici." No. 54. Reprint from "L'Energia Elettrica", Vol. XX, Fascicolo VI, VII, VIII. June-July-August 1943.

Gentilini, Bruno — "Luci totalmente e parzialmente rigurgitate (Ricerca sperimentale)." No. 60. Reprint from "L'Energia Elettrica", Vol. XXII, Fascicolo XI, XII, November-December 1945.

Gentilini, Bruno — "Il metodo dell'analogia elettrica ed alcune sue recenti applicazioni (Distribuzione della pressione sotto le traverse fondate su materiale permeabile)." No. 62. Reprint from "L'Energia Elettrica", Vol. XXIII, Fascicolo V. May 1946.

Gentilini, Bruno — "Sui processi di efflusso piano (Introduzione a una ricerca sperimentale)." No. 42. Reprint from "L'Energia Elettrica", Vol. XVIII, Fascicolo IV. April 1941.

Gentilini, Bruno — "Efflusso dalle luci soggiacenti alle paratoie piane inclinate e a settore." No. 46. Reprint from "L'Energia Elettrica", Vol. XVIII, Fascicolo VI. June 1941.

Gentilini, Bruno — "Stramazzi con cresta a pianta obliqua e a zig-zag (Ricerca sperimentale)." No. 48. Reprint from "L'Energia Elettrica",

Vol. XVIII, Fascicolo X. October 1941.

Marchetti, Aldo — "Prove su un modello di galleria forzata con diversi pozzi piezometrici (Confronto con i risultati forniti dal calcolo)." No. 49. Reprint from "L'Energia Elettrica", Vol. XVIII, Fascicolo X. October 1941.

Marchetti, Aldo — "Perdite di carico per regime uniforme nelle condotte dalmine di cemento - amianto con anima di acciaio, rivestite internamente di bitume centrifugato." No. 56. Reprint from "L'Energia Elettrica", Vol. XXI, Fascicolo VII-VIII. July-August 1944.

Marchetti, Mario — "L'influenza del colpo d'ariete sulla regolazione delle turbine." No. 41. Reprint from "L'Energia Elettrica", Vol. XVIII, Fascicolo III. March 1941.

Marchetti, Mario — "Il calcolo dell'energia defluente nelle condotte forzate durante il moto vario." No. 50. Reprint from "L'Energia Elettrica", Vol. XVIII, Fascicolo XI. November 1941.

Marchetti, Mario — "Profili altimetrici di massimo tornaconto delle opere di convogliamento d'acqua." No. 55. Reprint from "L'Energia Elettrica", Vol. XXI, Fascicolo V-VI. May-June 1944.

Marchetti, Mario — "Il laboratorio d'idraulica delle Scuole Centrali Antincendi in Roma." No. 58. Reprint from "Vigili del Fuoco", Anno V, No. 8. June 1943.

Marchetti, Mario — "Sui getti di massima efficacia effluenti da bocchelli (Con applicazione ai getti antincendi)." No. 63. Reprint from "Il Pompiere Italiano", Fascicoli 1, 2, 3. 1946.

de Marchi, Giulio — "La misura delle acque di irrigazione." No. 38. Relazione al Convegno d'istruzione professionale per dirigenti di Corsorzi d'irrigazione e di Aziende agricole irrigue, Milan, June 3-6, 1939.

de Marchi, Giulio — "Sistemazione dello sbocco del Lago Maggiore (Ricerca sperimentale su modello)." No. 40. 1940.

de Marchi, Giulio — "L'Istituto di Idraulica e Costruzioni Idrauliche del R. Politecnico di Milano e il Centro Lombardo di Ricerche Idrauliche del Consiglio Nazionale delle Ricerche (Notizie sulla organizzazione e sulla attività svolta nel decorso decennio)." No. 43. Reprint from "L'Energia Elettrica", Vol. XVIII, Fascicolo V. May 1941.

de Marchi, Giulio and Filippelli, Gennaro — "Esperienze sulle erosioni d'alveo a valle di traverse." No. 51. Reprint from "L'Energia Elettrica", Vol. XIX, Fascicoli IV e V. April-May 1942.

de Marchi, Giulio — "Onde di depressione provocate da apertura di paratoia in un canale indefinito." No. 57. Reprint from "L'Energia Elettrica", Vol. XXII, Fascicolo I-II. February 1945.

de Marchi, Giulio — "Sull'onda di piena che seguirebbe al crollo della diga di Cancano." No. 59. Reprint from "L'Energia Elettrica", Vol. XXII, Fascicolo VIII-IX-X. August-September-October 1945.

de Marchi, Giulio — "Canali con portata progressivamente crescente (Grondaie e collettori di sfioratori)." Reprint from "L'Energia Elettrica", Vol. XVIII, Fascicolo VI. June 1941.

THE NETHERLANDS

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SWEDEN

Bergsten, Folke	"Beräkning av de karakteristiska avrinningsvärdena i vattendrag med icke känd avrinning." Med. Statens Meteorologisk-Hydrografiska Anstalt, Band 7, No. 10. 1943. (Summary in English.)

U. S. DEPT. OF THE INTERIOR, BUREAU OF RECLAMATION, Denver, Colo.

Inquiries should be addressed to The Chief Engineer, Bureau of Reclamation, Denver, Colo.

CZECHOSLOVAKIA

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FRANCE

"Note sur l'amenagement du tiers central du Bas-Rhone et la construction de la chute de Donzere-Mondragon."

INDIA

Blench, T.	"Turbulent flow theory."

ITALY

The following publications issued by the Istituto di Idraulica e Costruzioni Idrauliche di Milano, Italy: (Complete reference to these publications will be found on pages 170 and 171.)

Citrini, Duilio	"Modellatori a risalto (Guida al progetto)."
Citrini, Duilio	"Diffusione di una vena fluida effluente in campo di fluido in quiete (Premessa ad una ricerca sperimentale)."
Citrini, Duilio	"Canali rettangolari con portata e larghezza gradualmente variabili."
Franzi, Giovanni	"Sul moto dei liquidi con materie solide in sospensione (Esame generale delle esperienze finora compiute e deduzioni pratiche)."
Gentilini, Bruno	"Efflusso dalle luci soggiacenti alle paratoie piane inclinate e a settore."
Gentilini, Bruno	"Stramazzi con cresta a pianta obliqua e a zig-zag (Ricerca sperimentale)."
Gentilini, Bruno	"Esperienze sull'efflusso dai tubi addizionali cilindrici."
Gentilini, Bruno	"Luci totalmente e parzialmente rigurgitate (Ricerca sperimentale)."
Gentilini, Bruno	"Il metodo dell'analogia elettrica ed alcune sue recenti applicazioni (Distribuzione della pressione sotto le traverse fondate su materiale permeabile)."
Marchetti, Aldo	"Prove su un modello di galleria forzata con diversi pozzi piezometrici (Confronto con i risultati forniti dal calcolo)."
Marchetti, Aldo	"Perdite di carico per regime uniforme nelle condotte dalmine di cemento - amianto con anima di acciaio, rivestite internamente di bitume centrifugato."
Marchetti, Mario	"Il calcolo dell'energia defluente nelle condotte forzate durante il moto vario."
Marchetti, Mario	"Profili altimetrici di massimo tornaconto delle opere di convogliamento d'acqua."

Marchetti, Mario	"Il laboratorio d'idraulica delle Scuole Centrali Antincendi in Roma."
Marchetti, Mario	"Sui getti di massima efficacia effluenti da bocchelli (Con applicazione ai getti antincendi)."
de Marchi, Giulio and Filippelli, Gennaro	"Esperienze sulle erosioni d'alveo a valle di traverse."
de Marchi, Giulio	"Onde di depressione provocate da apertura di paratoia in un canale indefinito."
de Marchi, Giulio	"Sul'onda di piena che seguirebbe al crollo della diga di Cancano."
de Marchi, Giulio	"Canali con portata progressivamente crescente (Grondaie e collettori di sfioratori)."
	"Sull'applicazione della serie di Fourier allo studio delle osservazioni termometriche in una diga massiccia."

TRANSLATIONS

ST. ANTHONY FALLS HYDRAULIC LABORATORY, University of Minnesota, Minneapolis, Minn.

The following translations have been prepared at the St. Anthony Falls Hydraulic Laboratory. Inquiries should be addressed to Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

Adler, M.	"Strömung in gekrümmten Röhren." (Flow in curved pipes.) Zeitschrift für Angewandte Mathematik und Mechanik, 14(5): 257-275. October 1934.
Böllinger, Hanns	"Laufschaufelregulierung bei Radialrädern." (Adjustable blade regulation in radial flow turbo-machine runners.) Mitteilungen des Institutes für Strömungsmaschinen der Technischen Hochschule Karlsruhe, Heft 3: 1-39. Kommissions-Verlag des V.D.I. - Verlages, Berlin. 1933.
Hinderks, A.	"Nebenströmungen in gekrümmten Kanälen." (Secondary currents in curved channels.) Zeitschrift des Vereines Deutscher Ingenieure, 71(51): 1779-1783. December 17, 1927.
Keutner, Chr.	"Strömungsverhältnisse in einem senkrechten Krümmer." (Flow conditions in a right-angle bend.) Zeitschrift des Vereines Deutscher Ingenieure, 77(45): 1205-1209. November 11, 1933.
Lell, Jacob	"Beitrag zur Kenntnis der Sekundärströmungen in gekrümmten Kanälen." (Contribution to the knowledge of secondary currents in curved channels.) Zeitschrift für das gesamte Turbinenwesen, 11: 129-135, 293-298, 313-317, 325-330. March, July 1914.
Lorenz, H.	"Der Widerstand von Rohrkrümmern." (The resistance of pipe bends.) Physikalishe Zeitschrift, 30: 228-230. 1929.
Nippert, H.	"Über den Strömungsverlust in gekrümmten Kanälen." (On the flow losses in curved channels.) Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, V.D.I., Heft 320: 1-67. 1929.
Richter, Hugo	"Der Druckabfall in gekrümmten glatten Rohrleitungen." (The pressure drop in curved smooth pipe-lines.) Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, V.D.I., Heft 338: 1-30. 1930.
Schroder, E.	"Strömungsuntersuchungen an einem Rotationshohlraum." (Investigations of flow in an impeller.) Mitteilungen des Institutes für Strömungsmaschinen der Technischen Hochschule Karlsruhe, Heft 2: 67-104. Kommissions-Verlag des V.D.I. - Verlages, Berlin. 1932.
Spalding, W.	"Versuche über den Strömungsverlust in gekrümmten Leitungen." "Experiments on flow loss in curved conduits.) Zeitschrift des Vereines Deutscher Ingenieure, 77(6): 143-148. February 11, 1933.
Steiss, Walter	"Über die Relativ-Strömung in einem Pumpen -- Laufrad von grossem Radien-Verhaltnis." (Concerning the relative flow in a pump runner of large radii ratio.) Mitteilungen des Institutes für Strömungsmachinen der Technischen Hochschule Karlsruhe, Heft 3: 77-91. Kommissions-Verlag des V.D.I. - Verlages, Berlin. 1933.
Weinel, E.	"Zur Hydrodynamik der idealizierten Kreiselradströmung." (The hydrodynamics of the idealized turbine flow.) Mitteilungen des Institutes für Strömungsmaschinen der Technischen Hochschule Karlsruhe, Heft 2: 1-26. Kommissions-Verlag des V.D.I. - Verlages, Berlin, 1932.

DEPT. OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station, Vicksburg, Miss.

The following translations have been prepared at the Waterways Experiment Station. Inquiries should be addressed to The Director, Waterways Experiment Station, P.O. Box 631, Vicksburg, Miss.

Burger, A.	"Het Friesche Kanalenplan." (Frisian canal project.) Weg en Waterbouw, Vol. 7, No. 3-4, March-April 1947. 18 pages. TR.173.47-20.
Dachler, Robert	"Krummlinige Filterbewegung." (Curvilinear seepage flow.) Grundwasserströmung, pp 37-44. TR.141.46-4.
Dachler, Robert	"Grundwasserprobleme als Randwertaufgaben der potential Theorie." (Ground-water problems as boundary problems of the potential theory.) Grundwasserströmung, pp 44-45. TR.141.47-7.
Dachler, Robert	"Die Strömungsformen des Grundwassers, ihre Bestimmung und Verarbeitung bei der Lösung praktischer Aufgaben." (Types of ground-water flow, their determination and treatment in the solution of practical problems.) Grundwasserströmung, pp 21-37. TR.141.47-9.
Daohler, Robert	"Anwendungsbeispiele." (Ground-water problems solved by means of conformal representation (conformal mapping).) Grundwasserströmung, pp 55-98. In 3 parts. TR.141.47-8, -10, -13.
Eisner, Franz	"Überfallversuche in verschiedener Modellgrösse." (Overfall tests to various model scales.) From Prussian Experiment Station for Hydraulic Structures and Shipbuilding, Report No. 11, 1933. 47 pages. TR.173.42-39.
Forchheimer, Philipp	"Die Mündung ins Meer." (Mouths of tidal rivers.) Hydraulik, pp 565-69. TR.173.47-14.
Forchheimer, Philipp	"Pfeilerstau. Druckverlust in Rechen. Schiffwiderstand." (Backwater at bridge piers. Loss of head at trashracks. Ship resistance.) Hydraulik, pp 519-527. TR.173.47-5.
Forchheimer, Philipp	"Hochwasserverlauf in Flüssen. Verflachung und Formänderung der Hochwasserwelle." (High river stages. Subsidence and deformation of the flood wave.) Hydraulik, pp 293-303. TR.173.47-6.
Forchheimer, Philipp	"Wellenbewegung." (Wave movement.) Hydraulik, pp 465-484. In 2 parts. TR.173.47-3, -4.
Kirschmer, Otto	"Grundsätzliches über Modellversuche für Hafenbauten." (Fundamental principles of model tests for harbor works.) Office of Military Government for Germany, 1946. 13 pages. TR.173.47-16.
Kirschmer, Otto	"Modellähnliches Geschiebe." (Similitude of model bed load.) 8 pages. TR.173.47-11.

U. S. DEPT. OF COMMERCE, NATIONAL BUREAU OF STANDARDS, National Hydraulic Laboratory, Washington, D. C.

The following translation has been prepared at the National Bureau of Standards. Inquiries should be addressed to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington, 25, D. C.

Lindqvist, Erik G. W.	"Settling basins of the Lovö type." Kommunalteknisk Tidskrift No. 2, 1945. (Translated by K. Hilding Beij.)

COMMITTEES

ADVISORY COMMITTEE ON BASIC RESEARCH IN UNDERWATER BALLISTICS, Office of Naval Research, Department of the Navy.

Chairman, Dr. J. H. Wayland, Ordnance Test Station, Pasadena, Calif.

This committee is organized to coordinate and guide research in underwater ballistics.

RESEARCH COMMITTEES OF THE SECTION OF HYDROLOGY, American Geophysical Union, 1530 P Street, N.W., Washington 5, D. C.

President, Section of Hydrology, Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

Reports of the research committees are published in the Transactions of the American Geophysical Union.

CHEMISTRY OF NATURAL WATERS.

Chairman, Mr. L. V. Wilcox, Bureau of Plant Industry, Rubidoux Laboratory, Riverside, Calif.

This committee's scope of activity embraces the chemical composition and chemical work of natural waters, above and below the surface, except ocean water. This field includes development of sampling techniques; the relation between fresh and salt water; precipitates affecting infiltration, erosion, or water-movement; formation of subterranean channels; and related research.

DYNAMICS OF STREAMS.

Chairman, Dr. F. T. Mavis, Carnegie Institute of Technology, Pittsburgh 13, Pa.

The scope of activity of this committee embraces the dynamics of the flow of water in streams and the relation between streams and the channels they occupy. This field includes the forces which the water exerts; the work done in eroding, transporting, and depositing materials comprising the channel; and related research.

EVAPORATION AND TRANSPIRATION.

Chairman, Mr. H. G. Wilm, Rocky Mountain Forest and Range Experiment Station, U. S. Forest Service, Fort Collins, Colo.

The scope of activity of this committee embraces the processes of evaporation or sublimation from water, snow, land, and vegetal surfaces. This field includes measurement; theory; geographical variations; and related research.

GLACIERS.

Chairman, Mr. Francois E. Matthes, 858 Gelston Place, El Cerrito, Calif.

The scope of activity of this committee embraces the hydrology of existing glaciers as distinguished from ancient glaciers. This field includes the systematic measurement and recording of current variations in volume of American glaciers; the interpretation of such variations; studies of structure, mode of movement, and regimen of glaciers; and related research.

GROUND WATER.

Chairman, Mr. Stanley W. Lohman, U. S. Geological Survey, 136 Custom House, Denver 2, Colo.

The scope of activity of this committee embraces the occurrence and movement of water in the zone of saturation. This field includes measurement of head and rate of movement; determination of the physical properties of water-bearing materials, and origin and sources of supply; geologic occurrence; geographical distribution; effects of pumping and other processes of artificial removal;

natural discharge, chemical character, and theory; and related research.

INFILTRATION.

Chairman, Mr. G. W. Musgrave, Research Specialist, Soil Conservation Service, U. S. Dept. of Agriculture, Washington 25, D. C.

The scope of activity of this committee embraces the movement of water into the surface-soil. This field includes measurement of rates and volumes; the relation of soil and rainfall characteristics, vegetation, and topography to infiltration; geographical variations of physical processes; and related research.

LAKES.

Chairman, Dr. Phil E. Church, Dept. of Meteorology and Climatology, University of Washington, Seattle, Wash.

The scope of activity of this committee embraces water occurring in natural or artificial lakes. This field includes measurements of surface elevations; distribution of temperature, seepage-losses, and densities; ice formations; seiches; sedimentation; origin; and related research.

LAND EROSION.

Chairman, Dr. W. C. Lowdermilk, 1620 LeRoy Avenue, Berkeley 9, Calif.

The scope of activity of this committee embraces the hydrologic aspects of the displacement of soil from its natural position in the soil-profile, as distinguished from the geological aspects of erosion. This field includes measurement of rate and volume; theory; the effect of alternate freezing and thawing; the effect of precipitation and snow-melt; the effect of vegetation and agricultural practices; and related research.

PRECIPITATION.

Chairman, Dr. Glen N. Cox, Louisiana State University, Baton Rouge 3, La.

The scope of activity of this committee embraces precipitated atmospheric moisture in the form of rain, snow, hail, and sleet. This field includes measurement; rain-drop characteristics; interception; storm characteristics; regional distribution; relation to engineering and agricultural problems; and related research.

PHYSICS OF SOIL MOISTURE.

Chairman, Dr. L. A. Richards, U. S. Regional Salinity Laboratory, P.O. Box 672, Riverside, Calif.

The scope of activity of this committee embraces the occurrence and movement of moisture within the soil or rock-mantle. This field includes measurement of rates and volumes; the dynamics of soil-moisture; the relation of soil characteristics to moisture; the effect of vegetal roots on moisture; and related research.

RUNOFF.

Chairman, Mr. Charles C. McDonald, Room 207 Federal Building, Tacoma, Wash.

The scope of activity of this committee embraces water flowing over and through the ground or in channels. This field includes measurement of volume and rate of flow; characteristics of hydrographs; effects of natural and artificial storage; sources of supply to streamflow, such as surface runoff, subsurface flow; and related research.

SNOW.

Chairman, Mr. Richard C. Farrow, Parliament Buildings, Victoria, B.C., Canada.

The scope of activity of this committee embraces snow after it is deposited on the ground. This field includes measurement of snow depth, water content, thermal quality, and structure; the phenomenon of melting; geographical distribution; influence on climate; and related research.

PERMEABILITY.

Chairman, Prof. C. E. Jacob, Dept. of Geophysics, University of Utah, Salt Lake City, Utah.

This committee was organized in 1943 to provide for the open discussion of the terminology relating to permeability, with a view toward the elimination of conflicting usages and the clarification and standardization of acceptable terms.

HYDRAULICS DIVISION, American Society of Civil Engineers.

The Hydraulics Division of the American Society of Civil Engineers was authorized in 1938 for the purpose of the advancement and dissemination of knowledge relating to the occurrence of water in nature and to its behavior in structures, water courses, and underground.

In particular, the field of the Hydraulics Division embraces 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 committees of the Hydraulics Division are:

EXECUTIVE COMMITTEE.

Chairman, Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

COMMITTEE ON FLUID MECHANICS.

Chairman, Dr. Hunter Rouse, Director, Iowa Institute of Hydraulic Research, The State University of Iowa, Iowa City, Ia.

Purpose: To further the advancement of hydraulics through coordination of endeavor with related fields of fluid mechanics.

COMMITTEE ON GROUND WATER HYDRAULICS.

Chairman, Mr. Thomas R. Camp, 6 Beacon Street, Boston 8, Mass.

Purpose: To sponsor and coordinate studies of the physical laws governing the motion of water underground, whether natural or induced, and to promote the gathering, systematizing, and publishing of materials relating to hydraulic design involving underground flow.

COMMITTEE ON HYDRAULIC DATA AND FACTS.

Chairman, Mr. E. W. Lane, Bureau of Reclamation, U. S. Dept. of the Interior, Denver, Colo.

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.

COMMITTEE ON HYDRAULIC RESEARCH.

Chairman, Mr. Joseph B. Tiffany, Jr., Waterways Experiment Station, P.O. Box 631, Vicksburg, Miss.

Purpose: To initiate, organize, sponsor, and coordinate research in the hydraulic field.

COMMITTEE ON HYDROLOGY.

Chairman, Mr. Merrill Bernard, Chief, Climatological and Hydrologic Services, U. S. Weather Bureau, Washington 25, D. C.

Purpose: (a) To stilumate 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 that 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.

JOINT COMMITTEE ON DESIGN AND OPERATION OF MULTIPLE-PURPOSE RESERVOIRS.

Chairman, Mr. Raymond A. Hill, 1000 Edison Building, Los Angeles, 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, Mr. Gerard H. Matthes, 518 Broadway Central Hotel, New York 12, N. Y.

Purpose: To promote the collection and compilation of data pertaining to floods in the United States, giving particular attention to the following: the interpretation of flood data; methods of flood control; hydraulic factors underlying the design of flood control works; problems arising from the operation of flood control works. Consideration is to be given to prevention of flood damage by methods other than flood control.

JOINT COMMITTEE ON SEDIMENTATION IN RESERVOIRS.

Chairman, Mr. Carl P. Vetter, U. S. Bureau of Reclamation, Boulder City, Nev.

Purpose: To study and report on problems connected with the depositing of sediment in reservoirs, its prevention and reduction.

RESEARCH COMMITTEE ON FLUID METERS, American Association of Mechanical Engineers.

Chairman, Prof. S. R. Beitler, Professor of Hydraulic Engineering, The Ohio State University, Columbus 10, Ohio.

The A.S.M.E. Research Committee on Fluid Meters is undertaking a research program for the development of basic information on the design and application of meters for measuring small rates of flow. This program is under the immediate direction of the Sub-Committee on Small Flows. Mr. H. S. Bean, Chief, Fluid Meters Section, National Bureau of Standards, Washington 25, D. C., is chairman of this subcommittee.

The program covers a metering study of systematically selected hydrocarbons, both liquid and gaseous; refrigerants; water; gases of technical and commercial importance, such as air, carbon dioxide, and hydrogen; acids, and other chemicals. Primary measuring devices include orifices, flow nozzles, venturi tubes, capillary tubes, porous plugs, and variable area and float devices, which will be investigated first in lines of standard pipe sizes ranging down to 1/4 inch. Rates of flow range from perceptible flow to values sufficiently high to permit correlation with existing data on larger meters. Some work is planned at high pressures and high Mach numbers.

Most of the detailed work of the program is to be performed by recipients of graduate fellowships to be established at several educational institutions. In conjunction with this, opportunity will be given fellows to do some of the work at the National Bureau of Standards. Results of the program, which will require about six years for completion, will be made available through means of papers and reports published by the A.S.M.E.

APPLIED HYDRAULICS COMMITTEE, Civil Engineering Division, American Society for Engineering Education.

Chairman, Prof. Cecil S. Camp, The University of Tennessee, Knoxville, Tenn.

The purpose of the committee is to further the advancement of the teaching of hydraulic engineering and fluid mechanics courses. Projects on which the committee are now working are (1) preparation of a program for presentation at the 1947 annual meeting of the Society in Austin, Texas; (2) questionnaire survey of hydraulics courses, including time alloted and year in which subjects are taught; (3) survey of availability of instructional motion pictures related to applied hydraulics; and (4) assembling and approval of drawings of certain standard laboratory apparatus.

A recently completed project was the preparation of portions of a library list to be published in the near future. The list includes publications under the following headings: Hydraulics and Fluid Mechanics; Hydrology; Irrigation and Drainage; Hydraulic Machinery; Dams; and Hydromechanics.

INTERNATIONAL ASSOCIATION FOR HYDRAULIC STRUCTURES RESEARCH.

The International Association for Hydraulic Structures Research was organized in 1935 to stimulate research and to facilitate the exchange on an international basis of work done in the general field of hydraulic research. The organization of this association provided opportunities for personal contact of fellow hydraulic specialists and a procedure for exchange of ideas and information on activities.

At the time of organization it was felt that the best means to secure fullest cooperation in research were to hold international meetings at stated intervals, and to publish, probably annually, a report of research in progress or recently completed in various hydraulic laboratories other than those in the United States. The report was to be in a form similar to the publication of the National Bureau of Standards, "Hydraulic Research in the United States".

The first meeting was held in Berlin in 1937; the second meeting was to have been held in Liege in September, 1939, but it was postponed because of the war. A report of the Berlin meeting was published; a volume containing the papers written for the Liege meeting was published in Sweden in 1940. Since that time, during the six years of the war, the Association has been dormant.

The first post-war meeting is to be held June 7-9, 1948, at the Hydraulic Laboratory of the Technical University in Stockholm, Sweden. It will precede a meeting of the Congres des Grands Barrages to be held June 10-12, also in Stockholm. Following the meeting of the latter organization, excursions to various dams and hydraulic works in Sweden will be made. Plans for the meeting are being formulated by President Wolmar Fellenius, Stockholm; Prof. Dr. E. Meyer-Peter, Zurich, Vice-President; and Prof. J. Th. Thijsse, Delft, Secretary. The principal subject for papers will be "Transportation of bed load; scour below weirs".

It is now planned that reports of hydraulic research carried on outside the United States will be published by the Association each year, and that international meetings will be held every two years. The Articles of the Association provide that the meetings preferably be held in connection with the World Power Conferences, the meetings of the Congres des Grand Barrages, or the meetings of the Permanent International Association of Navigation Congresses.

The American member of the permanent executive committee is Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn. Persons who wish information concerning this Association may communicate with him.

HYDROMECHANICS SUB-COMMITTEE OF THE RESEARCH AND TECHNICAL COMMITTEE, Society of Naval Architects and Marine Engineers.

Chairman, Dr. K. S. M. Davidson, Director, Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

The Sub-Committee was created to deal with technical questions and research in hydromechanics, in the fields of naval architecture and marine engineering. Its purpose is to collect and coordinate data on past and current research and to stimulate new research.

LABORATORY NOTES

BYRON JACKSON COMPANY, P.O. Box 2017, Terminal Annex, Los Angeles 54, Calif.

D. H. Cooper, Chief Test Engineer; Carl Blom, Chief Engineer; Aladar Hollander, Consulting Engineer.

During the past three years this company has been engaged in the design and construction of a new testing laboratory, the completion of which will initiate an accelerated program of research on centrifugal pumps and related products. The new laboratory will occupy 9000 square feet of floor space and have a reservoir capacity of 400,000 gallons. It will be equipped with vertical and horizontal General Electric DC dynamometers, 10 to 400 hp, 1500 to 4500 rpm. These incorporate selsyn speed-monitoring controls. Calibrated electric motors extend the range of power available to 3000 hp and the speed range down to 360 rpm. Venturis cover a range from 20 gpm to 50,000 gpm. Smaller sizes machined from 18-8 stainless steel forgings to extremely close tolerances incorporate new features believed to result in greater accuracy in flow measurement. Facilities are included for research and development of axial flow pumps. There will be oil reservoir capacity of 10,000 gpm for conducting research on the effect of viscosity on centrifugal pumps. Instrumentation is not entirely complete, and much of the detail will be developed after the laboratory is in operation.

THE CLEMSON AGRICULTURAL COLLEGE, Clemson, S. C.

Prof. D. D. Curtis, Head, Department of Mechanics and Hydraulics.

It is hoped that construction will soon begin on a new teaching laboratory, which will include facilities for some research.

COLUMBIA UNIVERSITY, Fluid Mechanics Laboratory, New York, N. Y.

Prof. Boris A. Bakhmeteff, Department of Civil Engineering.

The Fluid Mechanics Laboratory, which is used exclusively for research and graduate work, was inactive during the war. Since the resumption of activities, considerable overhauling was required, which is about completed. The facilities are being expanded by additional equipment. There has also been an increase of research activities both on previous and new lines.

GEORGIA SCHOOL OF TECHNOLOGY, Atlanta, Ga.

Prof. C. E. Kindsvater, Civil Engineering Department.

This edition of the Bulletin contains accounts of Georgia Tech's first hydraulic research projects carried out in the Civil Engineering Department's new hydraulics laboratory. With the financial assistance of two anonymous sponsors who deposited $35,000 with the Georgia Tech Alumni Foundation to equip the laboratory, a wing of the Civil Engineering Building has been converted into a compact hydraulics laboratory which will be suited to research as well as undergraduate and graduate instruction.

At the present time, slightly less than 3000 square feet of floor space is utilized for research equipment and a small shop. The facilities of several additional shops and laboratories on the campus are available at all times. The main water-circulation system at present consists of a two-pump circuit connected to an elevated constant-head tank. The maximum capacity of this system is approximately 7 cfs. The piping system, composed of flanged-joint light-weight steel pipe, is designed for maximum flexibility of use. An outstanding piece of research equipment already in use is a 3 by 3 foot steel and glass-walled flume. Construction has begun on a similar but smaller flume with gate-controlled headbay, and plans are under way for a short "river" flume to be constructed on the floor of the laboratory. A 20,000-pound capacity weighing tank is provided for precise calibrations. The laboratory is unusually well instrumented, and generous use is being made of transparent Lucite tubing and plate to develop demonstration

and experimental equipment. Plans for the future call for the installation of air and oil-flow equipment in addition to the water-flow facilities now available or under construction.

UNIVERSITY OF IDAHO, College of Engineering, Moscow, Idaho.

Allen S. Janssen, Dean, College of Engineering.

In addition to the installation of a model reaction-type turbine, the laboratory has added a Pelton wheel installation, an adjustable orifice meter, a new bank of pipes for the study of loss of head due to friction, and a Chrysler engine with two connected centrifugal pumps.

IRRIGATION RESEARCH LABORATORY, Logan, Utah.

Dr. C. W. Lauritzen, Soil Conservation Service, Box 179, Logan, Utah; and Dr. O. W. Israelsen, Research Professor of Irrigation and Drainage, Utah State Agricultural College, Logan, Utah.

Recognizing the seriousness of seepage losses from irrigation canals, and a need for information on methods and materials for lining canals, the Soil Conservation Service and the Utah Agricultural Experiment Station recently intensified their investigation of water conveyance problems. To facilitate a phase of this work which might be classed, in part, as the model testing of canal linings, an outdoor laboratory was constructed in 1945 on the Logan River near the mouth of Logan Canyon, one mile east of the Utah State Agricultural College.

The principal feature of the laboratory is the four channels simulating irrigation canals. The channels have bed widths of 3 feet, side slopes of 2 horizontal to 1 vertical, top widths of 9 feet, and lengths of 160 feet. Each channel is divided into eight sections, and each section is provided with independent underdrainage facilities to collect and measure seepage losses. The channel stream is continuous, making it necessary to operate each channel as a unit.

Present outdoor laboratory facilities are expected to provide information on the permeability of linings constructed from a variety of materials, the rate at which the linings deteriorate, and a basis for extending data on physical properties of materials to field practice.

"Irrigation Research Laboratory." C. W. Lauritzen and O. W. Israelsen. Farm and Home Science, June 1947.

"West's canal linings studied." C. W. Lauritzen and O. W. Israelsen. Western Construction News, May 1947.

THE JAMES LEFFEL & COMPANY, Springfield, Ohio.

J. Robert Groff, President and General Manager; G. A. Biggs, Chief Engineer, Hydraulic Testing Laboratory.

This laboratory is located in the manufacturing plant of The James Leffel & Company. It has been in existence for more than twenty years, and many hundreds of experiments relating to hydraulic turbine design, construction, and installation have been made. The present research program includes testing of turbine models of all types, Francis, propeller, and impulse designs. It also includes research and testing having to do with hydraulic water passageways to and from the turbine, including conduits, spiral cases, draft tubes, as well as experimentations on relief valves and pressure regulators. New equipment has been added to the laboratory testing facilities, including special precision instruments and means for increasing the range of head up to 200 feet.

UNIVERSITY OF MARYLAND, College of Engineering, College Park, Md.

S. S. Steinberg, Dean, College of Engineering.

The engineering research program at the University of Maryland is being reorganized, and construction is about to commence on new buildings to house the engineering departments. This program includes provision for an extension of instruction and research in hydraulics, but these new facilities will not be available for at

least another year.

NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY, Newport News, Va.

C. H. Hancock, Supervisor, Hydraulic Laboratory.

The hydraulic laboratory at Newport News has doubled in size since last year. The additional space is used to house additional testing facilities, which include a stress analysis laboratory, an electronics section, and a fluid flow laboratory. This latter contains various still water tanks and the circulating water channel. Additional shop facilities which include complete wood-working and metal-working machines enable the laboratory to do a large share of its own instrument work.

NEW YORK UNIVERSITY, College of Engineering, University Heights, New York 53, N. Y.

W. R. Bryans, Dean, Department of Civil Engineering.

Prof. A. H. Griswold is undertaking some research on velocity distribution and the development of the boundary layer in open channel flow. Equipment is being set up, and actual experimental runs will start early in 1948.

OKLAHOMA A & M COLLEGE, Stillwater, Okla.

Prof. Clark A. Dunn, Vice-Director, Division of Engineering.

A project on cavitation was commenced in 1945, but is at present inactive. Work is expected to be resumed at a future date.

THE PELTON WATER WHEEL COMPANY, 19th and Alabama Streets, San Francisco 10, Calif.

P. B. Dawson, Jr., Section Engineer - Development.

The testing program in Pelton's new laboratory has been very extensive during the last year, with increased facilities allowing for more accurate results and a wider range of testing. The testing of impulse buckets has been stepped up with the idea of improving the bowl shapes until optimum efficiency is obtained over a wide range of operating conditions. The impulse bucket testing program will be continued indefinitely as new bowl shapes and variation of old shapes offer an endless supply of buckets for testing.

A very interesting test program has developed around the research into vertical six and four nozzle impulse turbines, with the six nozzle turoine being concentrated upon at present. This turbine was tested in the laboratory and then taken into the field and tested at a higher head at the Halsey Power Plant of the Pacific Gas & Electric Company. The investigation has centered mainly around determining the turbine construction which will produce maximum efficiency of operation.

In addition, extensive testing has been carried out on very small wheels developing large horsepower, a new field which will be investigated more completely in the near future.

Also various types of valves, including an eccentric butterfly valve, a spherical valve, and a sleeve valve have been tested or are to be tested in the near future.

The testing program for the future will continue mainly with the items mentioned above.

RENSSELAER POLYTECHNIC INSTITUTE, Troy, N. Y.

Grant K. Palsgrove, Professor of Mechanical and Hydraulic Engineering.

Rensselaer Polytechnic Institute is not engaged in any hydraulic research at present, as the laboratories have been in process of complete overhauling. The hydraulic laboratory will be especially equipped for instruction of engineering students in the fundamentals of liquid flow and the commercial testing of current meters, flow meters, and small models. The laboratory is under the direction of Prof. Palsgrove.

THE UNIVERSITY OF ROCHESTER, Rochester 3, N. Y.

J. H. Belknap, Chairman, Division of Engineering.

The University of Rochester has just added electrical engineering, and through its physical plant is adding equipment for the three fields now offered, namely, mechanical engineering, chemical engineering, and electrical engineering.

ROCKY MOUNTAIN HYDRAULIC LABORATORY, Allenspark, Colo.

Prof. C. J. Posey, Director; University of Iowa, Iowa City, Ia.

The 1947 season at the Allenspark laboratory included finishing construction of shop and students' quarters and the construction of a new entry road.

At the annual meeting, Emory W. Lane, Ralph Powell, and R. A. Skrinde gave informal talks on current research and construction projects. Gerard F. Matthes, Clifford H. Stone, and Adolph F. Meyer were re-elected to the board of trustees, and Emory W. Lane was elected to replace Sherman M. Woodward, who retired from the board. Mr. Matthes was re-elected president; Professor Powell, secretary; and Professor C. J. Posey, director and treasurer.

ST. ANTHONY FALLS HYDRAULIC LABORATORY, University of Minnesota, Hennepin Island, Minneapolis 14, Minn.

Dr. Lorenz G. Straub, Director.

During the past year the St. Anthony Falls Hydraulic Laboratory has added considerable equipment, both for its shop and for general operation. There has been an expansion in floor space by the construction of a steel frame annex structure on the downstream portion of Hennepin Island; this building measures 40 feet by 100 feet in plan. An extension to the mezzanine floor of the main laboratory building is now being constructed. The additions increase the floor space by 5000 square feet.

In the past year the laboratory has begun its own publication series. Circular No. 1 is a descriptive pamphlet of the operating policy of the laboratory and of the status of the research program as of June 1947. A copy of this circular may be obtained by addressing the Director.

STANFORD UNIVERSITY, School of Engineering, Stanford University, Calif.

John K. Vennard, Associate Professor of Fluid Mechanics.

Main efforts during this academic year are being directed toward the improvement of facilities for laboratory instruction on the graduate level.

SYRACUSE UNIVERSITY, Syracuse 10, N. Y.

Donald E. Stearns, Professor of Civil Engineering.

Syracuse University is setting up a new hydraulic laboratory. It is hoped that an active program of research will be under way by the fall of 1948.

THE UNIVERSITY OF TENNESSEE, Knoxville, Tenn.

Prof. Cecil S. Camp, Department of Civil Engineering.

The Civil Engineering Department now has one staff member who will devote approximately one-half time to research in hydraulics and hydrology. It is hoped that personnel will be available so that one or more graduate research assistants may be added next year.

THE UNIVERSITY OF TEXAS, College of Engineering, Austin 12, Tex.

Walter L. Moore, Associate Professor of Civil Engineering.

The present equipment of the hydraulic laboratory is used entirely for instructional purposes. Space is available and plans are being made to add some

additional facilities for research, as well as improve the present equipment.

It is expected that a new glass-walled flume will be put in operation during the year. The flume will be used primarily for the study of two-dimensional flow patterns associated with spillways, drops, falls, etc., and with the dissipation of energy released at such structures. The flume can be adapted to the study of non-uniform flow in open channels due to changes in grade.

A small research project on the flow over weirs is being started this year, as described under Current Project No. 358, "Use of Total Head Measurement in Determination of Weir Flow", page 58.

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

Roscoe H. Suttie, Professor of Civil Engineering.

Professor Grant Robley is experimenting with different types of nozzles for a small bank turbine to determine the one of best efficiency. This work is continuing as time permits.

U. S. DEPT. OF AGRICULTURE, FOREST SERVICE, Central States Forest Experiment Station, Columbus 15, Ohio.

This Station expects soon to re-establish a Division of Flood Control Surveys and again participate in the Department of Agriculture flood control program, which was largely discontinued during the war. This program will consist entirely of preliminary examinations and surveys of watersheds in the Central States to determine the economic feasibility of carrying out a flood control plan through proper land management on the watersheds themselves.

U. S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, Everglades Experiment Station, Belle Glade, Fla.

The present work of this Station is largely concerned with an attempt to determine the increase in seepage from Lake Okeechobee due to the extra high lake stages which have prevailed recently. The record rainfall during 1947 has resulted in the highest lake stages of the past twenty years. As a result of these heavy rains the virgin lands of the Everglades were probably more deeply inundated than at any time since the beginning of the century.

Data on lake seepage is being obtained by means of pumping records, current meter measurements of seepage flow, and water-table readings. Also the movement of water over the virgin lands and the rate of drop are being studied by means of gage readings at selected points.

U. S. DEPT. OF THE INTERIOR, BUREAU OF RECLAMATION, Denver, Colo.

R. F. Blanks, Chief, Research and Geology Division.

Because of a very pressing design and construction program and a reduced staff, only those projects requiring immediate attention are being investigated in the laboratory. An extensive outdoor laboratory program for river control studies has been set aside for more urgent work. Likewise a program for the standardization of irrigation water measurement devices has been all but halted, and plans for a complete laboratory for pump testing and cavitation have had to be set aside for more urgent work.

NATIONAL RESEARCH COUNCIL, Division of Mechanical Engineering, Ottawa, Canada.

J. H. Parkin, Director.

The National Research Council maintains two model testing basins and an hydraulic laboratory where test work is performed for other government departments and private organizations.

The smaller model basin, built in 1931 for testing seaplane and flying boat hulls, is 350 feet long, 9 feet wide, and 6 feet deep. The cable-driven towing carriage has a maximum speed of 40 fps, and is equipped with a dynamometer for measuring

draft, trim, pitching moment, and drag force on the models. The new ship model basin is 450 feet long, 25 feet wide, and 10 feet deep. The carriage has a maximum speed of 20 fps, and is equipped with a recording dynamometer.

The hydraulic laboratory is equipped with a flume 65 feet long, 8 feet wide, and 6 feet deep, with an installed pumping capacity of 25 cfs. Sufficient floor space is available for building small hydraulic models.

UNIVERSITY OF TORONTO, Toronto 5, Canada.

E. A. Allcut, Professor of Mechanical Engineering.

The new laboratory for open channel flow will occupy the entire basement of a new wing of the Mechanical Building now under construction at the University of Toronto.

The laboratory will occupy a space approximately 200 feet long by 60 feet wide. The water supply is to be secured through a 24-inch diameter pipe placed below the floor and running the full length of the laboratory with 12-inch diameter lateral supply lines. A small towing channel is to be located along one side of the laboratory, equipped with a light-weight car. A 10 foot by 24 foot overhead supply tank will be supplied with 700 feet of spill weir length. The supply pumps will consist of three axial flow pumps having capacities of 4000, 3000, and 2000 imperial gallons per minute.

A new channel for testing models, 3 feet wide by 4 feet deep, will be fitted with glass sides and with venturi meter equipment for measuring discharge.

NO REPORT

A number of universities have suspended or greatly curtailed research activities for the present because of the increased teaching load imposed by the number of veteran students. In this category are the following:

Columbia University, Department of Mechanical Engineering, New York, N. Y.

Lafayette College, Department of Civil Engineering, Easton, Pa.

University of Maine, Department of Mechanical Engineering, Orono, Maine.

Purdue University, Department of Civil Engineering and Engineering Mechanics, Lafayette, Ind.

Union College, Department of Civil Engineering, Schenectady, N. Y.

McGill University, Department of Civil Engineering, Montreal, Canada.

EUROPEAN LABORATORIES

CZECHOSLOVAKIA

STATNI USTAV HYDROLOGICKY T. G. MASARYKA, Praha XIX - Podbaba.

F. Kovarik, Director.

The laboratory is being greatly enlarged with the special view to accommodate experimental research on utilization of water for power development.

FRANCE

THE NATIONAL LABORATORY OF HYDRAULICS (Laboratoire National d'Hydraulique), Ile de Chatou, 199 rue de Grenelle, Paris 7e.

M. Andre Nizery, Chief of the Service; M. Henri Gridel, Director of the Laboratory Division.

The National Laboratory of Hydraulics at Chatou is a combined agency of the Minister of Public Works and of l'Electricité de France (a national organization which has taken the place of the group of electrical agencies recently nationalized). Its operation has been entrusted to the Service of Hydraulic Studies and Researches of the latter organization.

The laboratory is charged with the experimental study of the hydraulic problems imposed by the construction of hydro-electric plants, hydraulic works in rivers for the improvement of navigation, and the protection of harbor structures against wave action, etc. The studies are made at the request of the public agencies or the industrial agencies interested. In addition, the laboratory will undertake studies of general interest, with the view of advancing theoretical and applied hydraulics. The laboratory was built under the direction of Monsieur l'Ingénieur en Chef Blosset, and has been operating since 1946 under his supervision.

At present the following investigations are in progress or in course of preparation:

(1) Levees on the Seine. A study of the extension of the dike protecting the entrance of the locks and of the control of the approach channel.

(2) Proposed reservoir dam at Chastang on the Dordogne. A study of flood spillways of the type called "en saut de ski", and of the emptying tunnel.

(3) Edea Dam on the Sanaga (Cameroon). A study of a special profile for an overflow dam of low height.

In the near future, several important models will be placed in operation, having for their objects (a) the study of flow conditions in the Rhine in the neighborhood of the port of Strasbourg; (b) the protection of the port of Tamatave (Madagascar) against sea waves and seiches; and (c) selection of the location of the canal intake for the hydro-electrical plant of Donzére-Mondragon on the Rhone. Other studies of fluvial and maritime hydraulics are envisaged.

HUNGARY

HUNGARIAN HYDROGRAPHIC INSTITUTE, Postbox 7o, Budapest.

Dr. John Bogárdi, Director.

The activity of the Institute is still below the peace-time program, but normal work is gradually being resumed. Study is being made of the silt transportation of the Tisza River, which it is planned to canalize in the future by means of four or five dams. Runoff conditions in Hungary and other problems in connection with the rebuilding of the country are also being studied.

After seven years of interruption, the "Vizügyi Közlemények" (Hydraulic Proceedings) of the Hungarian Hydrographic Institute has resumed publication. The

Institute is endeavoring to rebuild its contacts, disrupted because of the war, and is desirous of arranging for an exchange of publications with hydraulic laboratories, universities, libraries, etc., and will be glad to send its publications, so far as they are available, to interested persons and institutions engaged in hydraulic research. Requests should be addressed to Dr. Bogárdi at the above address.

SWITZERLAND

LABORATOIRE DE RECHERCHES HYDRAULIQUES ET DE MÉCANIQUE DES TERRES ANNEXE A L'ECOLE POLYTECHNIQUE FÉDÉRALE, Zurich.

E. Meyer-Peter, Director.

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.

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