HYDRAULIC RESEARCH in the UNITED STATES

Hydraulic Laboratory, Iowa Institute of Hydraulic Research
The State University of Iowa, Iowa City, Iowa

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HYDRAULIC RESEARCH IN THE UNITED STATES

Edited by Florence L. Bain

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F O R E W O R D

"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.

Current and completed projects are reported under one general heading, grouped under the organization conducting the research. References to published reports and articles are included in the individual project reports, and short abstracts are included in some instances. The arrangement of project descriptions has been changed in this volume, as will be noted by reference to the "Key to projects". 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 in 1947, and numbers assigned to continuing projects prior to that date are now discontinued. Numbers commencing with 516 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.

Because of the greatly increased number of projects that are reported in this issue, it has been necessary to edit the material more extensively than heretofore, in some instances abridging it considerably. Every effort has been made to retain essential information, and, where a more detailed report is desired, the contributing organization will furnish it upon request.

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

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

A limited number of Volumes 10, 11, and 12 are available to libraries; the supply of earlier issues is exhausted.

A similar bulletin, "Hydraulic Research", is compiled and published by the International Association for Hydraulic Structures Research, and contains information on hydraulic research being conducted in foreign countries. This publication follows closely the style of the United States bulletin, and the two publications endeavor to contain summaries of all hydraulic research being conducted in the world. The foreign bulletin is edited by Prof. J. Th. Thijsse, Director of the Hydraulic Laboratory at the Technical University of Delft, Netherlands, and Secretary of the International Association for Hydraulic Structures Research. Copies of the last edition of this bulletin, Volume 3, covering the period 1938 to 1947, were distributed by the National

Hydraulic Laboratory to the organizations contributing to the United States bulletin. This will be done again in 1949, but thereafter the foreign bulletin probably will be available in the United States only to members of the Association. Information concerning membership in the Association may be had by addressing the secretary, Prof. Thijsse, or the president, Dr. Lorenz G. Straub, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

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

KEY TO PROJECTS

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

HYDRAULIC RESEARCH IN THE UNITED STATES

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

Inquiries concerning Projects Nos. 271 to 273, incl., and 516 to 518, incl., should be addressed to Mr. H. J. Davis, Supervisor of I. P. Morris Hydraulic Laboratory, The Baldwin Locomotive Works, Eddystone, Pa.

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

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

(e) Runners of various designs in combination with different turbine settings are being tested in the I. P. Morris closed flume 11-inch cavitation laboratory. This flume was specifically designed to obtain cavitation data as well as efficiency, horsepower, and runaway speed characteristics of model turbines over a wide range of specific speeds. Recently additional special equipment was installed which provides a means of measuring the runner axial thrust over all ranges of field conditions including thrust at runaway speed. The pickup for these measurements consists of a number of SR-4 strain gages located on a specially constructed thrust bridge.

(f) Active.

(g) Results show promise of contributing to solution of specific design problems.

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

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

(d) Experimental, design.

(e) Model tests were made in the I. P. Morris closed flume 11-inch cavitation laboratory in connection with the design of hydraulic turbines for the Stewart Bridge project.

(f) Completed.

(g) Results of the model tests were utilized in arriving at the final design of the prototype units.

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

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

(e) The purpose is 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.

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.

(f) Suspended until the backlog of more urgent testing has been completed.

(516) INTERMEDIATE SPEED FRANCIS TYPE HYDRAULIC TURBINE MODEL - EFFICIENCY, HORSEPOWER, CAVITATION, RUNAWAY SPEED, AND THRUST MEASUREMENTS.

(b) Department of the Army, Corps of Engineers, Nashville District, for the Center Hill Hydroelectric Power Plant.

(d) Experimental; design.

(e) A model homologous from casing intake to draft tube discharge was tested in the I. P. Morris closed flume 11-inch cavitation laboratory in connection with the design of hydraulic turbines for the Center Hill Power Plant.

(f) Completed.

(g) The tests were considered satisfactory by the Corps of Engineers and on that basis the prototype units were accepted.

(517) INTERMEDIATE SPEED FRANCIS TYPE HYDRAULIC TURBINE MODEL - EFFICIENCY, HORSEPOWER, CAVITATION, RUNAWAY SPEED, AND THRUST MEASUREMENTS.

(b) Department of the Army, Corps of Engineers, Nashville District, for the Wolf Creek Hydroelectric Power Plant.

(d) Experimental; design.

(e) A model homologous from casing intake to draft tube discharge was tested in the I. P. Morris closed flume 11-inch cavitation laboratory in connection with the design of hydraulic turbines for the Wolf Creek Project.

(f) Completed.

(g) The tests were considered satisfactory by the Corps of Engineers and on that basis the prototype units were accepted.

(518) HIGH SPECIFIC SPEED FRANCIS TYPE HYDRAULIC TURBINE MODEL - EFFICIENCY, HORSEPOWER, CAVITATION, RUNAWAY SPEED, AND THRUST MEASUREMENTS.

(b) Department of the Army, Corps of Engineers, Norfolk District, for the Buggs Island Hydroelectric Power Plant.

(d) Experimental; design.

(e) A model homologous from casing intake to draft tube discharge was tested in the I. P. Morris closed flume 11-inch cavitation laboratory in connection with the design of hydraulic turbines for the Buggs Island Project.

(f) Active. Model is in the process of construction.

POLYTECHNIC INSTITUTE OF BROOKLYN, Brooklyn, N. Y.

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

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

(b) Laboratory project. (d) Compilation and analysis; undergraduate thesis.

(e) This is an attempt to write a history of hydraulic accumulators and related equipment, together with an analysis of the factors to be considered in the determination of efficient combinations of pumps and accumulators.

(520) THEORETICAL AND EXPERIMENTAL WORK ON WEIRS.

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

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

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

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

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

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

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

(523) VELOCITY DISTRIBUTION IN OPEN-CHANNEL FLOW.

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

(524) STUDY OF FLOW IN A STEEP CHUTE.

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

(e) The purpose is to study flow conditions in a rectangular chute making angles of from ten to thirty degrees with the horizontal. A number of runs will be made, varying the rate of flow, roughness, and slope.

(525) MODEL TEST OF DE LOIZA RIVER DAM.

(b) Buck, Seifert and Jost, 219 East 19 St., New York, N.Y.

(d) Experimental; design.

(e) Model test of dam for the Puerto Rico Aqueduct and Sewer Service, San Juan, Puerto Rico. Object is to determine best type of spillway buckets to produce a minimum of scour and a submerged type of flow at all river stages.

A wooden 1:48-scale model has been installed in a glass flume 10 inches wide. The river bed is simulated by gravel about 1/8 inch in diameter. Flows up to 2.5 cfs are run in the model, and photographs taken of the flow conditions. The scour profile is secondary and is taken on runs with maximum flows.

(f) In progress.

CALIFORNIA INSTITUTE OF TECHNOLOGY, Pasadena, Calif.

Inquiries concerning Projects Nos. 6, 7, and 11 should be addressed to Dr. V. A. Vanoni, and inquiries concerning Projects Nos. 8, 12, 15, 16, 17, and 279 should be addressed to Dr. Robert T. Knapp, California Institute of Technology, Pasadena 4, Calif.

(6) MECHANICS OF SUSPENDED LOAD TRANSPORTATION.

(b) Laboratory project.

(d) Experimental; basic research; for thesis (professional degree and doctoral).

(e) To investigate the internal mechanics of transportation of suspended load in flowing water; the effects of the material in suspension upon the velocity distribution of the flow; the distribution of sediment in open channel flow.

(f) A series of experiments has been completed and a report is being prepared for publication. The study is being continued.

(7) TRANSPORTATION OF BED MATERIAL LOAD.

(b) Laboratory project.

(d) Experimental; basic research; for thesis (professional degree and doctoral).

(e) To determine a general relationship between the rate of sediment movement by a stream and the hydraulic factors. The work is being carried out in flumes designed especially for sediment transportation studies.

(f) The study is being continued.

(8) DENSITY CURRENTS.

(b) Laboratory project.

(d) Experimental; basic research; for thesis (professional degree and doctoral).

(e) An investigation of density currents resulting from suspensions of fine sediments in reservoirs to establish principles governing their behavior.

(f) The study is being continued.

(h) "The effect of entrance mixing on the size of density currents in Shaver Lake." H. S. Bell, Trans. American Geophysical Union, Vol. 28, No. 5: 780-791. Oct. 1947.

(11) PIPE AND WIRE REVETMENT FOR STREAM CONTROL.

(b) Laboratory project.

(d) Field investigation, experimental; applied research.

(e) To obtain information upon which to base improvements on the design of pipe and wire revetments for streams. The study includes field investigations and laboratory experiments. Existing installations of pipe and wire revetment in the intermittent streams of Southern California and the Southwest are observed to determine the action and the effect of the various components of a revetment system. Practical data on flows, failures, etc., available in the files of the agencies responsible for the installations, are analyzed. The laboratory program is designed to determine the general behavior of this type of revetment and to evaluate any modifications which are suggested by the field study.

(f) Most of data required have been collected. Report is being prepared.

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

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

(d) Experimental; for design.

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

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.

(f) Experiments have been completed and report is being prepared.

(h) "Wave and surge studies for the Navy Base, Terminal Island, Calif.", R. T. Knapp and V. A. Vanoni, January 1945.

See also Project No. 528, "Waves and Surges in Apra Harbor, Guam, M. I.", University of California, page 16.

(15) STUDIES OF CAVITATION PHENOMENA.

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

(d) Experimental; basic research.

(e) Visual and photographic observations are made of cavitation on bodies of revolution and on other shapes, with a view to obtaining a physical picture of the cavitation phenomena. The problem will then be attacked analytically. For this work, a water tunnel with a working section of 14 inches in diameter and with a maximum velocity of 70 fps was 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 completed with the same size working section, but with a maximum speed of 100 fps. Provision is made to absorb air bubbles that are coming out of solution during cavitation before they are recirculated, so that the flow entering the working section will always be free from air. This feature has proved very satisfactory in operation. The tunnel also makes it possible to control the air content and to study its effect on cavitation.

(f) The project is progressing actively.

(h) For results of program see "Laboratory investigations of the mechanism of cavitation", R. T. Knapp and A. Hollander, Trans. A.S.M.E., Vol. 70, No. 5: 419-435. July 1948.

For description of the water tunnel see "The Hydrodynamics Laboratory of the California Institute of Technology", R. T. Knapp, Joseph Levy, J. P. O'Neill, and F. B. Brown, Trans. A.S.M.E., Vol. 70, No. 5: 437-457. July 1948.

For description of some of the photographic techniques see "Photographic techniques in experimental hydraulics", H. S. Bell, 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 Department.

(d) Experimental; basic research.

(e) Forces on bodies of different shapes and designs are measured in water tunnels, and the important steady state and damping force coefficients are thus obtained. These results are then used to predict the dynamic behavior through analysis. Once this is done, a body can be designed to have the desired dynamic behavior by selecting a shape with the appropriate values of these coefficients. A 14-inch diameter high-speed water tunnel with a maximum velocity of 100 fps, a free surface water tunnel with a working section of 20 inches by 20 inches in cross-section, with a maximum velocity of about 30 fps, with controlled pressure, and a launching tank where bodies can be launched from the air into the water at high speeds and the paths in the air and in the water observed photographically, are available for this work. The pressure of the air over the water in the launching tank can be controlled and its effect on the behavior of bodies during water entry studied.

(f) The project is proceeding actively.

(h) For a description of the apparatus, see "The Hydrodynamics Laboratory of the California Institute of Technology", R. T. Knapp, Joseph Levy, J. P. O'Neill, and F. B. Brown, Trans. A.S.M.E., Vol. 70, No. 5: 437-457. July 1948.

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

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

(d) Experimental; basic research.

(e) To investigate the applicability of the water analogy to the study of shocks in gases and to develop techniques for making measurements of surface shock waves on liquids. A specially built ripple tank about 4 feet wide and 6 feet long is used in these studies. Waves of different shape and intensity are produced in this tank, which is normally filled to 1/2-inch depth. Observations of these waves are made visually, by still and motion pictures, and by special electric depth gages which give a continuous record on an oscillograph.

(f) The project is progressing actively.

(h) "Progress report of the analogy between surface shock waves and liquids and shocks in compressible gases", H. A. Einstein and E. G. Baird, Report N-54 of the Hydrodynamics Laboratory, California Institute of Technology.

(279) FLOW IN ROTATING CHANNELS.

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

(d) Experimental; basic research and for design.

(e) The purpose is to determine the laws governing flow in rotating channels with a view to applying the results to the design of hydraulic machinery. Special apparatus that is cheap to operate and versatile in nature has been constructed. A principal feature 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 observations with Pitot tubes and photography. The range of operation will cover cavitating and non-cavitating conditions.

(f) The project is progressing actively.

(h) A paper describing the apparatus has been prepared for presentation to the annual meeting of the A.S.M.E.

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

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

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

(b) California Agricultural Experiment Station.

(d) Field and laboratory investigation; basic and applied research.

(e) Studies conducted on behavior of plants grown on waterlogged soils with controlled water tables through the crop season. Diffusion of gases through soils under various soil-moisture conditions are also being studied.

(f) Active.

(g) Work will yield information of value in analyzing cropping problems associated with high water tables.

(20) MOVEMENT OF WATER THROUGH SOILS.

(b) California Agricultural Experiment Station.

(d) Field and laboratory investigation; applied research.

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

(f) Active.

(g) Certain soils, when compacted to relatively high densities, do not permit entrance of roots of sunflower plants. Field experiments show evidence of lack of penetration by roots where high densities occur naturally.

(h) "Soil density and root penetration", F. J. Veihmeyer and A. H. Hendrickson, Soil Science, 65: 487-493. 1948.

"Sizes of prunes as influenced by differences in set and irrigation treatment", A. H. Hendrickson and F. J. Veihmeyer, Proc. Amer. Soc. Hort. Science, 51: 235-238. 1948.

(21) STUDY OF HYDRAULICS OF SPRINKLING SYSTEMS.

(b) California Agricultural Experiment Station. (d) Experimental; operation.

(e) Determination of the characteristics of jets and the distribution of water from sprinklers. Facilities available permit high speed photographs of sprinkler jets in order to record characteristics of these streams.

(f) Active.

(22) STUDY OF THERMODYNAMICS OF SOIL MOISTURE.

(b) California Agricultural Experiment Station.

(d) Field and laboratory investigation; basic research; doctor's thesis.

(e) The ability of soil to supply water to plants, and methods of measuring free energy or potential of soil moisture, are being studied. The effect of soluble material added to soils on the potentials of soil moisture is being studied.

(f) Active.

(g) Results to date indicate that applications of materials within limits practical under commercial practice do not affect the permanent wilting percentage.

(23) HYDROLOGY OF IRRIGATION SUPPLIES IN CALIFORNIA.

(b) California Agricultural Experiment Station. (d) Experimental; applied research.

(e) Studies are being continued on the effects of denudation of watersheds upon the water regimen of typical grazing areas in California. Experimental watersheds and paired plots are located in various counties of California. Soil-moisture histories are obtained from plots from which the brush has been removed by denudation or burning and adjacent plots which are left with original vegetative cover. Work will be continued for a number of years in connection with the removal of vegetation to permit growth of forage plants and its effect on runoff and erosion.

(f) Active.

(g) To date, burning of brush has not accelerated erosion or runoff on the areas tested.

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

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

(b) California Agricultural Experiment Station. (d) Experimental; design.

(e) Hydraulics of irrigation systems to better the design and efficiency of irrigation structures and equipment are being studied. A program is being initiated to investigate the capacities and head losses in standard orchard and alfalfa valves used on concrete pipe lines. Characteristics of water-measuring devices have been studied to determine their efficiency and practicability for use on the farm.

(f) Active.

(h) "Further data from siphon tests", C. N. Johnston, Agric. Engin., p 441, October 1948.

"Plastic garden hose", C. N. Johnston, Agric. Engin., 29(9): 393. September 1948.

"Portable irrigation siphons", C. N. Johnston, Farm Implement News, 68: 54-55, 86, 88. June 19, 1947.

See also Project No. 29, "Farm Irrigation Structures", University of California, Division of Irrigation and Soils, Los Angeles, Calif., page 9.

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

(b) California Agricultural Experiment Station.

(d) Field and laboratory investigation; basic and applied research.

(e) Soil infiltration rates are being studied with particular reference to quality of water applied.

(f) Active.

(g) Application of gypsum to irrigation water containing 50 percent or more sodium results in increased depth of penetration.

(h) "Gypsum in irrigation water", L. D. Doneen, California Fruit and Grower, 2:22. March 1948.

See also Project No. 28, "Physical and Chemical Factors Affecting Soil Permeability", University of California, Division of Irrigation and Soils, Los Angeles, Calif., page 9.

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

(26) DRAINAGE INVESTIGATIONS IN COACHELLA VALLEY, CALIFORNIA.

(b) Present work cooperative between this division and the Coachella Valley County Water District, Coachella, Calif.; Regional Salinity Laboratory, U. S. Department of Agriculture, Riverside, Calif.; and U. S. Bureau of Reclamation, Region III, Boulder City, Nev.

(c) J. S. Reger, Engineer, Coachella Cooperative Drainage Investigations, P. O. Box 158, Coachella, Calif. (Information available only after approval obtained from all cooperators.)

(d) Field investigations; applied research and design.

(e) The purpose is to develop economical techniques for observing the piezometric surfaces, the permeability, and the most feasible methods of draining the various aquifers which might contribute to drainage problems with the advent of Colorado River water for irrigation in the Valley.

(f) Active.

(g) Utilizing a hydraulic-rotary rig with core barrel, a two mile grid network of 4-inch observation wells has been established throughout most of the Valley. Mechanical analyses have been made of core samples. Excellent cores were obtained of the finer material, but only occasionally were cores obtained of the unconsolidated sands and gravels. At first coarse sand and gravel strata could not be penetrated, but the problem was completely solved by introducing a commercial product into the jetting water which significantly increased its viscosity. Banks of these small observation wells (piezometers) are being established to observe the shallower aquifers at the location of the 4-inch wells and to establish a one mile grid network. There has been but little activity related to aquifer permeability and drainage methods during the year.

(h) The following report summarizes the investigations by this laboratory prior to the initiation of the cooperative project:

"Hydrologic studies in Coachella Valley, California", M. R. Huberty, A. F. Pillsbury, and V. P. Sokoloff. University of California, Agricultural Experiment Station, Berkeley 4, Calif., 31 p, 1948 (multilith).

(27) HYDROLOGICAL EFFECTS OF RANGE MANAGEMENT PRACTICES.

(b) Laboratory project, coordinated with similar work by the Station under Dr. F. J. Veihmeyer, College of Agriculture, Davis, Calif.

(c) A. F. Pillsbury, Division of Irrigation and Soils, College of Agriculture, University of California, Los Angeles, Calif.

(d) Experimental; applied research.

(e) The purpose of this study is to evaluate the effects of watershed burning on runoff and erosion in southern California.

(f) Active.

(g) Data for the past year scant because of light rainfall.

See also Project No. 23, "Hydrology of Irrigation Supplies in California", University of California, Division of Irrigation, Davis, Calif., page 7.

(28) PHYSICAL AND CHEMICAL FACTORS AFFECTING SOIL PERMEABILITY.

(b) Laboratory project, coordinated with similar studies by the Station under Dr. F. J. Veihmeyer, College of Agriculture, Davis, Calif.

(c) M. R. Huberty, Division of Irrigation and Soils, College of Agriculture, University of California, Los Angeles, Calif.

(d) Experimental; applied research.

(e) A study of how infiltration into and both saturated and non-saturated flow through soils is affected by various physical and chemical factors.

(f) Active continuing project; certain phases are being summarized for publication.

See also Project No. 25 under the same title, University of California, Division of Irrigation, Davis, Calif., page 8.

(29) FARM IRRIGATION STRUCTURES.

(b) Laboratory project, coordinated with similar work under Dr. F. J. Veihmeyer, College of Agriculture, Davis, Calif.

(c) A. F. Pillsbury, Division of Irrigation and Soils, College of Agriculture, University of California, Los Angeles, Calif.

(d) Experimental and field investigations; applied research and design.

(e) Improvement in the design and operating performance of farm pipe lines, control structures, and sprinkling systems. Observations of causes of failure of plain concrete irrigation pipe are utilized to plan laboratory project now under way.

(f) A continuing project, with only one phase now active.

See also Project No. 24, "Measurement of Irrigation Water and Improvement in Farm Irrigation Structures", University of California, Division of Irrigation, Davis, Calif., page 8.

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

Inquiries concerning Projects Nos. 31, 32, 35 to 42, 44 to 47, 280 to 284, and 526 to 530, incl., should be addressed to Prof. R. G. Folsom, Department of Engineering, University of California, Berkeley 4, Calif.

(31) STUDIES IN FLOW THROUGH POROUS MEDIA.

(b) Laboratory investigation. (d) Experimental; for design and graduate theses.

(e) Measurement of the critical gradient which would exist at the toe of an earth filled dam or levee. Water was forced vertically upward through a pipe packed with various sands of known porosities. Critical escape gradient was noted when quicksand condition existed.

(f) Completed.

(h) "Critical escape gradient for a porous media with a free surface", K. S. Pister, M.S. thesis, 1948.

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

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

(e) Energy losses at the junction of pipes of various sizes, junction angles, and discharge ratios are being obtained experimentally. These are to be correlated for application in the design of flow circuits. Tests with water in converging flow in right-angle miter tees have been completed. These include a 6-inch by 6-inch welded tee, a 6-inch by 4-inch welded tee, and a 2-inch by 2-inch plastic tee.

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

(h) "Energy loss at the intersection of two circular conduits with converging incompressible fluid flow", E. A. Sorour, M.E. thesis, University of California, June 1948.

"Energy loss in mixing streams in closed conduits", W. R. Shuler, Master's thesis, University of California, May 1940.

(35) OSCILLATORY WAVES.

(b) Laboratory project. (d) Experimental; for graduate thesis.

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

(f) Active.

(36) MODEL LAWS FOR HYDRAULIC STRUCTURES.

(b) Laboratory research. (d) Experimental; for graduate thesis.

(e) To obtain experimental data for the design of models of hydraulic structures. The effect of scale, absolute size and width, roughness, and other factors will be investigated in the laboratory channels which are available.

(f) Suspended.

(h) "Scale effects on the performance of overflow spillway models", A. S. Chan, M.S. thesis, 1948.

(37) FLOW THROUGH LEVEES BY ELECTRIC ANALOGY.

(b) Laboratory project. (d) Experimental; for design.

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

(f) Suspended.

(h) "Determination of gravity flow system through porous dams with vertical faces", report by D. A. Bartley.

(38) STRUCTURES EXPOSED TO WAVE ACTION.

(b) Laboratory project. (d) Experimental; for graduate thesis.

(e) To obtain experimental data for the design and location of such shore protection works as groins, jetties, and bulkheads. Present work involves the measurement of pressures exerted on structures subjected to wave action.

(f) Active.

(h) "Wave action on beaches", J. H. Jones, M.S. thesis, 1948.

This study was concerned with the effects of various types of groins on wave action, littoral sand transport, and underwater topography in the vicinity of the structure.

"Wave pressures on structures", J. R. Morison, M.S. thesis, 1948.

Experimental measurements were made on the magnitude and distribution of pressure against a vertical wall caused by wave action.

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

(b) Laboratory project.

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

(e) To determine the nature and importance of the departure from equilibrium conditions for single and multiple component fluids which move through porous media under pressure gradients and which undergo a gradual phase change during the process.

Single component fluids, including water, ammonia, and propane, and a mixture of water and carbon dioxide, are made to flow through uniformly packed, unidirectional, insulated sand columns. The fluids enter as a single liquid-phase but experience a phase change as lower pressures are encountered downstream. Measurements are made of pressure, temperature, and liquid saturation as a function of distance. The theoretical investigation is being based on reaction rate considerations.

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

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

(b) Laboratory project; supported in part by Research Corporation.

(d) Experimental; basic and applied research; design.

(e) The isothermal flow characteristics of a solids-gaseous mixture (Al_2O_3, SiO_3

catalyst and air) are investigated in a 17 mm I.D. horizontal and vertical glass conduit for various air flow and solids flow rates. Pressure drops across test sections 2 feet in length are accurately measured for a series of air flow rates in which the solids to air ratio is varied from zero to 11 pounds of solids per pound of air. The solids (catalyst) are introduced into the flow system through a mixing nozzle fed by a slide valve controlled weighing tank, and have a size distribution varying from particles less than 10 microns to particles greater than 220 microns. Air velocities in the solids-free approach section vary from 50 fps to 150 fps. Several types of solids feed nozzles are investigated for stability of flow in the system (absence of pressure surges), and some qualitative information is available on the type of nozzle yielding the most uniform type of mixing.

(f) Active; data on metering of mixtures are being studied.

(h) "Dynamics of fluids-solids systems", presented at Symposium held at Cambridge, Mass., December 1948.

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

(b) Laboratory project. (d) Theoretical and experimental; graduate theses.

(e) To determine the transition conditions under which the gas and liquid phases are flowing in viscous and turbulent motion or in slug flow for isothermal flow in horizontal and vertical pipes. Mixtures of air and various liquids are made to flow through tubes at various orientations. Pressure drop and fluid distribution are determined for a range of liquid and gas rates which may be controlled separately.

(f) Some theoretical work is nearly completed; apparatus is being reconstructed. Five graduate theses have been completed.

(42) UNSTEADY FLOW IN CONNECTING PIPES.

(b) Laboratory project.

(d) Experimental; applied research and special senior paper or M.S. thesis.

(e) Experimental determinations will be made in the viscous and turbulent flow regimes to develop the amplitude and phase relationships of water surface elevations in a small gage well with respect to elevations in a large reservoir undergoing periodic variations.

(f) Suspended. Generalized theoretical curves have been completed for the viscous flow regime.

(44) THE SMALL WATER TUNNEL.

(b) Laboratory project. (d) Experimental; for design and M.S. theses.

(e) The work includes design and construction of an experimental water tunnel and associated test facilities. The measuring section will be about 24 inches in diameter.

(f) Suspended. Preliminary design considerations have been compiled.

(45) PUMP TESTING LABORATORY.

(b) Laboratory project.

(d) Theoretical and experimental; for design and M.S. and Ph.D. theses.

(e) Special equipment is available in the laboratory for investigations on improvement in design methods and performance of all types of pumps.

(f) Active.

(h) "Predicting liquid jet pump performance", R. G. Folsom, presented at the fourth annual meeting of the National Conference on Industrial Hydraulics, October

20-21, 1948.

The basic principles of the jet pump and the importance of momentum considerations in calculating the overall performance of a given unit are explained. Although momentum considerations give little or no information regarding details of design, certain recent experimental investigations clarify some geometrical relationships for optimum performance. The results from the application of the principles and confirming experimental conclusions are presented. Graphs present the overall performance of a simple jet unit with a given liquid over any external pressure conditions.

The usual water pressure system consisting of an interconnected centrifugal and jet pump is investigated. Calculations are made to demonstrate the shift in performance to be expected as pipe diameters and lengths are changed and the characteristics of the centrifugal pump are varied. Additional sample problems illustrating the use of the basic experimental curves in predicting the operation of the jet pump in any type of installation are included.

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

(b) Laboratory project. (d) Experimental and theoretical; graduate theses.

(e) 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. Velocity fluctuations are determined by measuring the potentials introduced 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 non-isotropic turbulence theory for the axisymmetric case.

(f) Active.

(47) GRAVITY WAVES AND RELATED PHENOMENON.

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

(d) Theoretical, laboratory and field investigation; basic research.

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

(f) Active.

(h) "Model studies made at the University of California River and Harbor Laboratory", J. W. Johnson. Trans. American Geophysical Union, Vol. 29, No. 1: 107-116. February 1948.

A few of the more important model investigations, made since establishment of the River and Harbor Hydraulic Laboratory at the University of California at Berkeley approximately ten years ago, are described briefly.

"The characteristics of wind waves on lakes and protected bays", J. W. Johnson. Trans. American Geophysical Union, Vol. 29, No. 5: 671-681. October 1948.

The results of investigations to determine the height and period of waves generated by wind blowing over lakes, reservoirs, or bays protected from ocean swell are given. Some information is presented on the variability of wave length and crest length as a function of fetch in the generating area. Recommendations are made for further investigations which are needed to adequately define the relationships between wave characteristics and wind velocity.

"Diffraction of water waves by breakwaters", J. A. Putnam and R. S. Arthur. Trans. Americal Geophysical Union, Vol. 29, No. 4, Pt. 1: 481-490. August 1948.

Application is made of a solution of the water-wave diffraction problem of Penny and Price to diffraction by a semi-infinite impermeable breakwater. Approximations are introduced to simplify application of the theory. Comparison of complete and simplified solutions is made with results obtained from a laboratory investigation. Best agreement between theory and experiment occurred in the lee of the breakwater. The simplified solution is shown to be adequate for most practical applications.

"The comparison of forecast and recorded waves on the Pacific Coast", J. D. Isaacs and Thorndike Saville, Jr. New York Academy of Science. March 1948.

"Forecasting waves and surf", Robert Stump. April 1948.

"Oscillatory waves. A compilation of charts and tables", R. L. Wiegel. Bulletin of Beach Erosion Board, Special Issue No. 1. July 1, 1948.

"Movement of beach sands by water waves", H. A. Einstein. Trans. American Geophysical Union, Vol. 29, No. 5: 653-655. October 1948.

"Graphical construction of wave refraction diagrams", J. A. Johnson, M. P. O'Brien and J. D. Isaacs. U.S. Navy Dept., Hydrographic Office, Pub. No. 605. 1948.

"Action and effect of waves", J. W. Johnson and J. D. Isaacs. Western Construction News, Vol. 23, No. 4: 97-102. April 1948.

(280) SEDIMENT TRANSPORT.

(b) Laboratory project. (d) Theoretical and experimental; Doctor's thesis.

(e) Measurement of the hydraulic forces on the surface particles of a sediment bed. The information is used for comparison with existing theories of sediment transport and friction.

(f) Active.

(g) Existence of lift forces as predicted in "Formulas for the transportation of bed load", H. A. Einstein, Trans. A.S.C.E., Vol. 107: 561-574, 1942, is substantiated.

(281) SCOUR BELOW DAMS.

(b) Laboratory project. (d) Experimental; for design.

(e) To obtain data for determining the relationship between the dimensions of the scour hole below a dam, sediment characteristics, and the flow conditions. A high-velocity stream was established by permitting flow to pass under a gate in a glass-walled flume. Various materials were placed at the end of the apron and the dimensions of the scour hole were observed. Aprons of various slopes and backwater conditions were tested.

(f) Suspended. The data are being analyzed and a report is being prepared.

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

(b) Sponsored by American Petroleum Institute.

(d) Theoretical and experimental; graduate theses.

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

(f) Theoretical studies are under way. Major apparatus is completed and preliminary experiment is under way.

(283) DIFFRACTION OF SURFACE WAVES.

(b) Laboratory project. (d) Experimental; design and Ph.D. thesis.

(e) To obtain experimental data on the diffraction of waves at gaps in breakwaters. Experiments were conducted in two sizes of wave basin: 6 feet by 12 feet, and 63 feet by 100 feet. Waves were allowed to pass through breakwater gaps of various dimensions, and measurement was made of the heights and direction of travel of the waves in the lee of the breakwater.

(f) Completed.

(h) "Diffraction of water waves passing through a breakwater gap", F. L. Blue, Jr. Ph.D. thesis, 1948.

The experimental results were found to verify the general form of the wave diffraction theory for breakwater gaps with gap-width/wave-length ratios as small as 1.41 in water of depth as small as 0.14 wave lengths. The theory and computation method form a usable basis for estimating the effect of diffraction on waves at a breakwater gap.

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

(b) Laboratory project. (d) Experimental; M.S. thesis.

(e) Approximately two-dimensional experiments with air as the working fluid in a 5-inch by 40-inch channel; pressure and velocity distributions are measured.

(f) Experiments completed with one nozzle; additional nozzles under investigation.

(g) Jet mixing zone can be considered in two regions: (1) mixing at constant pressure which takes place before the jet strikes the wall, and (2) mixing at variable pressure in the region where pressure rise exists.

(h) "Mixing of two jets in a region of pressure gradient", C. K. Ferguson. M.S. thesis, 1948 (unpublished).

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

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

(d) Experimental; special senior paper.

(e) Standard A.S.M.E. nozzles have been increased in their external dimensions so that a small clearance exists between the nozzle and pipe in which the nozzle is installed. Hydraulic grade lines are measured at several points downstream from the nozzle entrance for a series of different clearances between the nozzle and the pipe.

(f) Testing completed. A paper and report are in the process of preparation.

(g) Experimental data indicate little effect on nozzle discharge coefficients in the region upstream from the nozzle outlet. Downstream, a noticeable change in coefficients takes place.

(527) STUDY OF A DIFFUSER FOR A GRIT CHAMBER.

(b) East Bay Municipal Utilities District, Oakland, Calif.

(d) Experimental; for design.

(e) To build an efficient diffuser system between a sewage pump and the following grit chamber.

(f) Completed.

(g) On the basis of velocity distribution and of sedimentation tests, a minimum turbulence level was obtained in the grit chamber if the velocity reduction was achieved in a closed conduit which enters the grit chamber at the head wall.

(h) Technical Report HE 153-1 of the University of California, Berkeley, Calif., to the East Bay Municipal Utilities District.

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

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

(d) Experimental; applied research and development.

(e) Waves and surges that exist inside Apra Harbor will be measured by wave recorders and photographic methods and correlated with the atmospheric disturbances causing these phenomena.

(f) Active.

See also Project No. 12, "Investigation of Waves and Surges in the Apra Harbor, Guam, M. I.", California Institute of Technology, page 4.

(529) LITTORAL SEDIMENT FLOW ON A BEACH.

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

(e) On a model beach, the motion of sand is studied under wave action for determination of the littoral drift in function of direction, height, and period of waves. Devices measuring drift of water and sediment will be developed and study made of the influences of structures, such as jetties.

(f) Active.

(530) PARTICLE SEGREGATION ON DEGRADING SEDIMENT BEDS.

(b) Laboratory research. (d) Experimental and theoretical; basic research.

(e) Study of the behavior of different particles in a moving sediment mixture. In a 1 foot wide flume, later probably in a wider channel, transport of mixtures is measured under conditions of scour and compared with existing theories.

(f) Active.

UNIVERSITY OF SOUTHERN CALIFORNIA, Hydraulic Laboratory, College of Engineering, Los Angeles, Calif.

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

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

(c) Dr. K. C. Reynolds, University of Southern California, Los Angeles 7, Calif.

(d) Experimental; for design and for M.S. theses.

(e) Tests are being conducted in a uniformly sloping channel 3 feet wide and 42 feet long. The prototype channels are located at the Santa Monica Airport, Santa Monica, Calif. In the field, artificial rain is to be created over several channels of considerable length. The factors which affect the creation of artificial rain and which would influence runoff from airport runways are being investigated. Two pipes placed above and parallel to the channel are provided with nozzles whose type and spacing can be changed. The runoff hydrograph for the channel is used to study the effect of different factors.

(f) Active. Studies of the effect of impact have been completed. The next thesis will study the influence of distribution and other factors.

(h) "The effect of impact of raindrops of artificially created rain on the runoff of airport runways", G. A. Foy. Master's thesis, June 1949.

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

(49) RESEARCH FOUNDATION FOR CROSS-CONNECTION CONTROL.

(b) Laboratory project.

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

(d) Experimental research and field investigations; basic research.

(e) To supplement and evaluate existing information on mechanical backflow prevention devices operating under constant line pressure, to perform laboratory acceptance tests on all pressure types of backflow prevention devices. Field investigations covering operation and maintenance of all types of backflow prevention devices installed in the United States. 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.

(f) Active.

(g) Three years have been devoted to field and laboratory research.

(h) "Objectives, general testing procedure, specifications, results of tests". Paper No. 5. April 1948.

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

Inquiries concerning Projects Nos. 532 to 534, incl., should be addressed to Prof. F. T. Mavis, Carnegie Institute of Technology, Pittsburgh, Pa.

(532) CAVITATION IN HYDRAULIC INSTALLATIONS.

(b) Laboratory project. (d) Theoretical; for doctor's thesis.

(e) An evaluation of theories and data on cavitation pitting in hydraulic installations, a discussion of techniques in model investigations, and a plan for further study.

(f) Completed.

(533) HYDRAULIC JUMP.

(b) Laboratory project. (d) Experimental; undergraduate project.

(e) Dynamics of energy conversion involving the hydraulic jump and a sill in a rectangular channel.

(f) Active.

(534) HYDRAULICS OF RECTANGULAR CONDUITS.

(b) Laboratory project.

(d) Experimental; basic research for master's thesis.

(e) A basic study of entrance and outlet phenomena in a rectangular laboratory conduit and its relation to the dynamics of flow in open channels.

(f) Active.

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

(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, Department of Civil Engineering and Engineering Mechanics, Case Institute of Technology, Cleveland, Ohio.

(c) Col. H. D. Vogel, The District Engineer, Buffalo District, Corps of Engineers, Foot of Bridge St., Buffalo 7, N. Y.; or Prof. George E. Barnes, Head, Department of Civil Engineering and Engineering Mechanics, Case Institute of Technology, Cleveland 6, Ohio.

(d) Experimental; for design.

(e) Three series of model tests were made to calibrate for discharge-head capacity; to check on dissipation of energy of submerged jets from sluices; and to determine apron elevation and design of stilling basin, with the special problem of flow on spillway face alongside of vertical training walls striking the sloping faces of the training walls for the stilling basin. Models used were a 1:64 scale sectional model in a glass flume, and a 1:100 scale general model simulating all upstream and downstream end conditions.

(f) Three series of tests are completed, and at this time no further tests are contemplated.

(g) A remedy for the poor velocity distribution across the apron was found in building steps along the face of the stilling basin walls so as to direct the jet forward and thus remedy the bad end condition. The design of the stilling basin walls is novel, and believed to have considerable application.

(h) "Addenda A to supplementary and final report on hydraulic model studies for Mount Morris Dam", George E. Barnes, Case Institute of Technology, Cleveland, Ohio, 29 pp, 85 plates. October 1947.

COLORADO A & M COLLEGE, Fort Collins, Colo.

(52) HYDRAULIC SAND SEPARATOR.

(b) Laboratory project.

(c) Prof. Robert L. Lewis, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; for design.

(e) An apparatus has been designed and built which classifies sand according to fall velocity by a continuous flotation process. The process is purely dynamic, in that sand is introduced directly into the flow. A check of the apparatus indicates that duplications within plus or minus one percent are obtained. A design is being prepared for a pilot apparatus to perform sand separation on a continuous basis of operation.

(f) Active.

(53) SAND TRAPS AND SLUICEWAYS.

(b) Laboratory project, in cooperation with Soil Conservation Service, U.S. Department of Agriculture.

(c) R. L. Parshall, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; for design.

(e) To improve the efficiency of present 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.

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. 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.

(f) Suspended.

(g) 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.

(54) MEASURING DEVICE AND INTEGRATING INSTRUMENT.

(b) Laboratory project, in cooperation with Soil Conservation Service, U.S. Department of Agriculture.

(c) R. L. Parshall, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; for design.

(e) 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.

To adapt the principle of 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 at Fort Collins or Bellvue laboratory, where the law of discharge will be determined. Special apparatus will be built to verify the limitations of the recording instrument. Pyralin cylindrical chambers probably will be necessary to investigate the rotating action of the turbine that actuates the integrating mechanism of the instrument.

(f) Suspended.

(55) SNOW COURSE MEASUREMENTS AND FORECAST ANALYSIS.

(b) Laboratory project; also sponsored by Division of Irrigation, U. S. Soil Conservation Service.

(c) Homer Stockwell, Division of Irrigation, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(d) Field investigation; applied research.

(e) Measurement of depth of the water content of snow along many permanently

established snow courses is made systematically throughout the winter months to supply information as to the probable water supply for the coming irrigation season. 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.

(f) Active.

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

(b) Laboratory project; also sponsored by Division of Irrigation, U. S. Soil Conservation Service.

(c) Carl H. Rohwer, Division of Irrigation, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; for design.

(e) Tests have been made on various types of strainers, foot valves, gate valves, check valves, and other fittings to determine energy losses due to friction for the various discharges in the range required for irrigation pumping plants.

(f) Experimental work completed; data being analyzed.

(57) PHOTOGRAPHIC METHODS OF MAKING SNOW SURVEYS.

(b) Laboratory project.

(c) Prof. Maxwell Parshall, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; applied research.

(e) 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 methods of snow surveying. The extent of the correlation between these two factors is being investigated.

(f) Active.

(g) Data obtained by observation of one watershed over the last eight years indicate that this method of forecasting is equal in accuracy to the method now in use.

(287) PERFORMANCE TESTS OF WELL SCREENS.

(b) Laboratory project; also sponsored by Division of Irrigation, U. S. Soil Conservation Service, and various well-screen manufacturers.

(c) Carl H. Rohwer, Division of Irrigation, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; for design.

(e) (1) To determine head losses through screens of various dimensions surrounding a suction pipe similar to those used in irrigation wells. (2) To determine head losses through similar screens surrounded by gravel which is retained by a perforated casing. (3) To determine head losses through similar screens surrounded by a layer of gravel which is in turn surrounded by fine sand. Gravel is retained by a screen and sand by a perforated casing.

(f) Active.

(288) FLOW TRANSITIONS.

(b) Laboratory project.

(c) Prof. Maurice L. Albertson, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

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

(e) The purpose is to determine generalized curves for the energy loss, pressure distribution, and velocity distribution in various types of flow transitions. The initial phase of the research is with pipe in which the energy loss, velocity distribution, and pressure distribution are measured in a conical transition for various angles of flare, ratios of upstream and downstream pipe diameter, and values of Reynolds number. The approach velocity is being varied from one extreme of parabolic to the other extreme of uniform. Further investigations include studying the effect of rounding the transition, and the insertion of guide vanes to induce spiral flow. The second phase involves similar studies of flow through transitions in open channels.

(f) Active.

(g) Studies of energy loss have been completed for conical expansions with a variation in angle of flare of 7.5° to 180°, diameter ratio of 1.95 to 6.43, and Reynolds number of 5,000 to 150,000. Good correlation is obtained between theoretical equations and experimental data.

(h) "Energy losses in conical diffusers", J. E. Cermak. Master's thesis, Colorado A & M College, December 1948 (available on loan).

(535) SEDIMENT CAPACITY OF CHANNELS OF DEFINITE ROUGHNESS.

(b) Laboratory project.

(c) Prof. Maurice L. Albertson, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

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

(e) The purpose is to determine the relationship between a given channel with a definite roughness and its sediment carrying capacity. An attempt is being made to use a simple type of definite roughness that is easily reproducible.

(f) Active.

(536) MODEL STUDIES FOR BHAKRA DAM.

(b) International Engineering, Inc.

(c) Prof. Maurice L. Albertson, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; applied research, design.

(e) The purpose is (1) to determine the flow characteristics and relative desirability of various spillway designs and locations, (2) to determine the most desirable apron design and to study the action of the stilling pool with discharge from various outlets, and (3) to aid in the design of the draft tubes which are of a special type.

The model studies for the original design of this dam were done by the Bureau of Reclamation and reported in Volume 12 as Project No. 503, page 163. This study is an investigation of major changes in design which have been made since the original design.

(f) Active.

(537) VORTEX TUBES.

(b) Laboratory project.

(c) Prof. Maurice L. Albertson, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

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

(e) The purpose is to obtain generalized data for design of the most efficient vortex tube as a sand trap. The first step undertaken as a student thesis is the measurement of the efficiency of a tube at an angle of 45°. Factors being varied

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are the depth and discharge in the channel, the discharge through the tube, the size and rate of sand being introduced, and the relative heights of the upstream and downstream lips of the tube. Later investigations will include the effect of the angle of placement and the shape of the tube, and the size of the tube relative to the width of the channel.

(f) Active; project now being initiated.

See Project No. 53, "Sand Traps and Sluiceways", page 18.

(538) HYDRAULICS OF SPILLWAYS.

(b) Laboratory project.

(c) Prof. Maurice L. Albertson, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

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

(e) The purpose is to obtain generalized design information for spillways having the shape of the underside of the nappe from a sharp-crested weir. Design curves will be developed which will permit direct solution for any one of the following factors: design head, shape of spillway, height of spillway, discharge for all heads, and effect of downstream submergence.

(f) Active.

(g) Using laboratory data reported by other experimenters, dimensionless design curves have been developed which permit direct solution for the design head, the discharge, the height of the spillway, and the shape of the spillway crest.

(h) "Direct solutions for spillway designs", A. N. Harkauli. Special report, Colorado A & M College, August 1948 (available on loan).

(539) STILLING WELLS FOR METER GATES.

(b) Armco Drainage & Metal Products, Inc.

(c) Prof. Maurice L. Albertson, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; applied research and for design.

(e) The purpose of this project is to determine whether it is possible to simplify the design of the stilling wells and yet retain the accuracy and usefulness of the gate as a device for measuring flow.

(f) Active.

(540) DESIGN OF THE LOUP RIVER BED LOAD MEASUREMENT STRUCTURE.

(b) U. S. Geological Survey.

(c) Prof. Maurice L. Albertson, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colo.

(d) Experimental; basic research and for design.

(e) The purpose was to design a structure which would permit the measurement of the quantity of bed load moving in the Middle Loup River, either by trapping the bed load or by forcing it into suspension so that the total load of the stream could be measured with standard suspended-sediment sampler. The latter might be done by supplying turbulence to the stream either from an outside source or from the energy of the river itself. The last method was finally determined as most desirable because it was simplest in design and was continuous in operation, thereby always being in equilibrium.

To create the turbulence with the energy of the stream, roughness was added to the concrete slab placed on the river bottom. An attempt was made to simulate the bed load size in the model by making the ratio of the fall velocity to the

velocity in the stream a constant from the model to the prototype. The sand was introduced into the model by means of a specially designed sand-feed mechanism and the roughness was varied in size and arrangement until the necessary concentration was forced into suspension at the measuring section.

Plans now are being made to carry out a generalized program on the effect of relative roughness upon the sediment carrying capacity of a given channel.

(f) Completed, except for the plans mentioned above.

(g) The spacing of roughness had a material effect upon the sediment carrying capacity of the stream. For a discharge range of 250 cfs to 800 cfs, and a concentration of 2000 ppm, the final recommended design involved a reinforced concrete slab 39 feet long by 83 feet wide, set one foot higher than the normal river bed; that the roughnesses (baffles 12 inches high by 24 inches wide) be 2 feet apart longitudinally and 6 feet from center to center laterally; and that a rectangular measuring sill 6 inches high by 16 inches wide be placed downstream from the baffles, the total load then in suspension to be measured by a standard suspended load sampler at the downstream edge of the sill.

(h) "Loup River bed load measurement structure", final report, July 1948 (available on loan).

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

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

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

(b) Laboratory project. (d) Theoretical and experimental; basic research.

(e) To establish rational generalized expressions for permeability of porous beds consisting of grains of uniform or mixed size. The present phase, dealing with flow of air through beds of lead shot, sand, gravel, etc., is a continuation of the work systematically pursued since 1936 and interrupted by the war. It is anticipated that the results will furnish material permitting presentation of an integrated account of the phenomenon as a whole.

(f) Active.

(61) ELECTROMAGNETIC VELOMETER.

(b) Laboratory project. (d) Theoretical and experimental; basic research.

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

(f) Active.

(62) HYDRAULICS OF STRUCTURES.

(b) Laboratory project.

(d) Theoretical and experimental; basic research and for masters' theses.

(e) Preliminary master thesis research is in process on the following problems:

(1) Boundary layer regimen in intake reaches of open channels, and (2) flow patterns over beds curved in the vertical plane. An orientation thesis has been completed on the effect of tailwater on flow regimen over spillways.

(f) Active.

See Project No. 541 immediately following.

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

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

(e) For the purpose of acquiring knowledge of the physical features of the flow phenomena and formulating a comprehensive basis for design, especially in regard to spillways in submerged conditions.

(f) The experimental work is half completed.

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

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

(e) A wide range of systematic experimental studies is planned with emphasis on the physical aspects of the phenomena. Research will start with the following particular cases: (1) Expansion in conduits, and (2) knees and sharp bends in conduits.

(f) Apparatus is about completed for studies of expansion of conduits and conical diffusors. Experimental work, by way of master thesis, will start in the near future.

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

(b) Laboratory project. (d) Experimental; M.S. thesis.

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

(f) Active. Orientation masters' theses have been completed on (1) rational forms of bell mouth entrances, and (2) boundary layer regimen in outlet conduits. Plans are being worked out for systematic studies on both projects.

CORNELL UNIVERSITY, School of Civil Engineering, Ithaca, N. Y.

(542) MOVEMENT OF SAND BED LOAD.

(b) Laboratory project.

(c) Prof. M. S. Priest, School of Civil Engineering, Cornell University, Ithaca, N. Y.

(d) Experimental; for Ph.D. thesis.

(e) A study pertaining to the nature of sand bed load movement and the relation of quantities for describing that bed load movement.

(f) Active.

(543) EQUIPMENT FOR THE STUDY OF WAVE PATTERNS AND FLOW CHARACTERISTICS IN FREE-SURFACE FLOW OF LIQUIDS.

(b) Laboratory project.

(c) Prof. M. S. Priest, School of Civil Engineering, Cornell University, Ithaca, N. Y.

(d) Experimental; basic research.

(e) Development of equipment for the study of wave patterns and flow characteristics in free-surface flow of liquids. The principal equipment consists of a tilting, transparent table with movable strips for channel side walls and a recirculating system for supply of liquid.

(f) Near completion.

(544) FLOW OVER RECTANGULAR SUPPRESSED WEIRS AT VERY LOW HEADS.

(b) Laboratory project.

(c) Prof. E. W. Schoder, School of Civil Engineering, Cornell University, Ithaca, N.Y.

(d) Experimental; for master's thesis.

(e) A study of the flow of water over weir plates varying in thickness from .02 inch to 1.00 inch under heads below 0.2 foot to determine the effect of surface tension and viscosity. Water temperature was varied from 66° to 86°F.

(f) Completed.

(h) "An analysis of flow over weirs at very low heads", H. S. Meltzer. Master's thesis, Cornell University. September 1947 (available on loan).

GEORGIA INSTITUTE OF TECHNOLOGY, School of Civil Engineering, Atlanta, Ga.

Inquiries concerning Projects Nos. 291 to 295, incl., 545, and 546 should be addressed to Prof. C. E. Kindsvater, Hydraulics Laboratory, School of Civil Engineering, Georgia Institute of Technology, Atlanta, Ga.

(291) FLOW OF WATER OVER HIGHWAY EMBANKMENTS.

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

(e) Tests on a 1:6 model of a typical highway embankment section have been completed. Construction of a similar 1:12 model is under way. Future tests will be conducted in a 15-inch wide flume. Variables will include roughness and shape of crown, slope and height of embankment. Data will include discharge calibration, water-surface profiles, and tailwater levels corresponding to (1) free flow, (2) incipient submergence, (3) lower limit of surface flow, (4) upper limit of plunging flow, and (5) submerged flow.

(f) Active.

(g) Results from study of 1:6 model showed satisfactory agreement with broad-crested weir analogy. Weir coefficient was shown to increase slightly with increasing heads above about 0.1 foot. Effects of crest roughness were reflected as nearly uniform difference in coefficients over full range of heads. Unique relationships were defined for incipient submergence, limits of plunging and surface flow, and submergence coefficients.

(292) SIMPLIFIED PITOT TUBES FOR HYDRAULICS LABORATORY APPLICATIONS.

(b) Laboratory project. (d) Experimental; for design.

(e) To develop construction details and application techniques for Pitot Pitot-static, and static tubes of small size.

(f) Completed.

(g) Satisfactory tubes of 3/16-inch and 1/4-inch outside diameter were developed for

small pipe application. Tip design was based on results of National Advisory Committee for Aeronautics' research (Technical Note No. 546). Pipe connection gland was developed from standard fittings. Tests emphasized necessity for accurate shaping of nose. Loss of head due to static-tubes inserted on centerline of 6-inch pipe was shown to have appreciable effect on friction-loss tests. Tubes located upstream from bend meter caused error in meter calibration.

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

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

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

(e) Tests to determine friction-loss coefficients for a particular variety of galvanized, spiral-weld, flanged-joint pipe were confined to 6-inch pipe, with velocities up to 15 fps. Pressures were measured by means of static tubes and piezometers. Discharges were determined by weighing. Pipe coefficients (ratio of average to maximum velocities) were measured by Pitot tube.

(f) Completed.

(g) Tests show that this variety of pipe may be classified between "commercial steel and wrought iron" and "asphalted cast iron" pipe in Moody's charts for pipe friction factors. ("Friction factors for pipe flow", L. F. Moody, Trans. A.S.M.E., November 1944).

(294) STANDARD PIPE FITTINGS AS FLOW METERS.

(b) Laboratory project. (d) Experimental; design.

(e) Several standard and long-radius 6-inch elbows, a 12-inch standard elbow, and a 3-inch by 6-inch reducing elbow were tapped for calibration under various conditions of installations as bend meters. A Venturi tube was constructed of one standard and one special reducer, with base taps and throat taps both located in the standard reducer. Two asymmetric Venturi tubes of simple design were constructed of 3-inch Lucite tubing.

(f) Completed.

(g) All of the meters have been calibrated and are giving satisfactory service (see Project No. 292, "Simplified Pitot tubes for hydraulics laboratory applications", page 25, for effect due to upstream Pitot tubes). Asymmetric Venturi tubes constructed of Lucite were inexpensive and very satisfactory.

(295) LOSSES IN LUCITE TUBING.

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

(e) Flange-connected lengths of 3-inch Lucite tubing were equipped with piezometers for pressure-loss measurements over a wide range of velocities. Discharges were measured by means of a calibrated asymmetric Venturi tube (see Project No. 294, immediately preceding), and velocity distribution was measured with Pitot tubes. Auxiliary length of 2-inch Lucite tubing is used for study of expansion and contraction losses.

(f) Completed.

(g) Friction tests indicate that Lucite tubing may be classified as equal to "drawn tubing" on Moody's pipe friction charts (see Project No. 293, page 26). Tests to determine losses due to sudden expansion and sudden contraction are being conducted as an undergraduate laboratory project.

(545) A SMALL VARIABLE-PRESSURE WATER TUNNEL.

(b) Laboratory project.

(d) Experimental; for development and master's thesis.

(e) An inexpensive arrangement of standard pipe and fittings, a centrifugal pump, and a range boiler tank were utilized in the construction of a variable-pressure water tunnel. The working section consisted of a 3-inch Lucite tubing section approximately 3 feet long. An air ejector was used to provide pressure control. Velocities up to 20 fps were produced in the working section. In a later modification, an asymmetric Venturi tube of Lucite (see Project No. 294, page 26), generously equipped with wall piezometers, was substituted for the working section.

(f) Completed; to be used as undergraduate experimental equipment.

(g) As an inexpensive piece of demonstration and undergraduate experimental equipment, the device has been a success. A standard weld-type reducer, 8 inches by 3 inches, proved to be very satisfactory as a nozzle upstream from the working section. The small quantity of water contained in the system and the high speed of the pump combined to cause a rapid rise in water temperature. As a thesis project in which this equipment was utilized to investigate cavitation characteristics of modified cylindrical bodies, motion and still picture records were made over a wide range of the cavitation parameter.

(h) "An investigation of the formation of cavitation about modified cylindrical models", G. C. Robinson, Jr. Master's thesis, Georgia Institute of Technology, September 1948.

(546) SPILLWAY MODEL STUDIES, BARTLETT'S FERRY DAM.

(b) Georgia Power Company, Atlanta, Ga. (d) Experimental; for design.

(e) A 1:80 comprehensive model of the spillway and about 800 feet of river channel (both fixed and movable), and a 1:40 sectional model, including two bays of the spillway, were tested. Objectives included a study of the effect of proposed addition of buttresses for stabilization, development of certain features of the design, determination of a satisfactory gate-operation sequence, measurement of pressures on the spillway and buttresses, measurement of water-surface profiles, calibration of the spillway, and determination of satisfactory cofferdam locations and heights.

(f) Completed.

(g) The tests revealed that erosive tendencies below the spillway would be lessened by the proposed buttresses as compared with the existing structure. Other results are contained in the report listed below.

(h) "Spillway model studies, Bartlett's Ferry Dam", C. E. Kindsvater. Final Report, Project 135-47, Georgia Tech State Engineering Experiment Station, prepared for The Georgia Power Company. November 1948 (mimeographed, not for distribution).

UNIVERSITY OF IDAHO, Engineering Experiment Station, Moscow, Idaho.

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

(b) Laboratory project; in cooperation with U. S. Army Engineers, Weather Bureau, and Bureau of Reclamation.

(c) Prof. C. C. Warnick, College of Engineering, University of Idaho, Moscow, Idaho.

(d) Experimental; design and development.

(e) Tests are being conducted on movement of air around storage precipitation gages with a smoke wind tunnel to provide information for the improvement of windshield designs. High altitude precipitation gages are being installed at Mullan Pass, Idaho, to check performance of various shield designs under actual operating conditions against performance observed in wind tunnel studies.

(f) Active.

(g) Smoke stream pictures have given interesting record of updraft around the orifice of gages.

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

(b) Laboratory project; in cooperation with U. S. Geological Survey and Bureau of Reclamation.

(c) Prof. C. C. Warnick, College of Engineering, University of Idaho, Moscow, Idaho.

(d) Field investigation; applied research for development.

(e) Methods of measuring seepage losses are being studied by making tests with laboratory seepage meter and by measuring inflow and outflow in sections of unlined and compacted-earth lined canals near Post Falls, Idaho. Purpose is to provide simpler means of evaluating seepage losses and to give information on the effectiveness of compacted-earth lined canals.

(f) Active; measurement data being processed.

(549) STUDY OF FLUIDIZED MEDIA.

(b) Laboratory project.

(c) Prof. C. O. Reiser, Chemical Engineering Department, Kirtley Laboratory, University of Idaho, Moscow, Idaho.

(d) Experimental; basic research for master's thesis.

(e) Laboratory tests have been conducted with friction and pressure drop in fluidized suspensions of solids and gases. Also tests have been made to determine heat transfer coefficients in fluid media and to develop correlations for their estimations.

(f) Active.

(g) Over the range of conditions studied, pressure drop in flow of fluidized media showed the relative velocity of gas to sand to be about 3.5 to 1, and pressure drop could be expressed as a function of this ratio and Reynolds number. A study of heat transfer film coefficients in fluidized media indicates that for the range investigated, film transfer coefficients are increased 50 percent. Alterations of equipment to give more exact temperature data are needed for quantitative correlations.

(h) "Pressure drop in flow of fluidized media", T. A. Arnold. Master's thesis, University of Idaho. May 1948.

"Heat transfer film coefficients in fluidized media", R. N. Stanfield. Master's thesis, University of Idaho. May 1948.

(550) DETERMINATION OF SETTLING RATES.

(b) Laboratory project.

(c) Prof. L. A. Jobe, Chemical Engineering Department, Kirtley Laboratory, University of Idaho, Moscow, Idaho.

(d) Experimental; basic research, master's thesis.

(e) Laboratory tests have been conducted on effect of concentration on the settling rates of spherical particles and the effect of particle density on free settling rates.

(f) Active.

(g) A study of the effect of particle concentration on their settling rate showed that a correlation could be made by plotting the drag coefficient against a modified Reynolds number for fluid flow past spheres at different values of volume of voids. From this chart, settling rates can be predicted for conditions within the range of Reynolds number 15 to 8,000. An empirical equation

correlating the data was also developed.

(h) "The effect of concentration on settling rates of particles", E. S. Grimmett. Master's thesis, University of Idaho. May 1948.

ILLINOIS INSTITUTE OF TECHNOLOGY, Technology Center, Chicago, Ill.

(1) TURBULENT FLOW IN ARTIFICIALLY ROUGHENED PIPES.

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

(c) Dr. V. L. Streeter, Illinois Institute of Technology, Technology Center, Chicago, Ill.

(d) Experimental; basic research.

(e) To investigate the relationships between friction factor "f", velocity distribution profile, and geometrical types of roughness at fully developed turbulent flow by using artificially roughened pipes. Tests are being conducted in 4-1/2 inch aluminum pipe, the inside of which was cut into a spiral groove leaving square protuberances, 0.055-inch by 0.055-inch, at different spacings. Deviations from von Karman-Prandtl velocity distribution law appear at both the center portion and at the wall region. For the same roughness pattern, three different relative roughnesses cut into pipes will be investigated. Tests in pipes of larger diameter with air flow are also being planned.

(f) Active. The first series of experiments on pipes with the artificial roughnesses at different spacings has been completed.

(h) Nine issues of quarterly progress report, "Turbulent flow and heat transfer in artificially roughened pipes".

ILLINOIS STATE WATER SURVEY DIVISION, Urbana, Ill.

(551) RUNOFF FROM SMALL WATERSHEDS.

(b) Laboratory project, carried out in cooperation with U. S. Geological Survey.

(c) W. J. Roberts, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; applied research, design.

(e) Measurements are being made of watershed rainfall and stream flow, of stage, discharge over the spillway, and municipal pumpage on five small water supply reservoirs in Illinois.

(f) Active.

(g) Twenty years of continuous measurements have been completed.

(h) "Hydrology of five Illinois water supply reservoirs", W. J. Roberts. Bulletin 38, Illinois State Water Survey Division, 260 pp. 1948.

(552) SEDIMENTATION OF ILLINOIS RESERVOIRS.

(b) Laboratory project, in cooperation with Office of Research, U. S. Soil Conservation Service, and Illinois Agricultural Experiment Station.

(c) J. B. Stall, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; applied research.

(e) For design of water supply reservoirs, measurements of sediment accumulation have been made on eight lakes in Illinois. Sediment samples are being analyzed and complete surveys of watershed soil type, slopes, land use, and conservation practices are being made.

(f) Active.

(g) Results at Lake Decatur, Decatur, Ill., showed correlation between rate of sedimentation in the reservoir and the land use on the watershed.

(h) "Causes and effects of sedimentation in Lake Decatur", C. B. Brown, J. B. Stall, E. E. DeTurk. Bulletin 37, Illinois State Water Survey Division, 62 pp, illus. March 1947.

(553) CLOUD PHYSICS PROJECT.

(b) Laboratory project, in cooperation with the Pfister Hybrid Corn Co., El Paso, Ill.

(c) G. E. Stout, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; basic research.

(e) A radar installation is being used to track rainclouds, showing areal extent of each rain area and movement. Rainfall data are collected over a concentrated network of 46 rain gages and correlated with the radar for quantitative rainfall measurement.

(f) Active.

(g) Results indicate that radar will give an accurate picture of rainfall extent. Radar can be used for short period rainfall forecasts.

(h) "Report on May-June, July, August 1948 rainfall", F. A. Huff, G. E. Stout. Illinois State Water Survey Division, 22 pp. 1948.

(554) GROUND WATER RESOURCES IN WINNEBAGO COUNTY, ILLINOIS.

(b) Laboratory project.

(c) H. F. Smith, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; applied research.

(e) For design of well field extension, measurements were made of water levels, and chemical analyses of the water were made of a great number of wells in Winnebago County and in the industrial city of Rockford. Records were available of the decline of water levels in the past ten years. An analysis of the water movement on the surface and in the various aquifers was made in an effort to find the best source for water supply development.

(f) Suspended.

(g) Indications are that as much as 75 to 100 million gallons per day of ground water is discharging into the streams of the area. A substantial increase in pumpage in the neighborhood of Rockford would lower the hydrostatic pressure of the sandstones so that much of the ground water now being discharged into the streams would become available.

(h) "Ground water resources in Winnebago County", H. F. Smith and T. E. Larson. Report of Investigation No. 2, Illinois State Water Survey Division, 35 pp. 1948.

(555) EVAPORATION IN ILLINOIS.

(b) Laboratory project.

(c) W. J. Roberts, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; applied research.

(e) Measurements are being made of evaporation at two Class A pan-type stations and one psychrometric station on a small lake. An installation is being made at Urbana and includes a Class A pan-type station plus automatic dew-point recorders located at different elevations above a nearby stream. This installation will

furnish a continuous record of the vapor pressure gradient which may be correlated with the pan evaporation measurements.

(f) Active.

(g) Measurements have been made during only two growing seasons, and no general interpretation of these data have been made.

(h) Records are published in the monthly Climatological Data Bulletins of the U. S. Weather Bureau.

(556) PERMEABILITY OF GRADED SAND MIXTURES.

(b) Laboratory project.

(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Experimental; basic research.

(e) The permeability of known mixtures of graded sand is measured to determine functional changes.

(f) Suspended, waiting for completion of Peoria laboratory.

(g) Preliminary tests show a non-linear change in permeability in gradually varied mixture from one size of sand to a smaller one with a minimum permeability at from 60 to 70 percent of the larger size and 40 to 30 percent of the smaller size in tightest packing.

(557) TURBULENT FLOW THROUGH GRANULAR MEDIA.

(b) Laboratory project.

(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Experimental; basic research.

(e) Critical flow is determined to define conditions under which turbulent flow occurs outside of well screens.

(f) Suspended, waiting for completion of Peoria laboratory.

(g) In flow through granular media, the Reynolds number cannot be calculated from ordinary formulas. By assuming a critical Reynolds number as existing at the determined critical flow conditions, the corresponding pore size can be calculated. This has been done in preliminary tests, but further work is needed to get a correlation with screen analysis.

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

(b) Laboratory project.

(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; basic research.

(e) Sand boils occur during floods in leveed districts. These are mapped, classified, and sampled. Also sampled are river and nearby well waters.

(f) Active whenever floods occur.

(g) From chemical analyses and temperature measurements it was found that the water flowing in typical sand boils (those free from pipe connections towards the river) is different from the river water and similar to well water in neighboring wells. Such sand boils can be stopped from flowing by damming them up to a level that is below that of the river stage. They are not caused by leaks through the levee.

(559) ARTIFICIAL RECHARGE OF GROUND WATER.

(b) Laboratory project.

(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.

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

(e) Determination of amounts of water that can be put into the ground and its reduction by silting in laboratory tests and experimental field pit.

(f) Suspended, waiting for completion of Peoria laboratory.

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

(b) Laboratory project.

(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; basic research.

(e) To determine the ground water resources of the district, inventory of wells was made, including construction and logs of wells. Ground water levels are measured continuously, pumpage data collected, river stages and rainfall recorded, chemical analyses for changes in composition of ground water are made, areas of infiltration are determined, and all data are correlated with consideration of local ground conditions.

(f) Active.

(g) The existence of a recession was proven to be due to overpumpage and high local concentration of pumpage. Remedial measures have been recommended.

(h) "A pilot study of ground water resources in Peoria County, Ill.", Max Suter. Trans. American Geophysical Union, Vol. 24, Pt. II: 493. 1943.

"Apparent changes in water storage during floods at Peoria, Ill.", Max Suter. Trans. American Geophysical Union, Vol. 28; 425. 1947.

A manuscript of a general report is ready for publication.

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

(b) Laboratory project.

(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; basic research.

(e) To determine the ground water resources of the district, inventory of wells was made, including construction and logs of wells. Ground water levels are measured continuously, pumpage data collected, river stages and rainfall recorded, chemical analyses for changes in composition of ground water are made, areas of infiltration are determined, and all data are correlated with consideration of local ground conditions.

(f) Active.

(g) The existence of a recession was proven in locally overpumped areas.

(h) "Ground water studies in the East St. Louis district." The Illinois Engineer, Vol. 18: 16. 1942.

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

Inquiries concerning Projects Nos. 64, 297, 562, and 563 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.

(d) Experimental; basic research.

(e) 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, page 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.

(f) Experiment completed.

(h) Publication of results in Bulletin No. 381 of Illinois Engineering Experiment Station now in press.

(297) FLOW THROUGH ANNULAR PIPES.

(b) Laboratory project. (d) Theoretical and experimental; basic research.

(e) Experimental work was studied and coordinated with an analytical analysis.

(f) Work completed and paper being prepared for publication.

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

(b) Laboratory project.

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

(e) A Lucite channel 6 inches in cross-section and 15 feet long will be used to study velocity distribution in such a channel and to find the criterion to determine laminar or turbulent flow in open channels.

(f) Apparatus being built.

(563) A CALIBRATION OF SEVERAL COMMERCIAL VISCOSIMETERS AND AN ANALYSIS AND COMPARISON OF THEIR SPECIFICATIONS.

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

(e) Several commercial viscosimeters of different types will be carefully calibrated and compared. A critical analysis of the specifications of each type of viscosimeter will be made.

(f) Work in progress on five types of viscosimeters.

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

(296) INVESTIGATION OF STORM DRAINS FOR EXPRESS HIGHWAYS.

(b) Laboratory project, in cooperation with Illinois Division of Highways, and U. S. Public Roads Administration.

(c) Prof. J. J. Doland, Director of Research, and John C. Guillou, Civil Engineering Department, University of Illinois, Urbana, Ill.

(d) Experimental; basic research and design.

(e) Tests are being conducted on 1:3 and 1:2 models to determine the flow characteristics on pavements, gutters, grates, inlet boxes, catch basins, and collecting systems.

(f) Active.

(564) HYDROLOGY OF URBAN AREAS.

(b) Laboratory project, in cooperation with the Illinois Water Survey Division, and U. S. Geological Survey.

(c) Prof. J. J. Doland, Director of Research, Civil Engineering Department, University of Illinois, Urbana, Ill.

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

(e) Nine rain gages, one complete evaporation station including recording dew-point device, one radar station, and one recording stream gaging station are being installed for the determination of rainfall and runoff for an area comprising about four square miles.

(f) Active.

IOWA INSTITUTE OF HYDRAULIC RESEARCH, State University of Iowa, Iowa City, Iowa.

(66) HYDROLOGIC STUDIES, RALSTON CREEK WATERSHED.

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

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

(d) Field investigation; applied research and masters' theses.

(e) Study being made of relation between rainfall and runoff over a small area. Discharge from a 3-square-mile area measured by U. S. Geological Survey; rainfall records at five automatic recording stations collected by Soil Conservation Service. Continuous records since 1924 of precipitation, runoff, ground water levels, and vegetal cover.

(f) Active.

(g) Yearly records available for examination at Iowa Institute of Hydraulic Research.

(h) "A study of concentration time on Ralston Creek watershed", R. L. Smith. Master's thesis, State University of Iowa. August 1948 (available on loan).

(67) COOPERATIVE SURFACE-WATER INVESTIGATIONS IN IOWA.

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

(c) L. C. Crawford, Iowa Institute of Hydraulic Research, Iowa City, Iowa.

(d) Field investigations; applied research.

(e) Stream-flow measuring stations maintained throughout the State of Iowa cooperatively on a continuing basis. Records collected by standard methods of U. S. Geological Survey.

(f) Active.

(g) Stream-flow data computed and published.

(h) Records contained in Water-Supply Papers available through offices of the U. S. Geological Survey.

(68) HYDROLOGIC STUDIES, RAPID CREEK WATERSHED.

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

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

(d) Field investigation; applied research and masters' theses.

(e) Study being made of relation between rainfall and runoff over a small area. Discharge from a 25-square-mile area measured by U. S. Geological Survey; rainfall records at five automatic recording stations collected by Soil Conservation Service. Continuous records since 1941 of precipitation, runoff, ground water levels, and vegetal cover.

(f) Active.

(69) RELATION OF SEDIMENT CHARACTERISTICS TO BED EROSION.

(b) Sponsored in part by the Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.

(c) Emmett M. Laursen, State University of Iowa, Iowa City, Iowa.

(d) Experimental; for doctor's thesis.

(e) To evaluate general relations between geometric and kinematic parameters of flow and mean size and grading of bed sediments for an arbitrary condition of scour. Experiments to be conducted in glass-walled flume 15 feet long, 3 feet deep, 1-1/2 feet wide. Selected geometrical proportions will be kept constant during all runs, the variables being the rate of flow, the mean diameter and standard deviation of the sediment, and the time and depth of scour.

(f) 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, U. S. Navy Department.

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; basic research.

(e) To utilize the electrical analogy in the determination of the pressure distribution around bodies of revolution and along nozzle contractions and the profile forms of three-dimensional jets. Velocity and pressure distributions are determined along the boundary of Lucite models of various bodies of revolution, or segments thereof. Free-surface profiles are determined to satisfy the conditions of constant velocity or constant piezometric head along the surface. Studies of jet profiles are being continued.

(f) Active.

(h) "Use of the three-dimensional electrical analogy in the design of conduit contractions", M. M. Hassan. Doctor's thesis. August 1948. (Available on loan.)

"Deflection of a liquid jet by a perpendicular boundary", Andre Leclerc. Master's thesis. August 1948. (Available on loan.)

"Electrical analogy facilities design of cavitation-free inlets and contractions", Hunter Rouse and M. M. Hassan. Will be published in the spring of 1949 by A.S.M.E.

(73) MEASUREMENT OF TURBULENCE IN FLOWING WATER.

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

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; basic research and masters' theses.

(e) To develop practical instruments for the measurement of turbulence in flowing water. Electromagnetic and hot-wire devices, the effects of variation of electrical potential at a liquid-solid interface, and sensitive electrical pressure elements are being studied experimentally with the goal of devising an instrument which will indicate instantaneous and root-mean-square magnitudes of velocity components along three axes.

(f) Active.

(75) DIFFUSION OF SUBMERGED JETS.

(b) Sponsored in part by the Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; for masters' theses.

(e) To provide information as to distribution of velocity and turbulence in two- and three-dimensional submerged jets. The velocity distribution in the air jet with unlimited boundary was studied as a function of longitudinal and lateral distribution, velocity of efflux and size of outlet, and results were reduced to dimensionless relationships. The distribution of turbulence is being studied in a similar manner. The third phase extends the problem to the diffusion of the flow from a submerged sluice gate. The air jet with limited boundary is under investigation.

(f) Active.

(h) "Diffusion of submerged jets", M. L. Albertson, Y. B. Dai, R. A. Jensen, and Hunter Rouse. In process of publication by A.S.C.E.

"Investigations in the diffusion of submerged jets", W. D. Baines. Master's thesis. August 1948. (Available on loan.)

"Diffusion of flow under a submerged sluice gate", H. K. Liu. Master's thesis. February 1949. (Available on loan.)

(76) GRAVITATIONAL PHENOMENA IN STRATIFIED FLOW.

(b) Sponsored in part by the Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Theoretical and experimental; basic research and masters' theses.

(e) To provide general information on flow characteristics, such as velocity distribution and pattern and distribution of turbulence for relative motion between fluids of slightly different density due to heat, salinity, or suspended sediment. Studies involve characteristics of sub-surface waves, diffusion across an interface, and mixing due to gravitational convection.

(f) Active. Present phase of project involves free convection from single and parallel line sources.

(g) Characteristics of sub-surface waves, diffusion, and patterns of mean flow and turbulence have been investigated and reports on those phases prepared.

(h) "Free convection due to a point source of heat", C. S. Yih. Doctor's thesis. August 1948. (Available on loan.)

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

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

(c) D. E. Metzler, State University of Iowa, Iowa City, Iowa.

(d) Experimental; applied research.

(e) A model of a 1300-meter reach of the Paraiba River complete with dam was built of concrete at a 1:75 undistorted scale. Prevailing currents and sediment movement were determined, and a sediment-diversion structure consisting of groins and walls about the intake forebay has been studied. Investigations of flow conditions of the unimproved river and recommendations for improving the river and diverting the bed load have been completed. The operation of the gates for diversion of the bed load past the intake forebay was studied by means of potassium permanganate crystals and photographs, to determine the directions of the bottom currents, and by timing the passage of small spheres over the measured distances on the river model bottom to determine the relative bottom velocities. A half-model of one Tainter gate at a 1:14 scale was installed in a 2.5-foot glass-walled channel for study of the discharge characteristics and the pressure distribution on the gate and on the channel bottom under the gate.

(f) Active.

(g) Report of results submitted to Canadian-Brazilian Limited, Toronto, Canada.

(h) "A model study of tainter-gate operation", D. E. Metzler. Master's thesis, State University of Iowa. August 1948. (Available on loan.)

(79) CAVITATION.

(b) Sponsored in part by Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.

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

(d) Experimental and theoretical; basic research and masters' theses.

(e) Basic design information on pressure distribution around systematically varied boundary forms under various degrees of cavitation is sought. Tests are conducted in a 13-inch variable-pressure water tunnel. Measurements are made to determine effect of variation of boundary form, Reynolds number, and degree of cavitation on the pressure distribution around two- and three-dimensional boundaries by using 1-inch models. The boundary forms 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 being 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 being continued in a two-dimensional test section of the larger water tunnel to obtain data for a systematic series of slot dimensions and superelevations and curvature of the downstream edge of the slot.

(f) Active.

(g) A bulletin has been prepared, describing the preliminary tests and the results of measurements on various head forms at zero angle of yaw. Studies have been made at yaw angles other than zero, and the extension of the study of boundary discontinuity is well under way.

(h) "Cavitation and pressure distribution, head forms at zero angle of yaw", Hunter Rouse and John S. McNown. State University of Iowa Studies in Engineering, Bulletin 32.

"The effect of angles of yaw on pressure distribution around various head forms", C. A. Lamb. Master's thesis, State University of Iowa. August 1948. (Available on loan.)

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(80) TURBULENCE BEHIND SCREENS.

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

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

(d) Experimental project; basic research.

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

(f) Active.

(g) The influence of screen geometry upon the characteristics of both the mean flow and the turbulence has been determined. A summary of the wind-tunnel studies is being prepared.

See also Project No. 175, "Variable Pressure Water Tunnel - 60-inch", David Taylor Model Basin, page 144.

(81) MATHEMATICAL ANALYSIS OF PRESSURE DISTRIBUTION.

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

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

(d) Theoretical; basic research.

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

(f) Active.

(g) Computations for wedge shapes of various angles and representative computations for several boundary forms have been completed. A report will present adaptations of the von Kármán approximate method of determining pressure distribution and comparisons of the pressure distribution for two- and three-dimensional forms. The results on axisymmetric head forms are compared with experiments in the reports listed under Project 79, "Cavitation", page 37.

(82) HYDRAULICS OF MANIFOLDS.

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

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

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

(e) Divided and confluent flow in pipe lines have been studied. Tests were conducted in a 2-inch smooth brass pipe with a single right-angle lateral to determine the effect of discharge ratio and diameter ratio upon the changes in pressure at the junction. The effect of spacing in multiple lateral manifolds and the

pattern of flow and pressure variation in the immediate vicinity of the junction were studied.

(f) Essentially completed.

(g) Pressure variations for both divided and confluent flow have been determined, and rational explanations have been made of various phases of the occurrence.

(h) "Studies of manifold flow", Julio Escobar. Master's thesis, State University of Iowa. August 1948. (Available on loan.)

(298) FALL VELOCITY OF SEDIMENT.

(b) Laboratory project.

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

(d) Experimental; basic research and masters' theses.

(e) The effect of a cylindrical boundary and the particle shape on the fall velocity of individual particles, and the effects of concentration on the rate of settlement of sediment samples are being investigated. The fall velocities of spheres of various sizes, falling along the axes of vertical cylinders of selected diameters and through fluids of different viscosities, have been determined. Data have been collected through use of stroboscopic timing and a thermostatically controlled bath for sphere to cylinder diameters ranging from zero to unity, and for all Reynolds numbers from less than 1000. Approximate theoretical analyses have been made which agree well with the experimental results within the Stokes' range. The fall velocities for a variety of regular shapes have been determined, using the same equipment and technique. Analyses are being made and parameters sought in an attempt to systematize the effects of shape. Measurements are also being made of the effect of particle spacing, using clouds of uniform sediment.

(f) Active.

(g) Study of the cylindrical boundary effect has been completed, and investigation of the effects of shape is nearly complete. Experiments on the effects of sediment concentration are under way.

(h) "Influence of the boundary proximity on the drag of spheres", J. S. McNown, H. M. Lee, M. B. McPherson, S. M. Engez. Proc. VII Intern. Cong. of Appl. Mech., London, England. September 1948. (Publication pending.)

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

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

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

(d) Experimental; applied research and masters' theses.

(e) To determine pressure distributions on three-dimensional building forms of various proportions, for winds of different angles and velocities. Experiments conducted in wind tunnel; maximum velocities, 35 fps.

(f) Active. Study of block forms completed; investigations now being made of hangar-type structures.

(h) "Pressure distribution on models of three-dimensional buildings exposed to moving air", Ning Chien, Yin Feng, and Hung-Ju Wang. Master's thesis, State University of Iowa. June 1948. (Available on loan.)

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

(b) Laboratory project.

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

(d) Experimental; for master's thesis.

(e) Investigation of the effects of various sizes, shapes, and spacings of the

rotating elements on the operation of the vertical-axis water-velocity meter. 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.

(f) Completed.

(g) Studies of the effects of the number of cups and the angle of approach of the water on meter operation for the standard-sized Price cups, from 3 to 6, have been completed and dimensionless parameters studied.

(h) "Investigation of the effects of various spacings of the rotating elements on the operation of the vertical-axis water-velocity meter", Erik Raestad. Master's thesis (in preparation).

(301) TESTS OF A MUSHROOM (MORNING-GLORY) SIPHON SPILLWAY.

(b) Laboratory project.

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

(d) Experimental; for master's thesis.

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

(f) Completed.

(g) Tests were conducted to determine head required for priming and rates of flow for a circular spillway with dome suspended above, using different dome elevations.

(h) "Test on morning-glory type of siphon spillway", H. S. Chowdhary. Master's thesis, State University of Iowa. June 1948. (Available on loan.)

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

(b) Laboratory project

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; for doctor's and masters' theses.

(e) To develop a technique for rapid size-frequency determination by measurement of pressure differentials during relative motion between sediment and suspending liquid. Sample is introduced at top of a water-filled tube containing a pervious piston which can be displaced along axis of tube. Piezometers at top of tube and just above piston permit differential pressure, and hence immersed weight of suspended sediment, to be recorded during traverse of tube by piston.

(f) Active.

(h) "Development of a stratified-suspension technique for size-frequency analysis", H. J. Skidmore. Doctor's thesis. August 1948. (Available on loan.)

(565) AN INVESTIGATION OF THE AERODYNAMIC STABILITY OF BRIDGE SECTIONS.

(b) Laboratory project.

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; for master's thesis.

(e) A study of methods for increasing the aerodynamic stability of suspension bridge sections to provide safeguards against dangerous wind forces.

(f) Complete.

(g) The test performed indicated that conventional bridge sections are aerodynamically unstable and should not be used for suspension bridges where this unstability is a very important factor in determining the life and usefulness of the structure. Deck slots in H-sections had a definite stabilizing tendency.

(h) "An investigation of the aerodynamic stability of bridge sections", Elmo G. Peterson. Master's thesis, State University of Iowa. August 1948. (Available on loan.)

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

(b) Laboratory project.

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

(d) Field investigation; applied research for masters' theses.

(e) A study of storm intensities, areal extent, and runoff for the development of the form of the unit hydrograph for certain Iowa streams.

(f) Active.

(567) A STUDY OF FLOW OVER LATERAL SPILLWAYS.

(b) Laboratory project; partially supported by A.S.C.E. through J. Waldo Smith award.

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

(d) Experimental; applied research and masters' theses.

(e) Flow over a sharp-crested weir in one side of a rectangular channel is being studied as a function of the channel and weir dimensions, the channel depth, and the Froude number of the channel flow above the weir.

(f) Active.

(g) For the case of zero flow continuing past the weir, a marked influence of the Froude number for the approaching flow on the effective discharge coefficient for Froude numbers greater than 0.3 has been found.

(h) "A study of flow over lateral spillways", Hector Moreno-Gomez. Master's thesis, State University of Iowa. August 1948. (Available on loan.)

(568) SCOUR AT BRIDGE PIERS AND ABUTMENTS.

(b) Iowa State Highway Commission and Public Roads Administration of the Federal Works Agency.

(c) Emmett M. Laursen, State University of Iowa, Iowa City, Iowa.

(d) Experimental; applied research.

(e) It is planned to investigate the effects of pier and abutment geometry, sediment properties, and stream flow characteristics on the rate and pattern of scour, to the end of providing safe design criteria.

(f) Initial phase; the study of pier and abutment geometry was begun in September 1948.

(569) DESIGN AND CONSTRUCTION OF SEDIMENT TRANSPORT FLUME.

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

(c) Emmett M. Laursen, State University of Iowa, Iowa City, Iowa.

(d) Experimental; basic research and masters' theses.

(e) Flume is intended for simultaneous study of bed load and sediment load transportation. Flume will have an overall length of 100 feet, a width of 3 feet, and a depth of 15 inches, with controlled variation in slope from minus 0.5 percent to plus 1.0 percent, and a maximum discharge of 5 cubic feet per second.

(f) Flume should be in operation by Spring of 1949.

(570) ANALYSIS OF EVAPORATION AS A BOUNDARY-LAYER PHENOMENON.

(b) Laboratory project.

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; doctor's thesis.

(e) An investigation of the effect of the different types of boundary layer and the extent of their development upon the rate of evaporation. Special equipment is used in an experimental air tunnel to obtain data.

(f) Complete.

(h) "Analysis of evaporation as a boundary-layer phenomenon." M. L. Albertson. Doctor's thesis, January 1948, (Available on loan.)

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

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

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; design.

(e) Tunnel is planned primarily for study of flow around two-dimensional bodies, although interchangeable test sections will eventually be provided. Initial test section will have a width of 6 inches and depth of 2 feet, with maximum water speed of 40 fps.

(572) DESIGN AND CONSTRUCTION OF A LOW-VELOCITY AIR TUNNEL.

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

(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; design.

(e) Facility is planned for use in the study of boundary-layer development over rough surfaces. Test section will be 30 feet long, with 5-foot octagonal test section. Air speeds will range from 10 to 100 fps.

(f) Tunnel should be in operation by Spring of 1949.

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

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

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

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

(d) Experimental; basic research.

(e) Determination of pressure variation as a function of velocity head, magnitude of misalignment, and Froude number. An attempt will be made to correlate data with cavitation phenomena experiences with hydraulic structures; also to define misalignment tolerances for hydraulic structures. Pressure is measured along the bottom of an open channel in which a transverse step of variable height has been placed. Velocity and depth of flow, size and shape of steps are varied.

(f) Tests on 90° steps should be completed by June 1949.

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

(b) Laboratory project; major portion sponsored by Gannett, Fleming, Corddry and Carpenter, Inc., consultants for project.

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

(d) Experimental; design.

(e) Determination of stage-discharge relationships under varying conditions, evaluation of conduit transition loss. Drop-inlet type, with orifice at top, trash rack mounted over orifice. For flood control project requiring definite stage-discharge relationship. Both bell-mouthed orifice and I.S.A. flow nozzle are being investigated.

(f) Tests are more than half completed.

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

(303) A COMPARATIVE STUDY OF SECTOR GATES.

(b) Laboratory project.

(c) Prof. Cecil S. Camp, Louisiana State University and A & M College, Baton Rouge, La.

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

(e) A 1:34.3 model of the Empire, Louisiana, navigation lock, utilizing sector gates, was constructed. Tests were conducted to determine axial pull, opening time required, and water-surface elevations in the lock under different conditions of head and gate-opening speed.

(f) Completed.

(g) The tests verified design calculations made by the Louisiana Department of Public Works. A variable speed of opening for this type of gate would obtain more efficient operation.

(h) "A hydraulic model investigation of the Empire Navigation Lock Gates", E. Q. Moulton and W. M. Robbins. M.S. thesis, August 1948. (Available on loan.)

(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) Prof. Cecil S. Camp, Louisiana State University and A & M College, Baton Rouge, La.

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

(e) A distorted model of three barge canals entering Bayou Des Glaisses in the Atchafalaya River Basin was constructed with a horizontal scale of 1:400 and a vertical scale of 1:100. Powdered coal was used as the sediment and mechanically fed into the stream. Experiments were conducted with varying diversion angles of canals so that they entered both with and away from the current in the channel; spoil banks; and submerged and full sills.

(f) Completed.

(g) Submerged sills were most effective for reducing deposition for all stages of flow, while spoil banks alone effect a material reduction when compared with overbank flow.

(h) "An analysis of silt deposition in canals in the Atchafalaya River Basin", Charles Cohen, Jr. M.S. thesis. August 1948. (Available on loan.)

(574) AN ANALYSIS OF FLOW AROUND RIVER BENDS.

(b) Laboratory project.

(c) Prof. James F. Halsey, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge, La.

(d) Theoretical and field investigation; basic research for master's thesis.

(e) An attempt is being made to correlate the results obtained by measurements on a natural channel (the Amite River) with a theoretical approach to the problem of helicoidal flow. Attention is being given to the lateral variation of sediment concentration with the hope of tracing secondary flow patterns by means of density currents.

(f) A review of existing pertinent information has been completed, and the field investigation plan is under way.

(575) CHARACTERISTICS OF INTERFACE FOR FLOW WITH FLUIDS OF DIFFERENT DENSITIES.

(b) Laboratory project, under sponsorship of Lester F. Alexander fellowship fund.

(c) Prof. James F. Halsey, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge, La.

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

(e) Tests will be conducted in a transparent flume, using salt water at a constant head and with variable rates of fresh water discharge. Shape and movement of salt water wedge and mixing characteristics will be observed.

(f) Equipment is under construction.

(576) THE EFFECT OF VARYING THE HORIZONTAL ANGLE OF THE UPSTREAM FACE OF BAFFLE PIERS.

(b) Laboratory project.

(c) Prof. Cecil S. Camp, Louisiana State University and A & M College, Baton Rouge, La.

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

(e) Tests will be conducted in a glass-walled flume, using a sluice gate to produce high velocity flow. Various horizontal angles and shapes of upstream face of rectangular baffle piers will be studied. The effect of the baffle piers on formation of the hydraulic jump and effectiveness of stilling action will be observed.

(f) Equipment is under construction.

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

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

(306) SCOUR AROUND BRIDGE PIERS.

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

(e) Qualitative study of scour patterns for various geometric arrangements of pile groups. Quantitative comparison of scour for single piles under various conditions of uniform sediment sizes.

(f) Active; partly completed.

(g) Systematic studies for various pile groups have been completed. A series of scour measurements with different bed materials and flow conditions are available which, however, need further extension with respect to grain size and hydraulic conditions.

(h) "Comparative studies of scour around bridge piles", C. H. Banks and J. E. Schremp. M.S. thesis. June 1948.

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

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

(d) Theoretical and experimental; graduate research.

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

(f) Active; partly completed.

(g) Comprehensive analysis of density flows on basis of gravity and inertia forces was compiled. Experimental study of underflow in reservoirs at equilibrium of gravity and viscous forces was carried out in a glass-walled tank. Velocity distributions in reservoir and density current were determined. Critical stage of flow beyond which mixing occurs was determined for a large range of characteristic parameters. Work to be continued with a wider reservoir to reduce wall effects.

(h) "Investigation of mixing criteria for density currents", E. T. Podufaly and C. C. Noble. M.S. thesis. June 1948.

(308) SUPERCRITICAL FLOW IN OPEN CHANNEL CONTRACTIONS.

(b) Laboratory project. (d) Theoretical and experimental; graduate research.

(e) Theoretical analysis of standing wave patterns for supercritical flow in open channel contractions. Experimental measurements to verify analytical results were made for straight wall contractions.

(f) Completed.

(g) Basic tests for a limited range of Froude numbers in high velocity channel have verified essentially the theoretical analysis.

(h) "Channel transitions in supercritical flow of water", J. C. Adams, Jr., B.S. thesis. June 1948.

A comprehensive paper has been prepared for publication in Proc. A.S.C.E.

(309) CHARACTERISTICS OF OSCILLATORY WAVES.

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

(d) Experimental; basic and graduate research.

(e) Systematic investigation of forms and propagation of oscillatory waves. Development of techniques to record instantaneously wave forms, internal velocities, and pressures during passage of a wave. A Lucite wave tank has been built with a tilting device. Experimental techniques to photograph particle motion within a wave have been developed.

(f) Active.

(h) "Forms and propagation of waves in shallow water", A. H. Bagnulo and R. B. Burlin.

Master's thesis. June 1948.

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

(b) Laboratory project. (d) Theoretical; graduate thesis.

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

(f) Completed.

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

(h) "A theoretical study of flood waves resulting from sudden dam destruction", T. M. Nosek and R. I. Dice. Master's thesis. June 1947.

(311) HYDRAULIC ANALOGY TO SUPERSONIC FLOW OF GASES.

(b) U. S. Air Forces. (d) Experimental; basic research.

(e) The project is to provide experimental evidence for a wide range of Froude numbers as to the extent to which hydraulic shock waves conform to the theoretical analysis based on the analogy of hydraulic shock waves to supersonic flow of gas. A high velocity flume which can be tilted up to slopes of ten percent has been constructed. For 30 feet of the flume, the bottom consists of glass for easier observation of wave patterns.

(f) Active.

(577) CHARACTERISTICS OF SOLITARY WAVES.

(b) Laboratory project; also sponsored by the Office of Naval Research, U. S. Navy Department.

(d) Experimental; graduate research.

(e) Investigation of solitary wave characteristics for comparison with various mathematical theories. Forms and velocity of propagation of solitary waves are to be determined. Internal velocities and pressures are recorded instantaneously and related to wave form and relative wave height. The work is done in the Lucite wave tank mentioned in Project No. 309, page 45.

(f) Active.

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

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

(d) Experimental; development of instrumentation.

(e) Theoretical and experimental study of various instruments and methods to record instantaneous values of velocity and pressure in a turbulent flow.

(f) Active.

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

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

(d) Experimental; basic research.

(e) The influence of unsteady flow patterns on submerged bodies is to be explored in a specially developed water tunnel. The flow in the working section is to be adjusted so that desired accelerations can be maintained for a short length of

time. Total resistance and pressure distributions are to be determined for such flow.

(f) Active.

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

(b) U. S. Public Health Service. (d) Experimental; basic research.

(e) In the activated sludge process for sewage and industrial waste treatment, oxygen is transferred from the air supplied by various methods of air dispersion. The nature of the oxygen transfer is to be explored experimentally, and quantitative measurements of this transfer will be carried out systematically for different dispersion methods. With this information, means of more efficient oxygen transfer may be devised.

(f) Active.

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 Department.

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

(d) Experimental; basic research and design.

(e) Water at supercritical velocities flows in an open channel. The flow around bodies of various shapes is studied as regards wave patterns and water heights. The primary object is to obtain results which are applicable to the two-dimensional flow of a compressible gas.

(f) Active.

(g) Studies have been made of wave formation, wave interactions, wave reflections, flow through supersonic diffusers, and flow through supersonic cascades. The results are in good qualitative agreement with the results for gas flow, but must be used with caution for design purposes.

(h) "A study of supersonic diffusers; an application of the hydraulic analogy", B. D. Langtry, M.S. thesis, Massachusetts Institute of Technology, 1948.

"Experimental studies on supersonic cascades using water analogy", F. L. Giraud, M.S. thesis, Massachusetts Institute of Technology, 1948.

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

(b) Laboratory project.

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

(d) Experimental; basic research; student theses.

(e) Repeated pressure applied very suddenly by a liquid to a metal surface produces damage similar to that caused by cavitation. It is proposed to determine how sudden the application of repeated pressure must be to cause damage, and the character of the damage. Various liquids and specimen materials will be used.

(f) Active.

(g) Pressure waves of 1000 psi amplitude and building up at a rate of 100 psi per

microsecond have been found to deform an aluminum surface after 100,000 applications. Depth of deformation is about 0.001 inch.

(h) "Material testing by means of liquid impact, I.", C. G. Bragaw. Master's thesis, Massachusetts Institute of Technology. June 1948.

"Material testing by means of liquid impact, II.", L. E. Sobolewski, et al. Master's thesis, Massachusetts Institute of Technology. September 1948.

"A study of damage to metals caused by liquid impact", W. D. Allingham. Master's thesis, Massachusetts Institute of Technology. September 1948. (All available on loan.)

(581) INVESTIGATION OF THE COLLAPSE OF FLUID CAVITIES.

(b) Laboratory project.

(c) Prof. S. H. Crandall, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.

(d) Theoretical; basic research.

(e) The mathematical analysis of the flow of a compressible fluid is being applied to the field surrounding a fluid cavity in order to determine the theoretical pressure and velocity history.

(f) Active.

(g) An analysis based on the acoustic approximation has been completed.

(h) "On the collapse of a cavity within a fluid", S. H. Crandall. Submitted to Journal of Applied Mechanics for publication.

(582) TEMPERATURE MEASUREMENT OF HIGH TEMPERATURE GAS STREAMS.

(b) Laboratory project.

(c) Prof. Warren M. Rohsenow, Massachusetts Institute of Technology, Cambridge 39, Mass.

(d) Experimental; master's thesis.

(e) A sample of gas is continually drawn off through a water-cooled sampling tube placed in the gas stream. The static and dynamic pressures are measured at a point near the mouth of the sampling tube. The gas sample is passed through a cooler, and then its rate of flow is measured. From the two pressure readings and the rate of flow the temperature of the stream is deduced.

(f) Active; experimental apparatus is being constructed.

(583) FRICTION COEFFICIENTS IN THE INLET LENGTH OF SMOOTH, ROUND TUBES.

(b) National Advisory Committee for Aeronautics.

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

(d) Experimental; basic research and design.

(e) Apparent friction coefficients were measured near the entrance region of pipes, in the region of changing velocity profile. The effects of Reynolds number and initial turbulence were studied.

(f) Completed.

(g) Friction coefficients near the pipe inlet were several times as large as those for developed flow. Near the inlet the flow is laminar, irrespective of the Reynolds number based on pipe diameter. The results for the laminar portion of the flow agree well with the theory of Langhaar. The transition to turbulence occurs at a Reynolds number (based on distance from inlet) of about one-half million, which agrees well with the results for flat plates.

(h) "Friction coefficients in the inlet length of smooth round tubes", A. H. Shapiro and R. D. Smith. N.A.C.A. Technical Note No. 1785. November 1948.

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

(584) HARBOR MODEL STUDY FOR PORT SANILAC, MICHIGAN.

(b) Laboratory project; sponsored jointly by the U.S. Corps of Engineers, and the Michigan Waterways Commission.

(c) Dr. E. F. Brater, University of Michigan, 320 West Engineering Building, Ann Arbor, Mich.

(d) Experimental; applied research.

(e) For the determination of the best breakwater arrangement, a model of the harbor is being built with an undistorted scale of 1:75. Waves are generated by a plunging type wave machine 40 feet long. Storm waves will be projected from four directions, and the reduction in wave height within the breakwaters will be recorded for a number of different breakwater arrangements.

(f) Active.

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

(585) RESISTANCE OF BARGE TOWS.

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

(c) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh 19, Pa.; or Prof. Louis A. Baier, Room 326 West Engineering Building, University of Michigan, Ann Arbor, Mich.

(d) Experimental; design.

(e) Tests will be made in the naval tank to determine resistance of several formations of certain barge types relative to non-restricted straight channels and to selected channels restricted in width and depth. Each run will consist of movement of one model formation, at one draft and one depth of water for a given channel condition through a range of velocities sufficient to define a curve of functions of resistance versus velocity.

(f) Active; preparation of the naval tank is nearing completion.

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

(116) FLOW THROUGH SMALL LOW HEAD SIPHONS.

(b) Laboratory project.

(c) Prof. J. B. Butler, Missouri School of Mines and Metallurgy, Rolla, Mo.

(d) Experimental; for student demonstration.

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

(f) Temporarily discontinued.

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

(b) Laboratory project.

(c) Prof. J. B. Butler, Missouri School of Mines and Metallurgy, Rolla, Mo.

(d) Experimental; for student demonstration.

(e) Tests have been made on several small suction devices noting effect of adhesion and cohesion of water.

(f) Temporarily discontinued.

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

(b) Laboratory project.

(c) Prof. J. B. Butler, Missouri School of Mines and Metallurgy, Rolla, Mo.

(d) Experimental; basic research.

(e) Tests are being conducted on vertical flow in pipes and tubes up to 2 inches in diameter. Experimental results are then checked by application of Bernoulli's theorem.

(f) Active.

(318) FLOW THROUGH PIPE TRANSITIONS.

(b) Laboratory project.

(c) Prof. V. A. C. Gevecker, Missouri School of Mines and Metallurgy, Rolla, Mo.

(d) Experimental; basic research.

(e) Tests on various shaped transitions were made, noting discharge and friction loss.

(f) Suspended.

(319) WEIR STUDIES.

(b) Laboratory project.

(c) Prof. E. W. Carlton, Missouri School of Mines and Metallurgy, Rolla, Mo.

(d) Experimental; basic research.

(e) Tests on several Cippoletti weirs of widths increasing up to that of channel width are being made under similar conditions.

(f) Apparatus is being renovated.

(586) FLUID FLOW IN PIPES.

(b) Laboratory project.

(c) John G. Duba, Instructor in Civil Engineering, Missouri School of Mines and Metallurgy, Rolla, Mo.

(d) Library research; basic research and master's thesis.

(e) A study of the various formulas for solution of problems on fluid flow in pipes

is being made. A correlation of the categories of roughness recommended by Prof. E. W. Schoder of Cornell University for use in the "exact type" exponential formula with the relative roughness curves of Nikuradse used in determining the Reynolds number - friction factor relationship is being undertaken.

(f) Active.

(g) A selected bibliography has been assembled.

(587) CROSS-SECTIONAL STREAM VELOCITY IN PIPES.

(b) Laboratory project.

(c) James J. Trace, Instructor in Civil Engineering, Missouri School of Mines and Metallurgy, Rolla, Mo.

(d) Experimental; basic research.

(e) For studying velocity distribution in pipes, data are obtained by a Pitot tube for a wide range of velocity heads. The equation for the velocity profile is determined for each overall velocity head and then compared with equations for other velocity heads. The parameters of the equations are also compared.

(f) Active; experiments are in progress.

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

(b) Laboratory project.

(c) James J. Trace, Instructor in Civil Engineering, Missouri School of Mines and Metallurgy, Rolla, Mo.

(d) Experimental; basic research.

(e) Using a 6-inch Auger type runner designed for a 12-foot head and having adjustable blades, the efficiency, specific speed, and horsepower output are being studied for each head and setting of the blades. The application of small water turbines in the local streams around Rolla is being studied and necessitates a knowledge of the practicability of using one model of a water turbine for all installations for small output.

(f) Active; experiments are in progress.

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 Department.

(d) Experimental; design.

(e) Several types of ship models are towed in waves of various lengths in a ship model towing basin for the purpose of evaluating their seaworthiness characteristics. Data are obtained on pitching angle, vertical acceleration, and speed reduction for head seas and stern seas. Pitching angles obtained by photographic light traces and acceleration obtained electronically. Slow motion moving pictures in color accompany the report.

(f) Completed.

(g) It was found that values of the measured quantities reached a maximum when the ship model was towed in waves of approximately one ship length.

(h) "The equipment and methods used in operating the Newport News Hydraulic Laboratory", C. H. Hancock. Trans. Society of Nav. Arch. and Mar. Eng., Vol. 56. 1948.

(321) ELECTRIC ANALOGY.

(b) Laboratory project. (d) Experimental and theoretical; for design.

(e) The purpose is to examine the possibilities of the method and apply it to problems encountered in shipbuilding and in the design of centrifugal pumps and hydraulic turbines.

(f) Active.

(322) SUPERSONIC ANALOGY TANK.

(b) Laboratory project. (d) Experimental and theoretical; applied research.

(e) To investigate the analogy between surface waves in shallow water and shock waves in a gas. A circulating water channel has been constructed. Preliminary tests on basic shapes and on steam turbine nozzles have been made.

(f) Active.

(h) For details of the equipment and photographs of test objects, see reference listed under Project No. 320, "Seaworthiness Tests", page 51.

(323) FLUID FLOW BY BENTONITE METHOD.

(b) Laboratory project. (d) Experimental; for design.

(e) To apply method of visualizing fluid flow by means of a bentonite suspension.

(f) Active.

(g) Qualitative results of fluid flow mapping are obtained.

(324) CIRCULATING WATER CHANNEL.

(b) Laboratory project. (d) Experimental; for design.

(e) To obtain a high-speed, circulating water channel model on which to make alterations. This "cut-and-try" model is to furnish the basis for a final design of a large channel.

(f) Active. Scoop models now being made; tests not yet begun.

(h) For photograph and description of channel, see reference under Project No. 320, "Seaworthiness Tests", page 51.

NEW YORK UNIVERSITY, Chemical Engineering Department, 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, Associate Professor of Chemical Engineering, New York University, University Heights, New York 53, N. Y.

(d) Experimental and theoretical; design and student theses.

(f) Current.

(589) TWO-PHASE FLUID SOLID FLOW.

(b) Laboratory project.

(c) Prof. John Happel, Department of Chemical Engineering, New York University, University Heights, New York 53, N. Y.

(d) Experimental; for master's thesis.

(e) Experiments to determine the flow characteristics of particle-fluid mixtures have been conducted as a guide to more extensive work on the pressure losses in catalyst carrier lines and flowing fluid beds. The experiments were carried out in a 1-3/4 inch I.D. Lucite tube with air as the fluid medium.

(f) Active; experimental work is almost completed; report is being written.

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

(b) Laboratory project.

(c) Prof. John Happel, Department of Chemical Engineering, New York University, University Heights, New York 53, N. Y.

(d) Experimental; for masters' theses.

(e) Experiments to determine effects of gradations in size of particles and their roughness on pressure drop. Spheres of different sizes will be supported in various assemblages and water passed through these systems.

(f) Active; experimental work just begun.

(591) DRAG COEFFICIENTS OF LIQUID DROPS IN IMMISCIBLE LIQUIDS.

(b) Laboratory project.

(c) Prof. Frank D. Maslan, Department of Chemical Engineering, New York University, University Heights, New York 53, N. Y.

(d) Experimental and theoretical; basic research and design.

(e) The drag coefficients of liquid drops falling in immiscible liquids have been determined as a function of the physical characteristics of the liquids. The experiments were carried out in a 4-inch I.D. glass tube, using nineteen different pairs of immiscible liquids. Photographs were taken of the drop shapes. These data will be used in predicting flooding velocities in liquid-liquid contacting units.

(f) Active; experimental work has been completed.

NEW YORK UNIVERSITY, Fluid Mechanics Laboratory, New York, N. Y.

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

(b) Laboratory project.

(c) A. H. Griswold, Fluid Mechanics Laboratory, New York University, University Heights, New York 53, N. Y.

(d) Experimental; master's thesis.

(e) Tests will be conducted in a smooth horizontal flume 3 feet wide and 35 feet long with water flowing at a depth of 8 inches. The presence and extent of development

of the boundary layer will be determined by the use of a Pitot tube placed at various sections throughout the flow.

(f) Apparatus is now being assembled.

NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING, Raleigh, N. C.

(593) DYNAMIC SIMILARITY OF SMALL MODELS.

(b) Laboratory project, sponsored by Department of Engineering Research.

(c) Prof. N. W. Conner, Department of Mechanical Engineering, North Carolina State College, Raleigh, N. C.

(d) Experimental and theoretical; basic research.

(e) To make a theoretical study of dynamic similarity of small hydraulic models and at large scale ratios.

(f) One phase of the project has been completed, and a bulletin is being written.

(g) The results of the experiments will be coordinated with existing data to form an integrated series giving a complete picture of present knowledge.

NORTHWESTERN UNIVERSITY, The Technological Institute, Evanston, Ill.

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

(b) Laboratory project.

(c) Prof. W. S. Hamilton, Department of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.

(d) Experimental; basic research.

(e) Tests are to be conducted in a towing tank to determine the resistance coefficients of simple barge forms in terms of the shape and dimensions of the forms relative to the depth and width of the water in which they are towed. Speed is to be measured with a spark chronograph and resistance with a recording dynamometer carried by the model.

(f) Suspended; satisfactory equipment completed; no test results.

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

(b) Laboratory project.

(c) Prof. L. H. Kessler, Department of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.

(d) Experimental; for design.

(e) Tests are conducted to determine the extent to which surge pressures in pipe lines may be relieved by a preloaded, gas-filled compression chamber in which the gas is separated from the liquid in the pipes by a stainless steel bellows.

(f) Active.

(g) The present phase of the work has shown this type of unit free from fatigue

failure and capable of protecting pipe systems from severe shock.

(h) Progress report giving test data available on request.

(326) CAVITATION DAMAGES UNDER CONTROLLED CONDITIONS.

(b) Laboratory project.

(c) W. S. Hamilton, Associate Professor of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.

(d) Experimental; basic research, for masters' theses.

(e) The pressure in a vertical column of liquid is caused to fluctuate by a motor-operated piston and bellows arrangement, thereby forming and releasing a cavity at the top of the column. The amount of damage to various engineering materials will be related to variables such as size of cavity, static load, dissolved air content, and proximity of material to point of cavity collapse.

(f) Active.

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

(b) Laboratory project.

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

(d) Experimental; for masters' theses.

(e) A photoelectric apparatus has been developed to measure the turbidity of liquids. It includes a photoelectric cell, light source, amplifier, and ammeter. The ultimate objective is to determine the coagulent or coagulent aids which will eliminate low temperature sedimentation difficulties.

(f) Active. Apparatus has been completed; coagulation and sedimentation studies are now in progress.

(h) "Photoelectric investigation of the coagulation and sedimentation characteristics of Lake Michigan water", R. B. Banks and A. J. Fox. Masters' thesis, Northwestern Technological Institute, December 1948. (Available on loan.)

(595) METASTABLE FLOW OF SATURATED WATER.

(b) Laboratory project.

(c) J. F. Bailey, Assistant Professor of Mechanical Engineering, Northwestern Technological Institute, Evanston, Ill.

(d) Experimental; for doctor's thesis.

(e) The flow characteristics of saturated and nearly saturated water through 1/4-inch orifices and tubes are being determined. The present investigation has been restricted to flow from atmospheric pressure to back pressures varying down to 24-inch Hg. vacuum with initial water temperature varying from 180°F to 210°F.

(f) Active.

(596) THE SOLID-LIQUID CYCLONE.

(b) Laboratory project.

(c) Donald A. Dahlstrom, Instructor in Chemical Engineering, Northwestern Technological Institute, Evanston, Ill.

(d) Experimental; basic research and design; doctor's thesis.

(e) The use of the cyclone for the separation and recovery of fine solids from liquids is being investigated. The effect of the following variables on separation

efficiency is being studied: capacity, inlet nozzle diameter, overflow diameter, volume split between underflow and overflow, included angle of cyclone, cyclone diameter, retention time of liquid within cyclone, and separation between overflow and conical section of the cyclone. The laboratory studies are correlated with data from industrial cyclones now in operation.

(f) Active.

(g) The method is efficient and economically sound. Recovery of solids down to 10 microns has been experienced with little operating cost.

(h) "Cyclone elimination of contaminating solids from process waters", D. A. Dahlstrom and R. W. Maeser. Coal Technology, A.I.M.E. (Awaiting publication.)

THE OHIO STATE UNIVERSITY, Robinson Hydraulic Laboratory, Columbus, Ohio.

(597) ELIMINATION OF PULSATION ERROR IN FLUID METERS.

(b) Laboratory project; sponsored by American Gas Association.

(c) Prof. S. R. Beitler, Robinson Hydraulic Laboratory, The Ohio State University, Columbus 10, Ohio.

(d) Experimental; applied research.

(e) The flow of air from a two-stage reciprocating compressor, equipped with a pulsation eliminator, is being measured by two orifices in series. A sonic block is set up between the orifices so that pulsating flow is measured by the first and non-pulsating flow is measured by the second orifice. The secondary elements consist of standard flow meters. The difference in the rate of flow measured by each orifice is a measure of the error due to pulsation. The "pulsameter" is also being used to check its reliability in predicting pulsation errors over one percent.

(f) Active; apparatus is set up and preliminary runs have been made.

(g) To date the results show that the dampener is effective at its design region.

(h) "The present status of the problem of measuring pulsating flow", S. R. Beitler and D. J. Masson. 8th Annual Appalachian Gas Measurement Short Course, West Virginia University, September 1948. (Available on loan.)

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

(b) American Society of Mechanical Engineers and American Gas Association.

(c) Prof. S. R. Beitler, Robinson Hydraulic Laboratory, The Ohio State University, Columbus 10, Ohio.

(d) Experimental; applied research.

(e) Coefficients of discharge are being obtained for eccentric and segmental orifices in 4-inch, 6-inch, 10-inch, and 14-inch pipe lines. It is desired to publish curves from which coefficients for commercial use may be chosen for a large range of Reynolds numbers, diameter ratios, and pipe sizes.

(f) Active.

(g) No final results or conclusions can be made with the limited amount of data secured to date (4-inch and 6-inch). However, tentative results are being disseminated.

(h) "Coefficients of discharge for eccentric and segmental orifices in 4-inch and 6-inch pipe lines", S. R. Beitler and D. J. Masson. Annual meeting A.S.M.E., New York, N. Y., December 3, 1948.

OREGON STATE COLLEGE, School of Engineering and Industrial Arts, Corvallis, Ore.

(599) HYDRAULICS OF A POWER PLANT INTAKE.

(b) Laboratory project; sponsored by City of Eugene, Oregon, Water Board.

(c) Burke Hayes of Cornell, Howland, Hayes, & Merryfield, consulting engineers, Rennie Building, Corvallis, Ore.; or Dr. C. A. Mockmore, Head, Department of Civil Engineering, Oregon State College, Corvallis, Ore.

(d) Experimental; for design and operation.

(e) Tests conducted on laboratory model to determine flow characteristics from power canal into penstocks leading to water turbines.

(f) Laboratory tests practically completed.

THE PELTON WATER WHEEL COMPANY, San Francisco, Calif.

(600) IMPULSE TURBINE MODEL.

(b) Laboratory project.

(c) I. M. White, Manager of Engineering, or P. B. Dawson, Jr., Section Engineer - Development, The Pelton Water Wheel Company, 2929 19th St., San Francisco, Calif.

(d) Experimental; for design.

(e) Tests are being conducted on new bucket shapes to improve wheel efficiency.

(f) Active.

(601) HIGH PRESSURE TURBINE.

(b) Laboratory project.

(c) I. M. White, Manager of Engineering, or P. B. Dawson, Jr., Section Engineer - Development, The Pelton Water Wheel Company, 2929 19th St., San Francisco, Calif.

(d) Experimental; for development and design.

(e) Tests are being conducted on small impulse turbines under extremely high pressures.

(f) Active.

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

Information concerning Projects Nos. 131, 329, 330, 602, and 603 should be addressed to Prof. J. M. Robertson, Department of Civil Engineering, The Pennsylvania State College, State College, Pa.

(131) SHAVER CREEK HYDROLOGIC STUDY.

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

(d) Field investigation; applied research.

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

(f) Active.

(329) RESISTANCE IN OPEN CHANNEL FLOW.

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

(e) The effect of hydraulic radius and other factors on open channel flow resistance is being studied in a 50-foot adjustable slope flume. The channel is long enough to allow fully developed turbulent flow to occur in the measuring reach. Both rectangular and trapezoidal sections will be studied.

(f) Temporarily inactive.

(g) Tests have been run in a 7-inch by 10-inch wooden channel at subcritical velocities for slopes between 0.0025 and 0.0040.

(330) STUDY OF LIQUID TURBULENCE.

(b) Laboratory project; also supported by Research Corporation.

(d) Experimental; basic research.

(e) A fluid polariscope is to be used in an attempt to correlate the flow pattern with the occurrence of turbulence. It is planned to study the effect of wavy surface roughnesses both in channels and in the polariscope.

(f) Active; the polariscope has been built and some pictures have been taken.

(602) REACTION TURBINE TEST.

(b) Cooperative project with Fitz Water Wheel Company.

(d) Experimental; development.

(e) A 5-inch Fitz ruralite turbine is being tested under various operating conditions to determine its governor characteristics.

(f) Active.

(603) PITOT TUBE STUDY.

(b) Laboratory project; supported by Ordnance Research Laboratory, U. S. Navy Department.

(d) Experimental; master's thesis.

(e) The effect of support strut size and location on the static piezometers for a pitotstatic tube is being studied. A tube of 2-inch maximum length is desired for use in a large water tunnel at speeds up to 60 fps, with a constant coefficient.

(f) Active.

(g) The effect on the Pitot coefficient of the proximity of the 2-inch by 1-inch elliptical strut, to the end of which the Pitot tube is to be attached, and of the size and location of the tube support strut, have been determined separately. Final design is being detailed for construction.

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

(129) WATER TUNNEL FLOW STUDIES.

(b) Laboratory project in cooperation with the Hydraulics Laboratory.

(c) J. M. Robertson, Ordnance Research Laboratory, The Pennsylvania State College, P.O. Box 30, State College, Pa.

(d) Experimental; basic research, for design.

(e) Water tunnel components, of one-eighth prototype diameter, are studied in an experimental tunnel which does not include a model pump. A single pass system produces velocities up to 50 fps in the 6-inch working section. The sections are easily interchangeable, permitting rapid testing of various tunnel configurations and their interrelationships. Various nozzle contours, working section lengths, angles of diffuser, and one vaned turn combination have been studied. Experimental results are integrated with theoretical methods, to develop means for predicting prototype flow conditions.

(f) Nearing completion.

(g) Studies of flow in nozzles, the working section, and the vaned turn are completed.

(h) "Hydrodynamic design of the 48-inch water tunnel at the Pennsylvania State College", D. Ross, J. M. Robertson, and R. B. Power. To be published in the 1948 Trans. Soc. Naval Arch. and Mar. Engrs. Also published in Engineering (London), July 16, 1948.

"Design of vaned turns for a large water tunnel", A. J. Turchetti and J. M. Robertson. To be published in Trans. A.S.M.E.

"The experimental water tunnel at the Pennsylvania State College", Ordnance Research Laboratory External Report No. 7968-89. April 17, 1948.

"Water tunnel working section flow studies", Ordnance Research Laboratory External Report No. 7968-97. June 15, 1948.

(323) FLOW PAST SLOTS IN SURFACES.

(b) Laboratory project in cooperation with the Hydraulics Laboratory.

(c) J. M. Robertson, Ordnance Research Laboratory, The Pennsylvania State College, P.O. Box 30, State College, Pa.

(d) Experimental; for design and thesis.

(e) Studies will be made on the pressure and flow conditions near slots in surfaces, as affected by relative boundary layer thickness and contour of slot corners.

(f) Apparatus being redesigned.

(604) PROPELLER BLADE SURFACE CAVITATION NOISE.

(b) Laboratory project.

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

(d) Experimental; basic research.

(e) A study of the effects of blade geometry and rotational speed on cavitation noise. An eggbeater type apparatus is used in which flat pitched blades are rotated at various speeds below the surface of a lake. A hydrophone is used to measure the noise output. Results are correlated with a simplified theory based on dimensional analysis and physical reasoning.

(f) Essentially complete.

(g) The noise level at a given relative speed is found to vary inversely as the square

of the distance from the propeller and the listening frequency, directly with the number of blade surfaces cavitating, the fourth power of the diameter, and the cube of the critical rotational speed. A seasonal variation in noise has been noted, resulting from variations in the gas content of the lake water.

(h) "Effect of air content on cavitation noise", Donald Ross and B. W. McCormick. 8th Meeting of the American Towing Tank Conference, Ann Arbor, Mich. October 13, 1948. (Available on request.)

(605) FUNDAMENTALS OF SURFACE CAVITATION.

(b) Cooperative project with Department of Mineral Technology.

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

(d) Experimental; basic research.

(e) A laboratory size eggbeater apparatus will be used in which the noise inception point and noise output will be correlated with the chemical composition and nature of the liquid and the surface of the propeller.

(f) Test apparatus is being designed.

(h) "Gas evolution from supersaturated liquids", E. B. Marboe and W. A. Weyl. Mineral Industries, Vol. 18, No. 1. October 1948. Published by School of Mineral Industries, Pennsylvania State College. Also Mechano-Chemistry of Water, Research (London), Vol. 2. January-February 1949.

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

(134) THE EFFECT OF THROAT PIEZOMETER HOLES ON THE COEFFICIENT OF VENTURI METERS.

(b) Laboratory project.

(c) Prof. W. S. Pardoe, Civil Engineering Department, University of Pennsylvania, Philadelphia, Pa.

(d) Experimental; for design.

(e) Tests were conducted on a 10-inch by 5-inch meter with piezometer holes varying from 1/16-inch to 1 inch with burred square and counter-sunk edges.

(f) Active.

(g) Holes should be equal to or less than 1/4-inch in diameter.

(606) INFLUENCE OF PIPE FRICTION ON WATER HAMMER PRESSURES.

(b) Laboratory project.

(c) E. F. Stover or R. Lowy, Department of Civil Engineering, University of Pennsylvania, Philadelphia, Pa.

(d) Experimental and theoretical; for master's thesis.

(e) The apparatus consists of a 200-foot by 1-inch pipe line, special terminal valve, three equally spaced pressure measuring stations, electric strain gages, electronic equipment, scopes, and cameras.

(f) Active.

(607) CAVITATION MACHINE.

(b) Laboratory project.

(c) E. F. Stover or R. Lowy, Department of Civil Engineering, University of Pennsylvania, Philadelphia, Pa.

(d) Experimental and theoretical; basic research.

(e) Vertical shaft spinner 3000 rpm containing a layer of water on inside surface; stationary scoop directing jet on flat plate specimen. Accelerated erosion due to cavitation with measurable results in a few hours.

(f) Active.

(608) INFLUENCE OF ENTRAINED AND DISSOLVED AIR IN WATER SUPPLIED TO AN IMPULSE TURBINE.

(b) Laboratory project.

(c) I. L. Glassgold or R. Lowy, Department of Civil Engineering, University of Pennsylvania, Philadelphia, Pa.

(d) Experimental; for master's thesis.

(e) A 24-inch impulse wheel nozzle fitted with 90° deflector vane and weighing system. Air injection into supply line with measuring facilities.

(f) Completed.

(h) Thesis available on loan from Towne School Library, University of Pennsylvania, Philadelphia, Pa.

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

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

(b) Sponsored by the Princeton University Committee for fundamental research.

(c) Prof. A. Donald Hay, School of Engineering, Princeton University, Princeton, N.J.

(d) Experimental; basic research.

(e) Analysis of the experiments will establish a theory to explain the alteration of flow pattern about semi-submerged cylinders of finite length. The location and magnitude of the break in the curve of resistance versus speed will be located by formulae.

(f) Active.

RENSSELAER POLYTECHNIC INSTITUTE, Hydraulic Laboratory, Mechanical Engineering Department, Troy, N. Y.

(610) THE WATER TABLE.

(b) Laboratory project.

(c) Prof. Neil P. Bailey or Assoc. Prof. Harold A. Wilson, Mechanical Engineering Department, Rensselaer Polytechnic Institute, Troy, N. Y.

(d) Experimental; basic and applied research.

(e) The apparatus consists of a flat plate of glass, 4 feet wide and 5 feet long, with a small broad-crested weir at one end and sump tanks at both ends. Recirculating flow is provided by a centrifugal pump. Both sump tanks are screened to assure smooth flow over the weir and the glass table. The rate of flow (velocity) over the table may be regulated by means of a throttle valve in the pump circuit, the weir and an adjustable crest gate. A Mach number of the water of about 7 may be obtained. Uniform longitudinal velocity for any flow may be obtained by adjusting the slope of the bed (glass). Water depth is measured with a micrometer point gage. The purpose is to make visual the flow of water as affected by different phenomena and to correlate this flow with air flow as a means of amplifying air flow design and computations.

(f) Active.

ROCKY MOUNTAIN HYDRAULIC LABORATORY, Allenspark, Colo.

(332) TESTS OF SCOUR AROUND BRIDGE PIERS.

(b) Laboratory project.

(c) Prof. C. J. Posey, Engineering Building, State University of Iowa, Iowa City, Ia.

(d) Experimental; basic research.

(e) Experiments during the summer of 1948 were on methods of testing scour, using a single cylindrical pier 2-1/2 inches in diameter in a 6-foot flume, sand being fed at a high enough rate to secure a smooth bed except at the pier. The observation technique proposed by G. H. Matthes, using a transparent pier and mirror, was best.

(f) Continuation of tests is planned for summer of 1949.

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

Inquiries concerning Projects Nos. 99, 100, 103 to 106, 108, 333, 336, 338, 339, and 611 to 618, 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 115, and 619 to 621, incl., which are being conducted in cooperation with the U. S. Soil Conservation Service, should be addressed to Fred W. Blaisdell, Project Supervisor, U. S. Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

For reports on projects being carried on in cooperation with the St. Anthony Falls Hydraulic Laboratory by the Corps of Engineers, see Projects Nos. 193 to 196, and 411 to 415, incl., listed under Department of the Army, Corps of Engineers, St. Paul District, pages 109-112.

(99) HYDRAULICS OF CULVERTS.

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

(d) Theoretical; applied research, for design.

(e) Previous literature has been assembled and analyzed, and preliminary tests

completed, to determine flow characteristics in a model culvert, both for full and part-full conditions. It is intended ultimately to arrive at generalized design criteria for optimum culvert designs for all field conditions.

(f) Suspended, awaiting additional funds for continuation.

(g) Rating curves obtained for conditions investigated. Mechanics of the flow investigated by means of velocity traverses, piezometer gradients, etc.

(h) Two progress reports completed and in process of being prepared for sponsoring agencies. Probably bulletins will later be published by the laboratory for general distribution.

(100) AIR ENTRAINMENT RESEARCH.

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

(d) Theoretical and experimental; basic and applied research.

(e) A flume, 18 inches wide and 50 feet long, adjustable for slopes ranging from horizontal to vertical, is being designed. Electronic instruments are being perfected to measure the concentration and velocity over a relatively small area of the entrained flow in such a manner that a rather complete traverse of velocity and air concentration can be made. High speed motion picture equipment has been procured to permit observation and study of the high speed steady and transient phenomena occurring near the surface of the entrained flow. The air flow above the high velocity stream of water will be measured by conventional methods and varied occasionally by means of a blower. A portion of the exploratory and development work is being conducted in closed conduits and free jets where mixtures of air and water are introduced.

(f) Active.

(g) A review has been made of theoretical literature and reports on field measurements and laboratory experiments. A summary and bibloigraphy of this material is now being prepared. An electronic method of measuring air concentrations as high as 70 percent over a relatively small area has been developed.

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

(b) Sponsored by the Engineering Foundation.

(d) Experimental and theoretical; doctor's thesis.

(e) A recirculating system with heating equipment. Sediment is standard 20-30 Ottawa sand, and fluids used are water, sugar solution, and mineral seal oil. The purpose is to study the effect of such change in viscosity on the amount of sediment transported in the turbulent and the laminar regimes.

(f) Active.

(g) Some studies using cold and hot water and using 43 percent sugar solution have been completed.

(h) "Some effects of viscosity variation upon the movement of bed-sediment in an open channel", L. W. Neubaur. Ph.D. thesis. January 1948.

(104) FLOW DIVERSION RESEARCH.

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

(d) Theoretical and experimental; basic and applied research and design.

(e) Measurements of pressure and velocity magnitude and direction were made at many points in each of several cross-sections of a transparent radius elbow. Similar measurements were made in a transparent miter elbow fitted with several designs of guide vane cascades. In both cases photographic and visual observations were

made. One design of cascade has also been tested in a water tunnel bend. Parallel analytical work is directed toward explaining the experimental phenomenon and toward deriving general principles for guide vane design.

(f) Active; nearly completed.

(g) Work on radius bends has been completed and a report dealing with the fundamental nature of the flow has been published. A bulletin on conduit bends will be published shortly. Experimental work on guide vanes is nearly completed. The experiments have produced design data for guide vane cascades in 90° miter bends. Data for one such cascade have been published.

(h) "Model experiments for the design of a sixty-inch water tunnel, Part V, Vaned elbow studies", J. S. Holdhusen and O. P. Lamb. St. Anthony Falls Hydraulic Laboratory Project Report No. 14. September 1948. (Available at several technical libraries and on loan from the laboratory.)

(105) WATER TUNNEL DESIGN STUDIES.

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

(d) Experimental; applied research and design.

(e) Testing of a 4:1 model of a 24-inch open jet water tunnel is under way. Particular attention is being paid to the effect of the dynamometer shaft housing and diffuser pickup cone on the energy loss, velocity distribution, cavitation characteristics, and flow quality of the jet.

(f) Active.

(g) Testing of a 10:1 model of a 60-inch closed jet water tunnel has been completed. Reports have been published describing flow patterns, energy loss, cavitation characteristics, and description of special instrumentation. The operating characteristics of the original design were found to be satisfactory.

(h) The following project reports have been issued by the St. Anthony Falls Hydraulic Laboratory:

"Model experiments for the design of a sixty-inch water tunnel, Part I, Description of apparatus and test procedures", H. D. Purdy. Project Report No. 10, 48 pp. September 1948.

"Model experiments for the design of a sixty-inch water tunnel, Part II, Contraction studies", J. F. Ripken and J. S. Holdhusen. Project Report No. 11, 22 pp. September 1948.

"Model experiments for the design of a sixty-inch water tunnel, Part III, Test section and cavitation index studies", J. S. Holdhusen. Project Report No. 12, 24 pp. September 1948.

"Model experiments for the design of a sixty-inch water tunnel, Part IV, Diffuser studies", J. S. Holdhusen. Project Report No. 13, 17 pp. September 1948.

"Model experiments for the design of a sixty-inch water tunnel, Part V, Vaned elbow studies", J. S. Holdhusen and O. P. Lamb. Project Report No. 14, 80 pp. September 1948.

"Model experiments for the design of a sixty-inch water tunnel, Part VI, Pump studies", J. S. Holdhusen. Project Report No. 15, 23 pp. September 1948.

(106) MODEL STUDIES OF SEDIMENTATION BASINS.

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

(e) Tests are conducted on models of sedimentation basins to determine the relationships governing the magnitude and location of sediment deposited in model and prototype basins. The discharge, Reynolds number, sediment size, and inlet characteristics of the basins are varied. In some instances, comparisons are made between the flow-through efficiency, as determined by the color method, and the sediment retention efficiency.

(f) Two theses have been completed, a report is being prepared on a third, and experimental studies are under way on a fourth.

(g) The effect of entrance conditions upon flow-through efficiency has been established for several entrances. Comparisons have been made between flow-through efficiency and sediment retention for variation in entrance design.

(h) "An experimental study of a model sedimentation basin", A. G. Anderson. Master's thesis, University of Minnesota. June 1935. (Available on loan.)

"An experimental study of a model sedimentation basin", B. K. Banerjee. Master's thesis, University of Minnesota. October 1947.

(108) LARGE SCALE CULVERT STUDIES.

(b) Elk River Concrete Products Company, and American Concrete Pipe Association.

(d) Experimental; applied research.

(e) Entrance losses and pipe friction losses are being determined for various culverts and possibly various types of entrances for determination of coefficients and flow characteristics of various shapes, sizes, and kinds of commercial culvert pipe. Each culvert is approximately 200 feet long and is tested under conditions of submergence at both ends and of uniform flow at various depths.

(f) Tests have been suspended, but apparatus is now being assembled for resumption of tests.

(g) Data obtained for 24-inch concrete pipe and equivalent 24-inch deformed corrugated metal pipe.

(h) Reports are furnished to sponsoring agencies on results of tests of 24-inch culverts.

(333) RAMAPADASAGAR DAM.

(b) Government of Madras, India.

(d) Experimental; for design.

(e) A large scale movable-bed distorted model is being used, horizontal scale ratio 250:1, vertical scale ratio 100:1, to study the scour patterns and water surface levels consequent to constructing cofferdams that greatly restrict the flow.

(f) Active; verification tests are in progress.

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

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

(e) The nature of the flow and the pressure losses have been observed in a 26-foot test section of a vertical Lucite pipe (1-1/8 inch diameter). Concentration of air, initial size of bubbles, and velocity were varied for the downward direction of flow.

(f) Nearly complete.

(g) The completed experimental work is being analyzed as a guide to the possibility of conducting a larger scale more informative project.

(338) SCOUR BELOW A SPILLWAY AND ITS PREVENTION.

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

(e) To summarize by study of technical literature the solution of the problem of scouring below spillways.

(f) Active; the library research is finished.

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

(b) Laboratory project. (d) Theoretical and experimental; doctor's thesis.

(e) An attempt is being made to establish a criterion for mixing at the interface of two liquids having slightly different densities and a relative motion.

(f) Active. A literature review has been completed and the experimental work is under way. The interface between fresh water and salt water, and fresh water and silt-laden water will be studied.

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

(b) Laboratory project. (d) Theoretical and experimental; doctor's thesis.

(e) The objective is to determine the hydrodynamic effect of various systems of spheres located on the bed of an open channel upon a given fixed sphere located at various positions with respect to the channel bed. The procedure involves measurement of pressure distribution on the fixed sphere at various flow conditions. It is anticipated that the results will be largely applicable to problems of sediment transportation.

(f) Active; the preparatory phases have been completed.

(612) SIMILARITY IN SCOUR BELOW A SPILLWAY.

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

(e) Tests have been conducted in a horizontal glass-sided channel, 20-inches in width. Three geometrically similar spillway models and three coarse sediments of similar size distribution and different mean grain size were employed. All practical combinations of sediment and model were tested with varying tailwater elevations and discharges with the thought of checking the already existent logarithmic law of scour.

(f) Active. Experimental work is finished, and compilation and analysis of the data is proceeding.

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

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

(e) A plain concrete open channel, of flat, triangular cross-section such as used in highway and street gutters, was studied for the purpose of determining the effects of longitudinal slope, side slopes, and flow depth on the horizontal distribution of velocity and discharge.

(f) Experimental work is completed.

(g) Data are now being analyzed to arrive at a quantitative representation of the influence of the variables on velocity and discharge distribution.

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

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

(e) A long (50 foot) channel was brought into equilibrium using a uniform sand of average specific gravity. Into this system, a known amount of magnetite sand of the same size and shape was introduced. The resulting variations in magnetite concentrations both horizontally and vertically, the change in slope and character of the bed are recorded and tabulated for constant discharges and bed loads.

(f) Experimental work is in progress.

(615) CAPILLARY FLOW THROUGH EARTH DAMS.

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

(d) Experimental; for master's thesis.

(e) Tests being conducted in a channel with a plate glass front. Dams of brass plates are installed in the channel with a capillary gap between the dam and the plate glass to study the effect of the capillary rise on the velocity distribution and quantity of discharge through the dam.

(f) Active. Test apparatus is being constructed and adjusted.

(616) FLOW THROUGH GRANULAR MEDIA.

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

(e) Tests were made to determine the head loss resulting from flow through mixtures of spherical grains in relation to the Reynolds number. Rational expressions for the Reynolds number and the friction factor were developed, and the relationships between the expressions determined by experiment. The porosity of the mixtures was varied by changing the component percentages of the various sizes in the mixture.

(f) Completed.

(g) A general curve of friction factor versus Reynolds number was obtained, which included the results of this experiment as well as the results of other investigators.

(h) "Flow of water through lead shot mixtures", J. Brevdy. Master's thesis, University of Minnesota. December 1948. (Available for interlibrary loan from the University of Minnesota Library.)

(617) MODEL STUDIES OF HOLCOMBE DAM.

(b) Northern States Power Company, Minneapolis, Minn.

(c) Mr. Hibbert Hill, Hydraulic Engineer, Northern States Power Company, Minneapolis, Minn.

(d) Experimental; for design.

(e) Model studies were made on a 1:43.2 model of the spillway section. The model consisted of 2 bays equipped with tainter gates tested in a 20-inch glass-sided channel. A movable bed channel was placed both upstream and downstream from the model. The purpose of the study was to determine the extent of erosion to be expected below the spillway bucket and to determine discharge coefficients and the pressure distribution on the spillway. Tests were made with several types of buckets at a number of elevations.

(f) Project completed.

(g) Modifications in the length, apron angle, and lip elevation of the bucket were the only changes made in the original spillway design.

(h) Reports were prepared for the sponsor.

(618) ARCTIC AND SUBARCTIC DRAINAGE INVESTIGATIONS.

(b) Department of the Army, Corps of Engineers, St. Paul District, St. Paul, Minn.

(c) District Engineer, Corps of Engineers, St. Paul, Minn.; or Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

(d) Field investigations and library research; for design and operation.

(e) The objective is to determine design, construction, and maintenance procedures

suitable for the drainage of airfields located in arctic and subarctic areas and subject to potential military operations.

(f) Active. Field work is partly completed. A report is in process of preparation. Further field work is anticipated in the spring of 1949.

(111) DROP INLET CULVERT WITH PIPE CONDUIT.

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

(d) Experimental; applied research.

(e) Tests have been made on three different sizes of Lucite pipe set on slopes ranging from 2.5 to 30 percent to verify the similarity relationship. Information on discharges, pressures, and flow conditions has been obtained. Future studies will be on the effect of different types of inlets on the flow conditions.

(f) Active.

(g) Pipe drop inlet culverts laid on deep slopes will flow completely full even though the outlet discharges freely.

(h) "Preliminary results of tests on pipe bleeders laid on steep slopes," Fred W. Blaisdell, U. S. Department of Agriculture, Soil Conservation Service, 9 pp. November 1942.

(112) DROP SPILLWAY WITH BOX INLET.

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

(d) Experimental; for design.

(e) Experiments are made on 6-inch wide models to determine the effect of different length-to-width ratios, heights of drop, approach channel widths, dike locations, submergences, etc., on the head-discharge curve.

(f) Active.

(h) "The hydraulic design of rectangular spillways", A. N. Huff, U. S. Department of Agriculture, Soil Conservation Service, 64 pp. October 1943.

(113) OUTLET FOR BOX INLET DROP SPILLWAY.

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

(d) Experimental; for design.

(e) An outlet has been developed which will operate under a wide variety of field conditions including different shapes and depths of box inlet, different widths of outlet, and different tailwater depths.

(f) The study is complete.

(h) "Design of an outlet for box inlet drop spillway", C. A. Donnelly, U. S. Department of Agriculture, Soil Conservation Service, SCS-TP-63, 31 pp. November 1947.

(114) DIVERGING TRANSITION FOR SUPERCRITICAL VELOCITIES.

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

(d) Experimental; for design and master's thesis.

(e) Surface contours are determined for different Froude numbers, shapes of entering stream, sidewall flares, bed slope, bed friction, etc.

(f) Active.

(h) "Flow through diverging open channel transitions at supercritical velocities", F. W. Blaisdell, U. S. Department of Agriculture, Soil Conservation Service, Report No. MN-R-3-33, 30 pp. June 1947.

"Supercritical flow in straight-wall diverging channels on normal slope", M. H. Berg. Master's thesis, University of Minnesota, 36 pp. August 1948.

(115) CORRUGATED PIPE DROP INLET CULVERT.

(b) Minnesota Department of Conservation, Division of Water Resources and Engineering; Division of Drainage and Water Control, Soil Conservation Service, U. S. Department of Agriculture; Northwestern Division, Armco Drainage and Metal Products, Inc.; Minnesota Agricultural Experiment Station; St. Anthony Falls Hydraulic Laboratory.

(c) C. T. Ekman, Director, Division of Water Resources and Engineering, Minnesota Department of Conservation, St. Paul, Minn.; or Fred W. Blaisdell, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Minneapolis 14, Minn.

(d) Experimental; for development.

(e) The drop structure is made from 4-inch corrugated Lucite pipe sections. The inlet and outlet structures are tested with movable bed channels. Information is obtained on the hydraulics of the structure, head-discharge curves for different forms of inlet, the performance of the energy dissipator, and flow conditions in the downstream channel. The principal use of this drop structure is in drainage ditches and as highway culverts.

(f) Suspended.

(619) STREAM CHANNEL EROSION AND SEDIMENTATION.

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

(d) Experimental; applied research.

(e) Laboratory measurements of scour and transportation of sediment are anticipated as an aid in the solution of channel control problems on specific streams. The first phase of the work will be a review of the pertinent literature.

(f) The project is just being started.

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

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

(d) Experimental; for design.

(e) Models of paved trapezoidal channels and the channel junction are being constructed to develop a junction that will perform satisfactorily when the flow in both the main and the lateral is at supercritical velocities. Several junctions are scheduled for study.

(f) Active.

(621) JUNCTION OF DRAINAGE PIPES AND PAVED CHANNELS.

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

(d) Experimental; for design.

(e) Models of the structure used at the head end of a trapezoidal open channel flowing at supercritical velocity will be constructed. Several pipes of differing sizes enter this structure at various angles. Several structures will require study.

(f) Active.

SOUTHERN METHODIST UNIVERSITY, School of Engineering, Dallas, Tex.

Inquiries concerning Projects Nos. 144, 145, 622, and 623 should be addressed to Prof. I. W. Santry, Jr., School of Engineering, Southern Methodist University, Dallas 5, Tex.

(144) INVESTIGATION OF THE USE OF THE STANDARD TEE AS A FLOW MEASURING DEVICE.

(b) Laboratory project.

(d) Experimental; senior civil engineering student thesis.

(e) Tests are being conducted to determine whether a standard tee can be used for flow measuring, where it can be used, and what reliance can be placed on such use.

(f) Active. Work has been resumed, and more information should be available in about one year.

(h) Three undergraduate theses have been written to date.

(145) DISCHARGE RELATIONSHIPS OF CIRCULAR WEIRS.

(b) Laboratory project.

(d) Experimental; senior civil engineering student thesis.

(e) Tests are being carried out to determine the flow relationships over circular weirs with the possibility of applying the results to the design of special structures. Previous work is being checked, and the tests are to be expanded in an effort to determine the cause of the changes in the flow characteristics that take place during increases in the head on the weir.

(f) Active.

(h) Three undergraduate theses have been written to date.

(622) FLOOD FLOW PREDICTION.

(b) Laboratory project.

(d) Experimental; basic research and senior civil engineering student thesis.

(e) Investigations are being carried out to develop a short time method of predicting flood flows and the time of occurrence at various points down the stream.

(f) Active; work has just gotten under way.

(623) DIATOMACEOUS EARTH AS A FILTER MEDIUM.

(b) Laboratory project.

(d) Experimental; senior civil engineering student thesis.

(e) Tests are proposed, in the study of diatomaceous earth as a filter medium, to determine the hydraulic head losses through the medium under actual conditions of

variable loads of raw water and sewage.

(f) Active. Preliminary investigations are under way.

STANFORD UNIVERSITY, Hydraulic Laboratory, Stanford, Calif.

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

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

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

(d) Experimental; basic research.

(e) A study of the dynamics of cavities in non-flow apparatus under simplified conditions, to gather more information on the mechanism of expansion and collapse.

(f) Equipment is under construction.

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

(b) International Engineering Company. (d) Experimental; applied research.

(e) Model study to obtain spillway coefficients, to improve flow conditions upstream from spillway, and to improve design of bucket at downstream end of spillway.

(f) Design of equipment is completed; construction is about to start.

(626) EFFECT OF POROSITY ON PERMEABILITY.

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

(e) Permeability tests will be made on artificial assemblages of spheres with water and oil. Large variation of porosity of assemblage should allow extension of the basic laws which have been obtained from tests with small porosity variation.

(f) Active.

(627) STUDY OF TURBULENT BOUNDARY LAYERS.

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

(e) A study of velocity profiles and pressure drops in 2-inch diameter brass pipe downstream from bell mouth entrance.

(f) Equipment has been built; experimental work is just beginning.

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

(b) Laboratory project.

(c) Claud C. Lomax, Stanford University, Hydraulic Laboratory, Stanford, Calif.

(d) Experimental; basic research.

(e) Settling velocities will be measured for particles which have easily defined geometric shapes. Most of the tests will be made for velocities above the Stokes range. The variables will include density and viscosity of the fluid and density and shape of the particle. An attempt will be made to correlate the fall

velocities with those of equivalent spheres on the basis of some common physical property.

(f) Active formative stage.

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, Department of the Navy. A large number of projects involving commercial vessels of many different designs for private clients are also undertaken for the determination of effective horsepower, the resistance and directional stability of barges, the determination of shaft horsepower for river towboats and comparable vessels, resistances under sailing conditions of sailing yachts, and the hydrodynamic characteristics of flying boats, seaplanes, and seaplane floats.

(340) PLANING SURFACES (Project CC839).

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

(c) Prof. B. V. Korvin-Kroukovsky, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental; basic research.

(e) To investigate the fundamental factors affecting the performance of planing surfaces and the wave shape formed in wake of the planing surface. Investigations will extend from elementary planing surfaces of several dead-rise angles through warped, concave, or flared planing surfaces with Vee or pointed steps.

(f) Active.

(h) The following reports were published under the Sherman Fairchild Fund by the Institute of Aeronautical Sciences:

"The discontinuous fluid flow past an immersed wedge." Technical Report No. 334.

"An analysis of the fluid flow in the spray root and wake regions of flat planing surfaces." Technical Report No. 335.

"On the pressure distribution for a wedge penetrating a fluid surface." Technical Report No. 336.

"Wave contours in the wake of 20° dead-rise planing surface." Technical Report No. 337.

The following reports are in process of publication:

"Wave contours in the wake of 10° dead-rise planing surface." Technical Report No. 344.

"Wave contours in the wake of 30° dead-rise planing surface." Technical Report No. 339.

(341) EFFECT OF ROUGH WATER ON DIRECTIONAL STABILITY (Project CK111S, formerly Project 980).

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

(c) Dr. K. S. M. Davidson, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Theoretical; basic research.

(e) 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. The scope of this investigation is limited at the moment to the behavior of a destroyer in a seaway. At some later date other types of surface vessels are expected to be included in the study.

(f) Project is being continued.

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

(b) National Advisory Committee for Aeronautics.

(c) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental; design.

(e) To obtain hydrodynamic information on a series of hull models suitable for small flying boats and amphibians. A series of hulls which will entail probably 27 combinations will be tested for hydrodynamic characteristics including resistance, upper and lower limits of stability, center of gravity ranges, main spray characteristics, landing, high speed resistance, and effect of hull form and proportions.

(f) Active; testing is in progress.

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

(b) David Taylor Model Basin, Bureau of Ships, U. S. Navy Department.

(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Theoretical; design.

(e) To analyze the results of an earlier investigation on a series of Vee-bottom motor boat hulls tested at the Experimental Towing Tank and reported in Experimental Towing Tank Report No. 153.

(f) Active; final report is in preparation.

(346) HYDROFOIL (Project CG1002).

(b) John H. Carl and Sons, Inc.

(c) W. C. Axt, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental; basic research.

(e) To carry out a series of tests in the towing tank to determine the practicability of proposed methods for improving the stability of hydrofoils. A hydrofoil boat will be tested to determine the optimum arrangement and proportions of hydrofoils to obtain the maximum stability possible.

(f) Active. Experimental work on the second phase of the program is in progress.

(h) The first phase of this project is covered in Report No. 1, John H. Carl and Sons, Inc., "Preliminary tests and analyses of a free-to-trim and heave hydrofoil system".

(347) CORRELATION OF BARGE RESISTANCE (Project R810).

(b) Laboratory project.

(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Theoretical; design.

(e) To determine the effect of design trends and hull proportions on the overall resistance performance of barges. The project includes a compilation and correlation of all test results on all barge tests made at this laboratory.

(f) Active.

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

(b) Laboratory project.

(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Theoretical; design.

(e) To determine the effect on resistance of various hull proportions, drafts, trims, and hull features of high speed motor boats. All previous test results of high speed motor boats will be compiled and correlated in this project. Over 100 different models are involved.

(f) Active.

(349) BARGE YAWING (Project R975).

(b) Laboratory project.

(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Theoretical; design.

(e) To study the forces involved in the directional stability of barges. The project includes tests of two barges, one of which is stable and the other unstable, directionally.

(f) Active.

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

(b) Laboratory project.

(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Theoretical; design.

(e) To determine the effect of various form changes and proportions upon the sailing performance of a series of related sailing yacht hulls. A model of a 32-foot sailing yacht (New York 32) is being used as the parent model in this project. The proportions of the models will be systematically varied in beam, draft, and displacement. Other variations to be undertaken in later phases of this project will include variations in stern overhand, transom width, and fore and aft positioning of the keel.

(f) Active.

(g) The results of these model tests are being presented to subscribers to the project in Technical Memorandum No. 85, which will be in 12 or more parts. The first three parts have now been completed, viz., Part I, "The program and its history"; Part II, "Performance of the New York 32 as designed"; and Part III, "Effect of change of stability and sail area on the performance of the New York 32". Computations and tests have been completed for Parts IV and VI, and full-size performance tests have been carried out for inclusion as an appendix to Part II.

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

(b) Laboratory project.

(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental; development.

(e) To determine if successful self-propelled testing can be conducted using models of less than 12-foot length. Self-propelled tests will be conducted on an 11-foot model of the German motor ship "San Francisco", of which considerable full-scale trial data are available, to determine if SHP test results from a model of this size are practical.

(f) Active.

(g) Resistance tests have been made on three different sized models of this vessel to check for possible wall effect, and self-propelled tests will be made at a future date.

(629) EFFECT OF HULL PROPORTIONS UPON HYDRODYNAMIC COEFFICIENTS (Project CK1119, formerly 827).

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

(c) John B. Drisko, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental; basic research.

(e) Eight ship models derived from a single parent were used in this investigation. The proportions and the skeg areas of the models were systematically varied from the parent hull.

(f) Completed.

(g) Empirical relations between forces and moments and hull beam, draft, and skeg area are shown in final reports.

(h) "Progress report on related model tests for turning studies: Effect of changes of beam and draft of bare hull models", Report No. 338.

"Progress report on related model tests for turning studies: Effects of plate skegs fitted on bare hull models", Report No. 346.

(630) FORCES ACTING ON SUBMERGED BODIES NEAR THE SURFACE (Project CK1118).

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

(c) B. V. Korvin-Kroukovsky, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental and theoretical; basic research.

(e) Investigation of pitching moments and of forces of attraction or repulsion acting on underwater bodies moving parallel to surface due to proximity of surface. The work is being done experimentally and analytically.

(f) Active.

(g) Preliminary experimental work indicates that substantial forces and moments act on bodies near the surface at high speed-length ratios.

(h) Progress report on experimental work is in preparation.

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

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

(c) B. V. Korvin-Kroukovsky, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Theoretical and experimental; applied research.

(e) Methods of obtaining certain combinations of hydrodynamic parameters, particularly one which forms a criterion of unsteered dynamic stability, are being investigated analytically and experimentally, using rudders to force zig-zag oscillations. Tank experiments are in progress on a destroyer and a battleship model, with the object of selecting appropriate methods of controlling the model and of recording data. Two methods of controlling the heading angle are being tried, (1) a method using a radio control on the rudder, and a mirror system to signal an observer, who manually sends the radio signal, and (2) a method using a gyroscope which automatically changes the rudder angle when the heading has deviated a predetermined amount. Tests of a destroyer (full size) have been made and are being analyzed.

(f) Active. Theoretical basis for tests completed. Reports on experimental work are in preparation.

(g) Experimentally, the method shows promise of providing a practical test procedure. Indications are that it will provide only means practical at present for correlating course-keeping ability of model and prototype.

(h) Theoretical basis for work described in T.M. 83, "Model-prototype comparisons of torpedo performance".

(632) SPRAY STRIP STUDY (Project R1029).

(b) Laboratory project.

(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental; for design.

(e) To obtain additional information on the effect of spray strips on the running resistance and general behavior of Vee-bottom high speed hulls. Tank tests over a period of years on models with and without spray strips are being analyzed.

(f) Active; the project is nearly completed, and a report will soon be prepared.

(g) Spray strips are, in most cases, remarkably effective. These strips usually improve the running trim and cause a pronounced saving in effective horsepower. Full-size results largely confirm the model tests.

(633) UNDERWATER FLOW STUDIES (Project R1110).

(b) Laboratory project.

(c) William Sutherland, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental; development.

(e) Development of method of indicating direction of flow at or near the surface of models by photographing tufts streaming with the flow.

(f) Completed.

(g) Method developed has proved useful in visualizing flow conditions.

(h) "Underwater photographs of flow patterns", Experimental Towing Tank Memorandum No. TM-86.

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

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

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

(b) Sponsored by Naval Research Laboratory through Office of Naval Research, U. S. Navy Department.

(d) Experimental and theoretical; basic research for design and doctors' and masters' theses.

(e) Mechanical foam is generated by pumping water containing an active foaming agent into a mixing chamber containing compressed air. Physical characteristics of the foam such as expansion ratio, drainage rate, apparent density, and viscosity are being evaluated, and pressure drops in pipe lines are being measured. The aim is a correlation between pressure drop and physical properties in order that predictions may be made for design purposes.

(f) Active.

(635) FLOW CHARACTERISTICS OF AIR-SOLID SYSTEMS.

(b) Laboratory project.

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

(e) Air under controlled pressure is allowed to flow through a pipe line where a metered amount of powdered solid is picked up, e.g., powdered "cracking" catalysts. The aim is a correlation of fundamental data which will permit design calculations of pipe sizes, pressure drop, etc.

(f) Active. Initial studies on 1/8-inch standard pipe line have been completed.

(h) "The flow mechanism of catalytic cracking catalysts", R. E. Ringelman. Master's thesis, State University of Iowa. January 1948. (Available on loan.)

"The flow characteristics of solid-gas streams in pipes", R. E. Ringelman and C. S. Grove, Jr. (Publication pending.)

TEXAS A & M COLLEGE, Engineering Experiment Station, College Station, Tex.

Inquiries concerning Projects Nos. 356, 357, and 636 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) Laboratory project. (d) Theoretical; basic research.

(e) 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.

(f) Active.

(g) A simple mathematical relationship has been developed between the slope of the lines on the Stanton diagram and the values of the exponents x and y in the basic friction formula, h varies as V^x/D^y. This indicates the particular

range of Reynolds number in which the various exponential formulas apply and helps explain their differences.

(357) FRICTION LOSS IN STREAMLINE PIPE FITTINGS.

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

(e) The friction losses through streamline pipe fittings were determined for various rates of flow.

(f) Completed.

(g) Data have been obtained on a number of streamline pipe fittings.

(h) "Friction loss in streamline pipe fittings," S. J. Durr. Master's thesis, Texas A & M College. January 1948. (Available on loan.)

(636) STUDIES ON THE HYDRAULIC JUMP.

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

(e) The purpose of this project was to develop simple formulas for computing the dimensions of a hydraulic jump.

(f) Completed.

(g) Simple formulas have been developed for computing the length of hydraulic jumps in flat and sloping channels and the height of a jump in sloping channels.

(h) "Hydraulic jump in rectangular channels", C. K. Wu. Master's thesis, Texas A & M College. January 1949. (Available on loan.)

THE UNIVERSITY OF TEXAS, Department of Civil Engineering, Austin, Tex.

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

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

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

(e) An investigation is being made of the use of a total head measurement in determining the flow over weirs with particular emphasis on low weirs with a high approach velocity. The total head measurement is made at a point two weir heights upstream from the weir and at the same elevation as the weir crest.

(f) Active.

(g) Tests have been completed on a number of different weir heights and, as expected, the discharge coefficient based on the total head measurement remains more nearly constant as high approach velocities are encountered than does the conventional coefficient based on piezometric head.

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

(b) Laboratory project. (d) Experimental; for design.

(e) The flume is intended primarily for the study of problems in two-dimensional flow with a free surface. The glass-walled portion is 1 foot wide and includes a section 4 feet deep and 6 feet long followed by a section 2 feet deep and 18 feet long. The slope of the entire flume can be readily adjusted by a single jack.

(f) Active; construction is well under way.

UTAH STATE AGRICULTURAL COLLEGE, Agricultural Experiment Station, Logan, Utah.

(359) DRAINAGE OF IRRIGATED LANDS.

(b) Laboratory project.

(c) Dr. O. W. Israelsen, Utah State Agricultural College, Logan, Utah.

(d) Field studies; applied research and masters' theses.

(e) The major purpose of the studies is to find low cost, effective methods of drainage of waterlogged and alkali lands. Work has been concentrated on two Utah areas in need of drainage; one a 10,000-acre area in Cache County and another a 1,000-acre area in Salt Lake County, designated respectively the Lewiston and the Draper Areas.

(f) Active.

(g) Use of 3/8-inch diameter piezometers for low cost measurement of ground water flow patterns has been helpful in both areas. Pumping from sand formations having permeabilities as low as 3×10^{-5} feet per second shows a measurable influence in lowering the ground water table.

(h) "The drainage problem in the Lewiston Area, Utah", Sterling Davis. Master's thesis, Utah State Agricultural College. May 1948. (Available on loan.)

"The drainage problem in the Draper Area, Utah", S. H. Van Orman. Master's thesis, Utah State Agricultural College. October 1948. (Available on loan.)

UNIVERSITY OF UTAH, Department of Civil Engineering, Salt Lake City, Utah.

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

(b) Laboratory project.

(c) Prof. C. E. Jacob, Department of Civil Engineering, University of Utah, Salt Lake City, Utah.

(d) Theoretical and experimental; basic research for doctor's thesis.

(e) An analytical study of flow in confined groundwater bodies from which there is leakage at a rate proportional to the head. An attempt is being made to determine "Green's functions" for several combinations of lateral boundary conditions. These will be used to study problems in drainage and stability of levees. The theory will be checked by layered electrolytic models.

(f) Active.

(639) HYDRAULICS OF MANIFOLDS.

(b) Laboratory project.

(c) Prof. J. R. Barton, University of Utah, Salt Lake City, Utah.

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

(e) Tests are being conducted on a small commercially designed perforated pipe

underdrain for a rapid sand filter to determine the flow pattern, optimum ratio of manifold and lateral size, and optimum ratio of lateral and lateral orifice size. Piezometer connections in the manifold and in the laterals make possible the determination of relative pressures throughout the system.

(f) Active. Study of discharge pattern under various heads and orifice sizes has been completed.

THE STATE COLLEGE OF WASHINGTON, Hydraulics Laboratory, Department of Civil Engineering, Pullman, Wash.

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

(b) Division of Industrial Research, State College of Washington; and Concrete Products Association of Washington; directed by Department of Civil Engineering.

(c) J. A. Roberson, Junior Engineer, Washington State College, Pullman, Wash.

(d) Experimental and field investigation; applied research.

(e) The purpose of this project is to determine the causes of breakage and reduction in flow when concrete irrigation pipe is used for the conveyance of water, and to find ways of eliminating these problems. General field tests and studies were made to determine the conditions existing with each problem. Hydraulic model studies are planned to establish more quantitative and qualitative results.

(f) Active.

(g) The action of air in the irrigation pipe lines is the main contributing factor in both of the above problems.

(641) THE HYDRAULICS OF SPRINKLER IRRIGATION SYSTEMS.

(b) Sponsored by the Division of Industrial Research, State College of Washington.

(c) Prof. C. L. Barker, Department of Civil Engineering, State College of Washington, Pullman, Wash.

(d) Theoretical; for design.

(e) Using the experimental results of J. R. Barton, "A study of diverging flow in pipe lines", Master's thesis, University of Iowa, August 1946, an analytical study was made, taking the results from a single branch and working out the discharge ratios for multiple branches. The variables considered were the coefficient of discharge of the sprinkler or branch, diameter ratios, number of branches, and head loss coefficients between branches, and their values were selected to include the ranges ordinarily found in sprinkler irrigation systems.

(f) Active.

(h) "The hydraulics of sprinkler irrigation systems", M. R. Carstens, Division of Industrial Research, State College of Washington. (Unpublished.)

The results are mainly presented as a graphical solution whereby can be determined the discharge ratio of any branch in the line to the discharge of the downstream branch knowing the parameters listed in (e). The graphical solution includes also the summation of discharge ratios up to and including any branch from the downstream branch.

UNIVERSITY OF WASHINGTON, Department of Civil Engineering, Seattle, Wash.

(362) VISCOSITY OF OIL UNDER PRESSURE.

(b) Engineering Experiment Station, University of Washington.

(c) Prof. C. W. Harris, Hydraulics Laboratory, University of Washington, Seattle 5, Wash.

(d) Experimental; basic research.

(e) To obtain data concerning effect of pressures up to 40,000 pounds per square inch at normal atmospheric temperatures on the viscosity of oils not yet subjected to such tests, by use of rolling ball viscosimeter.

(f) Completed.

(g) Positive results were obtained and are on file at this laboratory.

(363) INTERNAL PRESSURES IN TURBULENT FLOW IN PIPES.

(b) Laboratory project.

(c) W. W. Saxton, Hydraulics Laboratory, University of Washington, Seattle 5, Wash.

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

(e) To determine relation of boundary pressure to the internal pressures in pipes flowing with high turbulence (especially in turbulence caused by sudden enlargement). A special piezometer tube has been designed to measure the pressure at any point within a 12-inch pipe.

(f) Active.

(g) Considerable data have been obtained, but have not as yet been completely evaluated.

(642) A STUDY OF THE HYDRAULIC RADIUS AS CORRELATING THE RELATIONSHIPS OF FLOW IN CHANNELS OF DIFFERENT SHAPES.

(b) Laboratory project.

(c) H. A. Smallwood, Hydraulics Laboratory, University of Washington, Seattle 5, Wash.

(d) Experimental; basic research and thesis.

(e) A series of tests to determine the effect of shape upon the flow functions. Initially these tests are being made on closed channels of constant hydraulic radius but of varying cross-sectional shape, and of the same uniform roughness.

(f) Active.

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

(b) Laboratory project.

(c) Arne Skretting, Hydraulic Laboratory, University of Washington, Seattle 5, Wash.

(d) Experimental; basic research.

(e) By varying the degree of turbulence and by introducing controlled amounts of spiral flow, to determine the effect on piezometer readings as an indication of pressure within a pipe; and by varying the size of piezometer openings, to determine the effect of this size on the accuracy of measurement.

(f) Active.

(644) FLOW IN PIPES AND CHANNELS.

(b) Laboratory project.

(c) Prof. C. W. Harris, Hydraulics Laboratory, University of Washington, Seattle 5, Wash.

(d) Experimental; basic research.

(e) To establish a means conforming to modern concepts of flow for identifying pipe and channel surfaces in relation to their resistance to passage of water, and to introduce a practical formula for applying a specific roughness coefficient, once found, to any size pipe or channel.

(f) Suspended.

(g) Definite concepts of the relations between the types of flow in pipes, and of the relation of the resistance to flow of water in pipes to specific roughness, have been developed.

(h) "Influence of random roughness in pipes." Bulletin No. 115, Engineering Experiment Station, University of Washington, Seattle 5, Wash.

THE UNIVERSITY OF WISCONSIN, Hydraulic Laboratory, Madison, Wis.

(149) EFFECT OF SUBMERGENCE ON DISCHARGE OF WEIRS AND ORIFICES.

(b) Laboratory project.

(c) James R. Villemonte, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(d) Experimental; for Ph.D. thesis.

(e) Tests are being run with various conditions of submergence on sharp-edged weirs and orifices.

(f) It is expected that the thesis based on these studies will be finished by May, 1949.

(h) "Submerged weir discharge studies", J. R. Villemonte. Engineering News-Record, December 25, 1947.

(365) MODEL TESTS OF PETENWELL DAM SPILLWAY.

(b) Wisconsin River Power Company.

(c) Dr. Arno T. Lenz, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(d) Experimental; for design.

(e) Additional tests to determine final design of spillway structure of dam now under construction on Wisconsin River were made with a 1:80 model of seven spillway gates, one regulating bay gate, and the powerhouse, to determine effects of combined operation of several units. Model tests on a 1:25 scale of a single bay at Castle Rock dam were also made.

(f) Model tests are completed; report is in preparation.

(366) HEAD LOSSES IN FLOW OF LIQUIDS IN PIPE AND FITTINGS.

(b) Laboratory project.

(c) Prof. James G. Woodburn, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(d) Experimental and library study; basic research.

(e) Analyses have been made of several experimental studies of pipe friction and of tests made here on small pipe at various pressures. A start has been made toward determining the behavior of the friction factor at much higher pressures

than normal in pipe lines.

(f) Project is active.

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

(b) Laboratory project.

(c) Prof. James G. Woodburn, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(d) Experimental; for M.S. degree.

(e) To determine the relation of discharge to head for orifices on the ends of pipe for use in locations where it is not possible to tap the side of the pipe to determine the head. Orifices 1/4, 3/8, 1/2, and 2/3 of the diameter of 8-inch, 10-inch, and 12-inch pipes have been tested at heads up to about 2 feet, including weir flow.

(f) Results are being analyzed and a thesis is in preparation.

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

(b) Laboratory project.

(c) Dr. Arno T. Lenz, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(d) Experimental; for M.S. thesis.

(e) To develop a flood-forecasting procedure, taking into account power plant operations on the Wisconsin River. A modified form of the unit hydrograph is being tested to route flood flows, starting at the gaging station below Rainbow Reservoir.

(f) Active.

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

(b) Laboratory project.

(c) Prof. G. A. Rohlich, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(d) Experimental; applied research and thesis.

(e) U-shaped weirs 8 inches wide, 6 inches deep, and 5 feet long are being tested at heads up to 0.3 feet. Such troughs and gutters are used in final effluent sedimentation tanks.

(f) One thesis has been prepared and another will be written.

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

(b) Laboratory project.

(c) Alfred C. Ingersoll, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(d) Experimental; for undergraduate theses.

(e) Studies will first be made with Ottawa sand grains glued to the glass surfaces of a flume 10 inches wide and 7 inches deep. Water will be used first, but oil will later be used, and other sizes and shapes of sand grains will be tested.

(f) Active.

(646) BEHAVIOR OF OIL-WATER SEPARATORS.

(b) American Petroleum Institute.

(c) Prof. G. A. Rohlich, Hydraulic Laboratory, University of Wisconsin, Madison, Wis.

(d) Experimental and theoretical; basic research.

(e) Determination of the effect of various width-length and width-depth ratios of flotation tanks. Wax spheres 0.2 mm in diameter with specific gravity 0.9 are being used. Experiments are being conducted in a tank with Lucite sides, so constructed that various width-length and width-depth ratios can be obtained. Flow rates have varied from 5 to 150 gpm.

(f) Active.

(g) Efficiencies of removal of wax for the various conditions have been determined.

WORCESTER POLYTECHNIC INSTITUTE, Alden Hydraulic Laboratory, Worcester, Mass.

Inquiries concerning Projects Nos. 647 to 651, incl., should be addressed to Dr. C. M. Allen, Director, Alden Hydraulic Laboratory, Worcester Polytechnic Institute, Worcester, Mass.

(647) CALIBRATION OF GENTILE TYPE FLOW METERS.

(b) Bethlehem Foundry and Machine Company. (d) Experimental; development.

(e) Six Gentile type flow tubes were calibrated over a Reynolds number range from 25,000 to 500,000. The meters were of different throat ratios and of different mechanical designs. The tests were preliminary and exploratory in nature, determining the possibilities of the meters.

(f) Completed. Report submitted to sponsor.

(h) A brief report of these tests may be presented at the Fluid Meter Session of the A.S.M.E. meeting in December 1948.

(648) DESIGN OF SHIP ROD.

(b) Pitometer Log Corporation. (d) Experimental; development.

(e) The purpose is to develop a rod suitable for application to high speed surface craft of shallow draft.

(f) Active.

(649) GOOSE POND SPILLWAY TEST.

(b) Granite State Electric Company (New England Power Association).

(d) Experimental; for design.

(e) The purpose is to increase economically the spillway capacity of an existing structure. A 1:16 scale model was constructed, and test work is in progress.

(f) Active.

(650) NEVERSINK TAILRACE POOL.

(b) Charles T. Main, Inc. (d) Experimental; for design.

(e) The purpose was to determine the nature of the flow conditions at the entrance to a tunnel at the downstream end of the tailrace pool. A 1:15 model was constructed, comprising the draft tailrace pool and approximately 15 diameters of conduit. Lucite windows were provided in the conduit to permit observation and photographs of the flow conditions. Piezometers were installed to measure the hydraulic

gradient.

(f) Active.

(651) HYDRODYNAMIC CHARACTERISTICS OF MISSILES DURING WATER ENTRY.

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

(d) Experimental; applied and basic research.

(e) Purpose is to make preliminary surveys of various aspects of the water entry problem to determine those phases of the work which may be pursued most fruitfully in more careful investigations. Models of various shapes are projected through the water surface and their motion recorded by 16 mm moving picture cameras using Edgerton stroboscopic lighting.

(f) Active.

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

(261) WATERSHED MANAGEMENT RESEARCH, CALIFORNIA.

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

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

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

(e) Purposes are: (1) to study the disposition of rainfall as influenced by watershed conditions, including vegetation, soils, geology, and topography; and (2) to develop methods of watershed management, including the treatment of areas denuded by fire, to assure maximum yield of usable water, and satisfactory regulation of flood runoff and erosion. Major work center is the San Dimas Experimental Forest. Rainfall, runoff, erosion, and stream flow are measured on two main drainage areas, on ten large and seven small watersheds within these areas, and on eighteen experimental plots. Twenty-six large lysimeters furnish comparisons of the use of water by various species of shrubs and one species of pine. Climatic data are obtained from several meteorological stations. Studies of erosion as influenced by fire and the revegetation of large burns are in progress.

(f) Active. On the San Dimas Experimental Forest the collection and analysis of rainfall, stream flow, and erosion data are being continued. Special rainfall studies are in progress. Fiberglass soil moisture measuring units developed by this Station have been installed in several lysimeters, and are also being tested under field conditions. Improved techniques for the revegetation of fire-denuded watersheds are being studied.

(g) Records of stream flow from burned and long unburned watersheds showed that peak flows were increased two to thirty times the first year after burning, and do not return to normal for twenty to sixty years. Annual erosion rates increased on the average about 35 times the first year after complete burning of the brush, and at least ten years are required for erosion rates to return to normal.

(h) "The San Dimas lysimeters", E. A. Colman and E. L. Hamilton. Forest Research Note No. 47, California Forest and Range Experiment Station. December 1947.

"Water for today and tomorrow", C. H. Gleason. California -- Magazine of the Pacific. March 1948.

"Influence of woodland chaparral on water and soil in Central California", P. B. Rowe. Division of Forestry, California Department of Natural Resources. 1948.

"How to sow mustard in burned watersheds of Southern California", C. H. Gleason. Forest Research Note No. 37, California Forest and Range Experiment Station. January 15, 1944, revised September 1948.

"Soil surveying on wildlands: the problem and one solution", E. A. Colman. Jour. of Forestry, Vol. 46, No. 10: 755-762. October 1948.

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

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

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

This project is a continuation of the work listed under Projects Nos. 371, 372, and 373 in Volume 12 of this bulletin, according to a new scheme of work projects at this Station.

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

(d) Field investigation; basic and applied research.

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

(f) Active.

(g) Exploratory study of factors affecting erosion of granitic soils in southwest Idaho has been completed.

(h) "Watershed management for sediment control", R. W. Bailey and G. W. Craddock. Proc. Fed. Inter-Agency Sed. Conf., Bureau of Reclamation, U. S. Dept. of the Interior, pp 302-310, illus. 1948.

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

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

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

(d) Field investigation; basic and applied research.

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

(f) Active.

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

(h) "Watershed management for summer flood control in Utah", R. W. Bailey, G. W. Craddock, and A. R. Croft. U.S. Dept. of Agriculture Misc. Pub. 639, 24 pp, illus. 1947.

"Reducing runoff and siltation through forest and range management", R. W. Bailey. Jour. Soil and Water Conservation, 3: 24-31. 1948.

"Insuring Utah's water supplies through watershed research", G. W. Craddock. Utah Magazine. September 1948.

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

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

(d) Field investigation; basic and applied research.

(e) Tests on plots and watersheds of the effects of forest, brush, and herbaceous cover on interception and evapo-transpiration losses; to determine the kind of plant cover required for producing maximum yields of useful runoff from watersheds. Principle effort now limited to study of evapo-transpiration loss in aspen-herbaceous cover on Wasatch Mountains, northern Utah.

(f) Active.

(g) Completed two years of exploratory study in aspen type.

(h) "Water loss by stream surface evaporation and transpiration by riparian vegetation", A. R. Croft. Trans. American Geophysical Union, Vol. 29: 335-339. 1948.

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

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

(d) Field investigation; basic and applied research.

(e) Measurements and studies of climatic factors including precipitation, temperature, wind, etc., that have a bearing on the hydrologic behavior of forest and range watershed lands. These studies are confined to experimental watershed areas at the Boise Research Center near Idaho City, Idaho; Wasatch Research Center, Farmington, Utah; and Great Basin Research Center, near Ephraim, Utah.

(f) Active.

(g) Exploratory study of induced snow drifting at high elevations on the Wasatch Plateau in central Utah has been completed. An interim study of summer storm rainfall characteristics on the Wasatch Mountains of northern Utah has been completed.

(h) Reports on the two studies listed in (g) will be published in 1949.

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

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

(374) FROST SURVEY IN ALLEGHENY RIVER WATERSHED.

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

(e) Periodic frost observations made during the winter of 1947-48 on 60 sites in forest and open areas in gaged subwatersheds of the Allegheny River watershed are being analyzed to determine the influence of cover and site conditions on type and depth of frost and runoff. Additional data will be secured during the winter of 1948-49.

(f) Active.

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

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

(e) Periodic frost observations made during the winter of 1947-48 on 60 sites over a wide range of land use and condition in New England, New York, and northern Pennsylvania are being analyzed to determine the effect of cover type and site condition on ground freezing in the northeastern United States.

(f) Active.

(656) FOREST INFLUENCES INVESTIGATION (WATERSHED MANAGEMENT).

(b) Laboratory project; in cooperation with the Pennsylvania Department of Forests and Waters.

(c) H. C. Storey, Northeastern Forest Experiment Station, Williams Hall, Lehigh University, Bethlehem; or Arthur Bevan, Chief, Division of Flood Control Surveys, Northeastern Forest Experiment Station, 102 Motors Ave., Upper Darby, Pa.

(d) Experimental; applied research.

(e) Studies were initiated in November 1948 on the Lehigh-Delaware Experimental Forest of about 1800 acres to determine the influence of the present scrub-oak cover on runoff. Recording rain gages, one climatic station, gaging station, and ground water wells have been installed. Frost observations will be made during the winter of 1948-49 to relate the type and depth of frost in the ground to cover and condition. After a period of calibration of the watershed, it is planned to convert the cover from scrub-oak to better forest types by forest management and protection measures and to evaluate the effect of these changes in cover on runoff and ground water.

(f) Active.

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

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

(376) FOREST INFLUENCES RESEARCH, MANITOU EXPERIMENTAL FOREST.

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

(e) The project includes studies of the influence of grazing, timber cutting, and revegetation of depleted watershed lands upon water supplies and more particularly upon erosion and sedimentation. Infiltration and erosion are measured by portable equipment. The purpose is to solve problems in watershed management for the forest- and range-covered watershed lands of the Rocky Mountain Front Range.

(f) Active.

(g) Surface runoff from moderately and heavily grazed areas of bunchgrass range is increased 50 percent over runoff from ungrazed areas. Soil erosion on heavily grazed areas was almost doubled, but moderate grazing did not increase erosion. The removal of litter from stands of young ponderosa pine more than doubled surface runoff and increased soil erosion 72 times in the first year of treatment. After eight seasons of needle fall accumulation, the treated plots are again reacting similarly to those untreated. The infiltration capacity of soil in ungrazed areas averaged 2.5 inches per hour. Grazed areas averaged only 1.38 inch per hour, but the results did not show any correlation with the intensity of grazing.

(377) FOREST INFLUENCES RESEARCH, FRASER EXPERIMENTAL FOREST.

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

(e) Experiments are designed to show the influence of lodgepole pine and spruce-fir forests and of the cutting of this timber upon factors associated with the yield of water, largely from stored snow. The aim is to solve problems in watershed management for forested watersheds of the Continental Divide zone of the Central Rockies.

(f) Active. First phase of experiments in mature lodgepole pine was completed in 1944. A number of articles have been published, and a Department bulletin is now awaiting publication.

(g) Reduction in density of the forest canopy through partial clearing of timber has resulted in 15 to 30 percent increase in precipitation reaching the soil. This increase is all, or in part, an addition to ground water, since the sum of evaporation and transpiration losses from the soil are not increased by the timber cutting.

(378) FOREST INFLUENCES RESEARCH, WESTERN COLORADO.

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

(e) Major effort at present is devoted to the analysis of range and watershed problems for drainage basins of western Colorado. Experiments are planned to show the influence of forest and range vegetation and of its use upon water yields, erosion, and sedimentation. Two small forested watersheds in the headwaters of the Eagle River have been placed under experimental control, 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.

(f) Active.

(379) TRAPEZOIDAL FLUMES FOR OPEN-CHANNEL FLOW.

(b) Laboratory project. (d) Experimental; design.

(e) Study to work out the design for an improved gaging station for use in mountain stream channels which will not become clogged with bed load material, silt, ice, and snow, or other obstructions, and will provide an accurate stage-discharge relation over a wide range of discharges. Scale models of trapezoidal flumes were tested, including several variations in overall length, piezometer position, and floor and wall slope.

(f) Completed.

(g) An apparently satisfactory flume shape has been obtained which awaits field testing.

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

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

(b) Laboratory project.

(c) I. T. Haig, Director, Southeastern Forest Experiment Station, P.O. Box 252, Asheville, N. C.

(d) Field investigation; basic and applied research.

(e) To determine the effect of vegetation on the phases of the hydrologic cycle, the effect of land use and land management practices on water yield and water quality, and to develop standards and methods of watershed management. On the 5500 acre Coweeta Hydrologic Laboratory are approximately 35 individual watersheds whose stream flow is being continuously gaged. There are 13 recording and 63 non-recording (standard) rain gages, 21 recording and 19 non-recording ground water wells, 5 recording hygrothermographs, 2 recording anemometers, and one evaporation pan. Water samples for quality analysis are collected on a daily basis from selected watersheds. 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 is established on the John C. Calhoun Experimental Forest near Union, S.C.

(f) Active. Research projects include determination of effects of (1) permanent complete removal of all major vegetation; (2) temporary complete removal of all major vegetation; (3) removal of riparian vegetation; (4) local logging practices; (5) mountain agriculture; (6) woodland grazing; and (7) forest fires on water yield and water quality.

(g) The results of canopy interception studies have been summarized in interception tables for four different types of forest stands for summer and winter. An uncontrolled logging operation in the southern Appalachians has increased the average stream turbidity from 4 to over 90 parts per million. The maximum has been increased from 80 to over 5000 ppm. The average leaf area of rhododendron maximum per unit of ground area has been determined. Changes in frequency of levels of stream flow brought about by land use and vegetation changes have been demonstrated.

(h) "Loblollies and the land", Jackson Bennett and P. W. Fletcher. Soil Conservation, XIII (5): 115. December 1947.

"Local climate in the Copper Basin of Tennessee as modified by the removal of vegetation", C. R. Hursh. U. S. Department of Agriculture Circular No. 774, 38 pp. January 1948.

"Watershed management research in Coweeta Experimental Forest." (Handbook.) Division of Forest Influences' Staff. May 1948.

"The effect of uncontrolled logging on stream turbidity", J. A. Lieberman and M. D. Hoover. Water and Sewage Works. July 1948.

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

(657) FOREST INFLUENCES INVESTIGATIONS AND WATERSHED MANAGEMENT.

This project is a continuation of the work reported under Projects Nos. 381, 382, and 383 in Volume 12.

(b) Laboratory project.

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

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

(e) To determine the influence of vegetation on stream flow, water uses, water losses, and erosion and sediment production. Work center is at Sierra Ancha Experimental Forest, with additional experimental watersheds and plots in representative areas throughout the Salt River Watershed. Watersheds are equipped to measure stream flow, precipitation, and climate. The calibration period on watersheds in the pine-fir forest area is nearing completion, and the effect of timber harvest on water yield will be studied. Watersheds located in other types have been through the calibration period and are under grazing treatment to determine effect of vegetation manipulation on water yield. Water utilization by semidesert and chaparral vegetation is studied by periodic weighing of natural soil blocks, and the measurement of precipitation and of surface and subsurface runoff from small and large lysimeters of natural soil blocks.

(f) Active.

(g) Though watershed vegetation uses some water, the amount evaporated from bare soil is almost as much, and the vegetation which comes in on deteriorated sites uses up more water than the desired perennial grasses. Most of the water yield occurs during the winter period as subsurface runoff. There are increases in summer surface runoff and erosion, and significant decreases in average areal infiltration capacities from overgrazing, but winter percolation appears to be independent of

grazing use.

(h) Annual Reports for 1944-47.

Research Notes 1, 3, 41, 67, 71, 78, 79, 85, 96.

"Soil erosion and stream flow on range and forest lands of the upper Rio Grande watershed in relation to land resources and human welfare." U.S. Department of Agriculture Technical Bulletin 567. May 1937.

"The relationship of stream flow to precipitation on the Salt River watershed above Roosevelt Dam." University of Arizona Technical Bulletin 76. July 1938.

"Effect of forest litter on soil temperature", B. A. Hendricks. Chronica Botanica VI, 19-20: 440-441. December 1941.

"Effects of fire on steep mountain slopes in central Arizona", B. A. Hendricks and Jerry M. Johnson. Jour. Forestry, 42(8): 568-571. August 1944.

"Forecasting stream flow of the Salt River, Arizona", C. K. Cooperrider, H. O. Cassidy, and C. H. Niederhof. Trans. American Geophysical Union, Vol.25, Pt. II: 275-282. October 1945.

"Watershed research aids Salt River Valley." October 1947 (mimeograph).

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

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

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

(b) Laboratory project. (d) Experimental; development.

(e) 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.

(f) Active. Field work tests have been completed on gathering the data.

(g) Considerable work has been done on the basic formula developed from about 600 tests on some 100 reaches of commercially smooth pipe less than one year old, varying from one inch to 216 inches in diameter, velocity range of one fps to fifty fps. The experimental data coincide remarkably well with the basic formula.

(385) FLOW OF WATER IN CONCRETE PIPE.

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

(e) 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.

(f) Active.

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

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

(e) (1) To determine the relationship between the suspended silt load and the discharge of Texas streams; (2) to establish criteria for planning surface reservoir storage based on suspended silt to be handled; (3) to determine the characteristics of silt deposit in reservoirs for use in evaluation of the life of a given reservoir; (4) to secure data necessary to determine the effect of silt load on the cost of preparing water for domestic and industrial use; and (5) to determine the relationship between silt load and the management of the tributary watersheds.

(f) Active.

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

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

(e) (1) To develop from snow surveys and related data advance knowledge of the amount and distribution of the water supply 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 stream flow and ground waters in principal stream basins are being studied in relation to occurrence, distribution, utilization, and efficiency of use.

(f) Active in several states. Snow cover - runoff relations are being established and used as basis for water forecasts.

(g) Research projects are being conducted in several states in cooperation with State Agricultural Experiment Stations, to determine methods of developing and applying general forecasting principles to local conditions.

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

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

(e) (1) To determine the effect of deviation from normal of late fall and early spring precipitation on the established snow cover - runoff relationship for Utah streams; (2) to determine the effect of temperature and other climatic factors upon the quantity and distribution of runoff from Utah's snow-fed streams; (3) to determine the effect of various meteorological phenomena on the distribution and extent of the "snow blanket" for particular storms with special reference to established snow courses. At present data are being gathered at two mountain installations, consisting of a standard rain gage, a recording rain gage, and a recording thermograph. Soil samples are taken for a determination of soil moisture.

(f) Active. It will take several seasons' observations before any trend in relationship between the various phenomena can be ascertained.

(389) STORAGE OF WATER UNDERGROUND FOR IRRIGATION.

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

(e) The objective 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 the principal objectives are to determine the cause of the rate decrease and to find practical methods of maintaining the higher initial rates. Field tests are being made on test ponds and strips, as follows: (1) chemical, (2) mechanical, (3) addition of organic matter, (4) operational procedures, and (5) vegetation.

(f) Active.

(g) Many treatments have been eliminated after tests show no advantage. The application of cotton boll hulls to the plots can materially affect the rate of percolation, but no conclusions have been reached as to what causes this increased rate.

(390) IMPERIAL VALLEY DRAINAGE INVESTIGATIONS.

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

(e) The objectives are (1) to continue the refinement of criteria established during the past five years 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.

(1) The Division of Irrigation will endeavor to analyze the effect of pumping from deep drainage wells on the water levels of the surrounding area by means of piezometer measurements.

(2) Imperial Irrigation District experimental farm. Analyses of the virgin and future soil-water relationships as they will affect irrigation practices and ground water conditions are proposed. A piezometric study of the changes in water table elevations within and adjacent to the farm will be made to determine the effect of extensive development of the East Mesa on the ground water of the Mesa and the agricultural lands of the Imperial Valley.

(3) Evaluation of designed tile drainage systems will be continued. The study of complex stratified soil conditions will be continued as time permits.

East Mesa water table study: A review of all observation wells and stratigraphic data, and field inspections of the morphological and stratigraphic aspects of the East Mesa area under study will be made. Observation wells will be installed adjacent to the East Highline and the Coachella Branch Canals. Data will be used to establish the 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: It is proposed to set up one or more evaporation stations on the edge of Salton Sea to obtain continuous records for a long period. Analysis of existing 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.

A drainage manual will be prepared, outlining procedure for drainage investigation on irrigated farms and a program for solving drainage problems.

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. From these observations, a recommendation regarding the most efficient methods of leaching will be made.

(f) Active, making application of basic findings obtained during first five years to field practices.

(391) SAN FERNANDO VALLEY DRAINAGE INVESTIGATIONS.

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

(e) To obtain basic physical data necessary to design an adequate drainage system to control the ground water in San Fernando Valley Soil Conservation District, and to develop methods and techniques that might be applied to the solution of similar problems in other areas.

(1) Compilation, correlation, and analysis of existing data; (2) initiation of additional field work, 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; (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.

(f) Active. The preliminary work has been completed.

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

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

(e) Test plots with various types of crops are given different irrigation treatments to determine the rate of growth, the amount yielded, and the moisture level of the soil. Plots have been set up to study the effect of various types of organic matter on the soil structure and water penetration.

(f) Active.

(53) SAND TRAPS AND SLUICEWAYS.

(54) MEASURING DEVICE AND INTEGRATING INSTRUMENT.

(55) SNOW COURSE MEASUREMENTS AND FORECAST ANALYSIS.

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

(287) PERFORMANCE TESTS OF WELL SCREENS.

(b) Soil Conservation Service, in cooperation with Colorado Agricultural Experiment Station, Colorado A & M College, Fort Collins, Colo. For complete reports, refer to the above numbered projects, listed under Colorado A & M College, pages 19 and 20.

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

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

(b) U. S. Soil Conservation Service and the Washington Agricultural Experiment Station.

(c) George D. Clyde, Chief, Division of Irrigation and Water Conservation, U. S. Soil Conservation Service, College Hill, Box D, Logan, Utah.

(d) Experimental; applied research.

(e) A study of the irrigation and erosion characteristics of different size irrigating streams as they are influenced by furrow grade, crop and crop sequence, tillage, and soil moisture. Application and runoff measured by automatic water level recorders on type HS flumes. Detailed soil moisture determinations made with soil tube, gravimetric plugs, and resistance blocks.

(f) Active.

(h) Field Day Progress Reports (mimeographed) available for 1943 through 1948.

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

(151) LINING OF IRRIGATION CANALS AND DITCHES.

(b) Laboratory project; U. S. Soil Conservation Service and Utah Agricultural

Experiment Station.

(c) C. W. Lauritzen, Research Project Supervisor, Soil Conservation Service; and O. W. Israelsen, Research Professor of Irrigation and Drainage, Utah Agricultural Experiment Station, Logan, Utah.

(d) Experimental; basic and applied research.

(e) 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. This year investigations were extended to include three field tests on concrete of two thicknesses with and without reinforcing, gunite of two thicknesses with and without reinforcing, precast concrete slabs with mastic joints, loosely-placed concrete slabs over a soil-bentonite mix, and loosely-placed concrete slabs over clay, gravel over a soil-bentonite mix and butyl-coated fiberglas in the main canal and two laterals. Linings in the field laterals include butyl-coated fiberglas, precast concrete slabs, half-round concrete liners, and earth treated with sodium silicate.

(f) Active.

(h) "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.

"Earth linings for irrigation canals and storage reservoirs", C. W. Lauritzen and O. W. Israelsen. Proc. Soil Science Society of America, 1948 (in press).

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, North Appalachian Experimental Watershed, Coshocton, Ohio; Blacklands Experimental Watershed, Waco, Texas; and Central Great Plains Experimental Watershed, Hastings, Nebr.

(150) HYDROLOGIC EXPERIMENT STATIONS.

(b) Soil Conservation Service, U. S. Department of Agriculture, and the State Agricultural Experiment Stations of Ohio, Texas, and Nebraska.

(c) Lewis A. Jones, Chief, Division of Drainage and Water Control, Soil Conservation Service, Washington 25, D. C.

(d) Experimental; applied research and design.

(e) Rainfall, runoff, evapo-transpiration, moisture storage, moisture transmission through the soil, and percolation of water to the ground water table are studied in watersheds of various sizes. The purpose is to determine the hydrologic effect of physiography, tillage, and ground surface conditions, vegetal covers, soils and geology; also the effect of conservation farming on runoff and erosion, and the characteristics of flood runoff from agricultural watersheds.

(f) Active.

(g) Limitations in the magnitude of water conservation are being discovered and evaluated. Future research is planned to determine ways of overcoming these limitations.

(h) "Hydrologic design of farm ponds and rates of runoff for design of conservation structures in the North Appalachian region", L. L. Harrold, Soil Conservation Service Tech. Pub. 64. December 1947.

"Rates of runoff for the design of conservation structures in the Central Great Plains of Nebraska and Kansas", J. A. Allis, Soil Conservation Service Tech. Pub. 69. August 1948.

"Runoff and soil conservation practices", R. W. Baird. Agricultural Engineering,

Vol. 29, No. 5: 216-217. May 1948.

"Land use practices on runoff and erosion from agricultural watersheds", L. L. Harrold. Agricultural Engineering, Vol. 28, No. 12: 563. December 1947.

U. S. DEPARTMENT 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, Research Supervisor, Soil Conservation Service, Agricultural Engineering Building, Purdue University, Lafayette, Ind.

(d) Experimental; for design.

(e) To study the effects of types of land-use and cultural practices as a means of reducing the rates and amounts of surface runoff, for purposes of soil and moisture conservation and upstream flood control. Continuous records of rainfall and runoff are collected for 20 small watersheds, and records are kept on watershed cover, soil character and conditions, farming operations, etc. The results are intended to be applicable for soil conditions, climate, and agriculture generally representative of a large part of the eastern section of the corn belt.

(f) Active.

(g) Individual storm-runoff summaries, seasonal runoff totals, and critical rate data are available for eight years for permanent pasture and wood lots and for corn, wheat, and meadow under the "prevailing" type of treatment; and six years for corn, and four years each for wheat and meadow under the conservation type of treatment.

U. S. DEPARTMENT 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. Department of Agriculture; and the Oklahoma Agricultural Experiment Station.

(c) Lewis A. Jones, Chief, Division of Drainage and Water Control, U. S. Soil Conservation Service, Washington 25, D. C.

(d) Experimental; for design.

(e) Measured flows up to 150 cfs are passed through outdoor test channels of various cross-sections up to 40 feet in width 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. The purpose is 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.

(f) Active.

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

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

Reports on projects conducted by the Soil Conservation Service at the St. Anthony Falls Hydraulic Laboratory are listed under St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn., Projects Nos. 111 to 115, incl., and 619 to 621 incl. Inquiries should be addressed to Fred W. Blaisdell, U. S. Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

U. S. DEPARTMENT OF AGRICULTURE, U. S. REGIONAL SALINITY AND RUBIDOUX LABORATORIES, Riverside, Calif.

(659) CHARACTERISTICS OF FLOW THROUGH WELL CASINGS.

(b) Laboratory project.

(c) Ronald C. Reeve, Irrigation and Drainage Engineer, U. S. Regional Salinity Laboratory, P. O. Box 672, Riverside, Calif.

(d) Experimental; applied research.

(e) Tests are being made to determine head losses through well casings and screens in conjunction with artificial gravel packs and natural water-bearing sands. Piezometer connections along the test cylinder serve for measuring head losses. The sealing effect of the driller's mud used in drilling hydraulic rotary wells is also being studied.

(f) Active. Studies with six casing and two well screen test sections in conjunction with one gravel pack have been completed.

DEPARTMENT OF THE ARMY, OFFICE OF THE CHIEF OF ENGINEERS, BEACH EROSION BOARD, Washington, D. C.

Inquiries concerning Projects Nos. 181 to 185, incl., 398, 399, and 660 to 664, incl., should be addressed to The Resident Member, Beach Erosion Board, 5201 Little Falls Road, N.W., Washington 16, D. C.

(181) EQUILIBRIUM PROFILE OF BEACHES.

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

(e) The purpose is to evaluate the effect of wave form, initial beach slope, range and frequency of tides, and sand grain size in determining the equilibrium profile of beaches. Experiments are made in a concrete wave tank, 88 by 14 by 4 feet in size. Tests have been made with an original beach slope of 1:15, 1:30, and a

combination of 1:10 and 1:20; wave period of 1.3, 2.2, 1.75, 2.75, and 3.3 seconds; wave height 0.4 feet; and sand sizes 0.21, 0.56, 1.25, and 2.25 mm, median diameter. The tests are continued until the rate of change of the shape of the beach is very slight, usually 100 hours.

(f) Active.

(h) Quarterly Summary, Waterways Experiment Station.

(182) STUDY OF WAVE REFLECTION.

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

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

(f) Completed, except for report being prepared for publication by the Beach Erosion Board.

(h) Quarterly Summary, Waterways Experiment Station.

(183) SETTLING VELOCITY OF BEACH SANDS.

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

(e) The purpose is to develop an apparatus capable of measuring the settling velocity distribution curves of beach sands, and to study the settling velocity curves of representative beach samples as a possible index to their action under various types of wave attack. The apparatus consists essentially of a water column in a pipe through which the sand settles and manometer tubes to measure the change in pressure as the sand passes opening in the side of the pipe. The change in level in the manometer tube is recorded by a combination of a float, rotating mirror, lamp, and moving photographic film.

(f) Completed.

(g) A satisfactory instrument has been developed.

(h) Quarterly Summary, Waterways Experiment Station.

A report has been prepared and submitted to the American Geophysical Union for publication.

(184) STUDY OF MODEL SCALE EFFECTS.

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

(e) The purpose is to determine the laws of model similarity governing the action of waves on movable sand beaches. The tests are made in a wave tank 42 feet by 1.5 feet by 2 feet. Conditions of wave height, wave period, beach slope, and grain size of sand are adjusted to various scales in an attempt to simulate the results of the tests obtained in the large wave tank for Project 181, "Equilibrium Profile of Beaches", page 98.

(f) Active.

(h) Quarterly Summary, Waterways Experiment Station.

(185) STEEL SHEET PILING INVESTIGATION.

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

(e) The purpose is to determine the probable life of steel sheet piling as used in

maritime structures, to evaluate the causes of deterioration, and to determine practical methods of extending the probable life. Thickness measurements of representative steel sheet piling samples in maritime structures located along the East coast were made in 1936, 1940, and 1946. When available, data on salinity, pH, water temperature, and pollution were also compiled.

(f) The report has been completed and is being edited for publication.

(h) Quarterly Summary, Waterways Experiment Station.

(398) WATER TRANSPARENCY TEST.

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

(e) The purpose was to evaluate the British water transparency method of determining water depths from aerial photographs. The depth of the ocean along a line previously surveyed by standard hydrographic methods was determined from selected pairs of aerial photographs using the technique and procedure outlined in the British method.

(f) Completed.

(g) The tests indicate that other methods of depth determination are more adaptable to field operations, in that they do not require such ideal meteorological and oceanographic conditions and such strict photographic control.

(h) "Proof tests of water transparency method of depth determination." Beach Erosion Board Technical Memo No. 9 (available on request).

(399) DEVELOPMENT OF 6-FOOT WAVE TANK.

(b) Laboratory project. (d) Experimental; for design.

(e) The purpose is to obtain data for use in the design of a wave tank for the study of the effect of waves 6 feet high and 300 feet long. Various types of wave generating mechanisms, the power required by the generator to form the waves, and the action of the waves on a beach which is placed at an angle to the axis of the tank have been studied in a 1:12 model.

(f) Active.

(h) Quarterly Summary, Waterways Experiment Station.

(660) OBSERVED WAVE CHARACTERISTICS.

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

(e) The purpose is to develop methods of recording the characteristics of waves acting on a beach and to develop methods of analyzing these records to obtain data which will be useful in the study of the effect of waves on the motion of the sand. Two types of electrical recording wave gages have been developed, one for fresh water and the other for salt water. Methods of studying the wave records visually to obtain significant data for comparison with the movement of the sand are being studied.

(f) Active.

(h) "An ocean wave measuring instrument." Beach Erosion Board Technical Memo No. 6. October 1948.

Quarterly Summary, Waterways Experiment Station.

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

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

(e) The project is a study of the relation between movement of beach material and

natural forces such as waves, tides, and littoral currents. Fourteen million cubic yards of sand have been placed on Hyperion Beach, Santa Monica Bay, and one million cubic yards have been placed on Sunset Beach, Anaheim Bay, Calif. The rate that this material is moved away from the place where it was deposited is being studied by means of frequent surveys. The intensity and direction of the waves are being recorded.

(f) Active.

(h) Quarterly Summary, Waterways Experiment Station.

(662) DEVELOPMENT OF BED LOAD SAMPLER FOR OCEAN BEACHES.

(b) Laboratory project. (d) Experimental; development.

(e) The purpose is to develop an apparatus which can be used to measure the amount of sand which is being moved along the bottom by currents and wave action. Several 1:5 scale models were constructed and tested in the wave tanks at the laboratory. The most promising, a tunnel type, 9 inches long, 2.8 inches wide, and 0.4 inches high in front and 1.8 inches high in back, was made in a full-scale model and is being tested at Long Branch, N. J.

(f) Active.

(h) Quarterly Summary, Waterways Experiment Station.

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

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

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

(f) Active.

(h) Quarterly Summary, Waterways Experiment Station.

(664) DEVELOPMENT OF SUSPENDED SAND SAMPLER.

(b) Laboratory project. (d) Experimental; development.

(e) The purpose is to develop an apparatus which can be used to determine the amount of sand in suspension in the water near beaches on which waves are breaking. Laboratory tests have been made with a pump-type sampler with various sized sand and various velocities of stream flow past the nozzle. Field tests are being made with the apparatus at Long Branch, N. J.

(f) Active.

(h) Quarterly Summary, Waterways Experiment Station.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Bonneville Hydraulic Laboratory, Portland, Ore.

Inquiries concerning Projects Nos. 189 to 192, incl., 401 to 410, incl., and 665 to 667, incl., should be addressed to Mr. R. B. Cochrane, Head, Hydraulic Design Section, Portland District, Corps of Engineers, 628 Pittock Block, Portland, Oreg.

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

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

(d) Experimental; for design.

(e) A fixed-bed type, 1:100-scale, undistorted model, constructed of concrete, reproduces a 3.7 mile reach of the Columbia River, at the site of McNary Dam. After verification of the natural river conditions was completed, the powerhouse, spillway, navigation lock, and fishway structures were installed, and provisions made for determining water-surface profiles, velocities, and photographic data. The tests were made to determine the best arrangements of spillway dam, powerhouse, fishways, and lock structure in the interest of navigation and power generation, and to study certain problems with regard to fishway approaches and cofferdam construction.

(f) Tests are nearing completion.

(g) Basic tests indicated that realignment of the structures, especially that of the powerhouse, would be necessary. Tests on a revised design showed satisfactory improvements with changes in alignment. Cofferdam studies indicated satisfactory flow conditions for the various steps or arrangements during construction of the project structures.

(h) Preliminary reports have been issued on the tests completed to date.

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

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

(d) Experimental; for design.

(e) A 1:36-scale model reproduces three complete 50-foot-wide bays of the spillway section, including ogee crest, piers, 50-foot by 50-foot gates, and stilling basin. Various designs of ogee spillway, piers, gates, and stilling basins are being investigated to provide the most effective and satisfactory design for control of flow and dissipation of energy. Certain problems pertaining to fish-ladders are also being studied.

(f) Tests are nearing completion.

(g) Several shapes of piers, arrangements of stilling basins, and types of radial and vertical lift gates were tested. Based on these tests, a pier with an eliptical-shaped nose, split vertical lift gates, and stilling basin with two rows of baffle piers have been adopted.

(h) Twelve preliminary reports have been issued.

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

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

(d) Experimental; for design.

(e) The model reproduces on a scale of 1:25 a section of the forebay, the lock chamber complete with ports, culverts, and control valves of the filling and emptying systems, and the lower lock approach channel. The purpose is to obtain comparable test data on several types of lock filling and emptying systems to permit selection of the most satisfactory hydraulic system for the designed lock 86 feet wide by 675 feet long.

(f) Active.

(g) Tests show that a bottom lateral culvert system is more satisfactory than a longitudinal culvert system. Reverse tainter valves reduced entrance of air into the culverts, resulting in less turbulence and lower hawser forces during filling. Negative pressures in the culverts downstream from the filling valves, in the

reversed position, can be reduced by opening the valves at a non-uniform rate.

(h) Two preliminary reports have been issued.

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

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

(d) Experimental; for design.

(e) The model was constructed to a scale of 1:50 with a portion of the forebay and 120-foot earth-fill dam, gravity-type 200-foot wide spillway, stilling basin, the five 5-foot by 6-foot sluiceways, and a portion of the tailbay being reproduced. Hydraulic characteristics of the spillway and stilling basin as designed were studied.

(f) Tests have been completed.

(g) Model results indicated that with the stilling basin sloped 1 on 21.3, with a broad-crested type sill, and with conventional rectangular-faced baffles, a satisfactory hydraulic jump formed for all discharges up to and including the design flood.

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

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

(d) Experimental; for design.

(e) The model, on a scale of 1:16, reproduced a section of the fishladder proposed for McNary Dam. This section includes a 180° bend and 13 bays upstream and 7 bays downstream therefrom. Flow conditions in the fishladder were studied for various widths, slopes, head on the weirs, and the effect of submerged orifices and shapes and sizes thereof on the flow conditions within individual pools between the weirs.

(f) Tests have been completed.

(g) Tests show that a fishladder 30 feet wide, with bottom slope of 1 on 20, with spacing between weirs of 20 feet and with 2 orifices per weir was the most satisfactory.

(h) Preliminary reports have been issued.

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

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

(d) Experimental; for design.

(e) The model was constructed to a scale of 1:10, and reproduced a 3 bay section of the 30-foot wide fishladder. The 20-foot by 30-foot center bay contained a diffuser consisting of a chamber 8 feet in depth beneath the normal flow of the ladder. Flow was introduced into this diffuser from an auxiliary water supply system. The diffused flow was extruded into the bottom of the fishladder through baffles to merge with the flow passing downstream through the ladder proper. This study was made to determine the best arrangement of introducing auxiliary water into the fishladder under proposed tailwater and general operating conditions.

(f) Tests have been completed. A preliminary report has been issued.

(g) Tests on a revised design showed that a stepped floor in the fishladder underneath the diffuser was the most satisfactory in distributing auxiliary water inflow laterally in the diffuser pool.

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

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

(d) Experimental; for design.

(e) The model is of the fixed-bed type constructed to a scale of 1:72. A section of the prototype forebay extending some 2,000 feet upstream from the dam, and the lower riverbed to a point 2,400 feet downstream from the dam, 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 is reproduced in its entirety. Tests are being made to study the hydraulic performance of both the side channel spillway and a gravity type spillway to determine the most satisfactory type for the site available for the structure.

(f) Active.

(g) Tests completed on models of the original and revised designs of the side channel spillway indicate satisfactory operation of the revised design. A decision has been made to incorporate this design in the prototype.

(404) MODEL STUDY OF MERIDIAN DAM TUNNEL AND OUTLET WORKS (LOOKOUT POINT SITE), MIDDLE FORK, WILLAMETTE RIVER, OREGON.

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

(d) Experimental; for design.

(e) The model, on a scale of 1:25, includes a portion of the forebay, 750 feet by 1,000 feet, the intake tower containing the tunnel entrances, the 20-foot flood control tunnel and 27-foot power tunnel, Howell-Bunger valves, and a portion of the tailbay area. Tests will be made to study the hydraulic characteristics of the power and flood control tunnels, including discharge capacities, pressures, and velocities as affected by alignment, slopes of entrances, and type and location of control valves.

(f) Active.

(g) Tests have been completed on the designs of the power and flood control tunnels. Tests are underway on realignments and revisions of the tunnels.

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

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

(d) Experimental; for design.

(e) The model is of the fixed-bed type, constructed to an undistorted scale of 1:100, and reproduces the river from mile 8.3 to mile 11.0. The proposed structures include the spillway with fourteen 40-foot bays equipped with vertical-lift gates, the powerhouse with five turbine generator units, a single-lift navigation lock 86-feet wide by 500-feet long, and two fishways. The most satisfactory layout of the structures with regard to navigation, power generation, and passage of fish will be determined.

(f) Active.

(g) Verification tests of the natural river conditions have been completed. Basic tests with the proposed structures in place are in progress.

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

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

(d) Experimental; for design.

(e) The model will consist of a 3-bay section of the spillway dam constructed to a scale of 1:32. Investigation will be made of proposed designs of the spillway, apron, baffles, and gates. Improvements, where necessary, will be made to determine the most effective design for dissipation of energy and control of flow.

(f) Active. Design of the model has been completed, and construction is nearing completion. Tests are scheduled to begin about February 1, 1949.

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

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

(d) Experimental; for design.

(e) A bottom-lateral filling and emptying system for a lock 86 feet wide by 500 feet long will be investigated first in a model being built to a scale of 1:25. The model will include the entire lock chamber and culvert system, and a portion of the approach and exit channels. Filling and emptying characteristics will be observed, and hawser forces and changes in water-surface elevations will be recorded electrically from a central control panel. The purpose of this study is to develop satisfactory hydraulic filling and emptying systems for a navigation lock with a head of 100 feet for Ice Harbor.

(f) Active. Design of the model and construction of the wall culverts and tainter valves have been completed.

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

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

(d) Experimental; for design.

(e) The model is of the fixed-bed type, on a scale of 1:80, and includes the Columbia River from mile 545.8 to either mile 544.1 or mile 543.2. The 25-bay spillway and 18-unit powerhouse will be reproduced. Normal operating head will be 162 feet. This study is being made to determine the most economical and effective arrangements of spillway dam and powerhouse, to determine the forebay and tailbay flow conditions with various operating conditions, and to obtain a satisfactory program of cofferdam construction.

(f) Construction of the model was suspended pending decision on alternate sites for the prototype structure.

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

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

(d) Experimental; for design.

(e) The model will be sectional and consist of three 40-foot wide bays of the gate-controlled spillway dam with 5-foot 8-inch by 10-foot sluices, on a scale of 1:32. The purpose of the study is to determine the most effective and economical stilling basin design, to check the performance of the modified end bays of the spillway, and to verify the performance of the sluices.

(f) Construction of the model was suspended pending decision on alternate sites for the prototype structure.

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

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

(d) Experimental; for design.

(e) The model will be constructed to a scale of 1:25. A section of the powerhouse forebay, one 23-foot penstock complete from entrance through turbine scroll case, and the entrances of the adjacent penstocks on either side will be reproduced. Normal head for the dam is 162 feet. Provisions will be made to permit extension, at a later date, of the penstock length and installation of a turbine wheel and an electric dynamometer to measure relative turbine efficiency. The purpose of the tests is to develop the most efficient and satisfactory penstock entrance and transition sections, and to investigate the effect of angularity of entrance, varying curvatures of transitions, piers, and guide vanes.

(f) Construction of the model was suspended pending decision on alternate sites for the prototype structure.

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

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

(d) Experimental; for design.

(e) The model is built to a scale of 1:10 and includes a single spillway bay complete with 50-foot by 50-foot split-vertical gate. It is located over the channel leading to the downstream end of the fish locks between the Bonneville powerhouse and navigation lock. A maximum model discharge of 320 cfs is available. Pressures underneath the gate, in the gate slots, and in the spillway crest will be measured with pressure cells for several gate positions and discharges. Upon completion of the McNary gate studies, the model will be modified to simulate the Bonneville Dam vertical-lift gate, and tests will be made to check pressures and general hydraulic characteristics under various flow conditions.

(f) Construction of the model is nearing completion. Tests are scheduled to begin about January 1, 1949.

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

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

(d) Experimental; for design.

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

(f) Active. A pressure study on a valve and in a culvert section immediately above and below the valve has been completed.

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

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

(d) Experimental; for design.

(e) The model, on a scale of 1:16, reproduces the auxiliary water supply system in the lower end of the fishladder. Complete diffusion chambers to add sufficient water in the submerged portion of the ladder to maintain selected velocities were simulated. Pressures were observed in critical sections of the water supply systems to the diffusion chambers to determine the hydraulic grade lines and to locate low pressure areas which might be detrimental to the prototype structure.

(f) Active.

(g) Tests indicate that the valves controlling the flow to the diffusion chambers should be fully open or fully closed for flows throughout the lower range of

tailwaters. High negative pressures occurred in the lines downstream from the valves with partial valve openings. The valves were submerged during high tailwater stages, and danger from negative pressures was eliminated.

DEPARTMENT 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, Department of Civil Engineering and Engineering Mechanics, Case Institute of Technology, Cleveland, Ohio.

For a report on this project, refer to Project No. 400, listed under Case Institute of Technology, page 18.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Fort Peck District, Fort Peck, Mont.

(668) HYDRAULIC MODEL OF FORT PECK TUNNEL OUTLET AREA, FORT PECK DAM, FORT PECK, MONTANA.

(b) Laboratory project.

(c) District Engineer, Fort Peck District, Corps of Engineers, Fort Peck, Mont.

(d) Experimental; for design.

(e) Tests are being conducted on a model of the Fort Peck tunnel outlet area built to a scale of 1:73.5, to determine the necessary corrective measures or additional construction works to dissipate the energy in the water discharges, to prevent concentration of outflows along either river bank, and to prevent erosion of the river banks and channel downstream from the apron. The effect of training walls, weirs, sills, and piers is being studied.

(f) Active.

(g) Tests indicate satisfactory improvements will consist of training walls downstream from the tunnel outlets and a line of piers parallel to and upstream from the edge of the outlet apron.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Little Rock District, Little Rock, Ark.

(669) TEST OF TAINTER GATE FOR CONTROL OF CONDUIT FLOW.

(b) Department of the Army, Office of the Chief of Engineers.

(c) District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.

(d) Experimental; design and operation.

(e) A 4-foot wide by 6-foot high tainter gate is being constructed and installed at

Norfork Dam at the downstream end of an existing conduit. It will be operated under a head of about 180 feet. Tests will be made to determine downpull, vibration, air intake volume, and measurement of pressures on the face of the gate and in the conduit. Different types of rubber seals will be used during the tests.

(f) Project is under construction, and tests will probably be started during the first quarter of 1949.

See also Project No. 681, "Tainter Test Gates for Sluices, Norfork Dam", page 129, for model tests.

(670) PROTOTYPE TESTS OF SLIDE GATES.

(b) Department of the Army, Office of the Chief of Engineers.

(c) Director, Waterways Experiment Station, P. O. Box 631, Vicksburg, Miss.

(d) Experimental; design and operation.

(e) The downstream gate of one outlet, 4 feet by 6 feet, was used for tests on high-pressure slide gates. The main purpose was to determine the hydraulic downpull forces on two gates of different design; one wherein the gate lip was flat, and the other with a 45° sloping front face with a 2-inch sealing surface on the bottom. Other phases of the program included determination of the air requirement downstream from the two gates when they were operated at various openings to regulate the discharge; study of the performance and operation of the gates under high heads (approximately 165-foot); the study of pressure conditions on various parts of the gates; a study of the flow and pressure conditions in the conduit immediately downstream; and the study of vibration and movement in the gates.

(f) Field tests are partially completed, and compilation of data previously obtained has been undertaken. It is estimated that all tests will be completed and a comprehensive report submitted during the first quarter of 1949.

See also Project No. 419, "Slide Gate Tests, Norfork Dam, Arkansas", page 124, for model tests.

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

Inquiries concerning Projects Nos. 188 and 671 should be addressed to the District Engineer, Los Angeles District, Corps of Engineers, 5180 Metro Station, Los Angeles 55, Calif.

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

(b) Laboratory project. (d) Experimental; for design.

(e) Tests were conducted on a 1:30 model to determine the effect on water surface of a series of curves and reverse curves with transition spirals and superelevated bottoms for rectangular channels with various discharge; and to determine flow conditions at the confluence with Tujunga Wash for various combinations of discharges.

(f) Completed. Preparation of report is in progress.

(g) Velocity of flow was supercritical. It was found that longitudinal slope of channel should be at least 25 percent greater than critical slope to eliminate undulating surface waves.

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

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:30 model has been built of the confluence of the Sawtelle-Westwood Channel and Ballona Creek to study flow conditions for various combinations of discharges in the two channels.

(f) Active. Tests are in progress.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Pittsburgh District, Pittsburgh, Pa.

(585) RESISTANCE OF BARGE TOWS.

(b) University of Michigan, Department of Naval Architecture and Marine Engineering, Ann Arbor, Mich.; and Corps of Engineers, Pittsburgh District.

For a complete report on this project, refer to Project No. 585 listed under University of Michigan, page 49.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Portland District, Portland, Ore.

Projects being conducted by this District are listed under Corps of Engineers, Bonneville Hydraulic Laboratory, pages 101-106.

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

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

Inquiries concerning Projects Nos. 193 to 196, incl., and 411 to 415, incl., should be addressed to The District Engineer, Corps of Engineers, St. Paul District, 1217 U. S. Post Office and Custom House, St. Paul 1, Minn.

(193) AIRFIELD DRAINAGE STRUCTURES INVESTIGATION.

(b) Chief of Engineers, Corps of Engineers, Department of the Army, Washington, D. C.

(d) Experimental; for design.

(e) To determine the capacities of paved airfield gutters for various roughnesses, surface textures, and gradients; to determine discharge characteristics and capacities of typical commercial inlet gratings; and to determine discharge characteristics of curb inlets for various approach slopes. Three models were used: (1) a portion of pavement, slab, and gutter to full scale with 5 gutter gradients; (2) various commercial grate inlets of 1/4, 1/3, and 1/2 size tested in Model 1 for all gradients; and (3) curb gutter inlets of 1/2 size tested in Model 1 for 3 gutter gradients.

(f) Testing program completed June 30, 1947. Preparation of final report in progress.

(g) Manning's n formula was about 0.13 for uniform flow in the model of the shallow runway gutter with a simulated belted concrete finish. With runoff from an adjacent runway, the flow was about 10 percent deeper. Flush type inlets in a continuous gutter operated best with gratings of bars running parallel to the gutter and with the gratings extending across the gutter. The flow intercepted depended on the gross width and length of opening. The discharge capacity of grated inlets in a ponded area was defined reasonably well by the theoretical weir formula for heads less than about 0.4 foot and by the orifice formula with a coefficient of about 0.67 for a submergence greater than about 1.4 foot. In the intermediate range, vortices altered the flow characteristics. The inlets tested were relatively inefficient.

(h) "Progress Reports" and "Quarterly Report for Model Studies", the District Engineer, Corps of Engineers, St. Paul District.

(194) A STUDY OF METHODS USED IN MEASUREMENT AND ANALYSIS OF SEDIMENT LOADS IN STREAMS.

(b) Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation.

(d) Experimental; for design.

(e) After a survey of previously used suspended sediment sampling equipment, field techniques, and laboratory methods, improved designs of point-integrating and depth-integrating samplers and new laboratory methods were developed to improve the measurement and analysis of the sediment load in streams. Based on extensive field tests, improvements have been made in the mechanical operation of the point-integrating sampler, and special purpose depth-integrating suspended samplers have been developed to cover a wider range of sampling conditions.

(f) The testing and development program is in progress.

(g) Heavy, electrically-operated depth-integrating suspended sediment samplers for use in deep swift streams, and light-weight hand-operated wading samplers for use in shallow streams have been produced and are undergoing field tests by cooperating Federal agencies.

(h) "Field practice and equipment used in sampling suspended sediment." CE-A No. 1. August 1940.

"Equipment used for sampling bed load and bed material." CE-A No. 2. September 1940.

"Analytical study of methods of sampling suspended sediment." CE-A No. 3. November 1941.

"Methods of analyzing sediment samples." CE-A No. 4. November 1941.

"Laboratory investigations of suspended sediment samplers." CE-A No. 5. December 1941.

"A study of new methods for size analysis of suspended sediment samples." CE-A No. 7. June 1943.

"Measurement of the sediment discharge of streams." CE-A No. 8. March 1943.

"Density of sediments deposited in reservoirs." CE-A No. 9. November 1943.

"Field conferences on suspended sediment sampling", M. E. Nelson. September 1944.

"Comparative field tests on suspended sediment samplers", M. E. Nelson and P. C. Benedict. Progress report, December 1944.

"Study of methods used in measurement and analysis of sediment loads in streams", M. E. Nelson and P. C. Benedict. July 1946.

"Preliminary report on the US DH-48 (hand) suspended sediment sampler." April 1948.

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

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

(d) Experimental; for design.

(e) To check the proposed design of the filling and emptying systems and to develop improvements. Models were built of a main lock, 110 feet wide by 1,200 feet long, and an auxiliary lock 110 feet wide by 600 feet long, at a scale of 1:25. The normal lift is 22.1 feet. The main lock is filled and emptied through a series of side-wall lock chamber ports; the auxiliary lock is filled and emptied through a lateral system in the lock chamber.

(f) The testing program has been completed.

(g) A detailed study of discharge manifolds for both locks to minimize turbulence in the lower approaches has been completed and resulting data compiled.

(h) "Progress reports", and "Quarterly report for model studies", the District Engineer, Corps of Engineers, St. Paul District.

(196) MISSISSIPPI RIVER, FILLING AND EMPTYING SYSTEM FOR NEW 1200-FOOT LOCK AT LOCK AND DAM NO. 19, KEOKUK, IOWA.

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

(d) Experimental; for design.

(e) Model 1, 1:25 scale, simulating a lock 110 feet wide by 1,200 feet long, with intermediate gates to provide 800-foot and 400-foot chambers, was tested in 1947. The normal lift was 38.2 feet. The upper lock gate, a submergible tainter gate, was used to supplement the bottom-filling system for the 1,200-foot 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. Emptying system consisted of stub culverts discharging into either the open river or the tailbay. In 1948, Model 2 was constructed to a scale of 1:25, simulating a lock 110 feet wide by 1200 feet long without the intermediate gate. A through culvert system with lock chamber laterals was used for both filling and emptying.

(f) The testing program for Model 1 and Model 2 has been completed, and the compiling of data for the report has been started.

(g) Studies of Model 2 lock operation with 20 and 26 lock chamber laterals were made and the resulting data compiled.

(h) "Progress reports" and "Quarterly report for model studies", the District Engineer, Corps of Engineers, St. Paul District.

(411) ST. ANTHONY FALLS LOWER DAM SPILLWAY AND LOCK TAINTER GATES.

(b) Department of the Army, Corps of Engineers, St. Paul District, St. Paul, Minn.

(d) Experimental; for design.

(e) The study of the lower dam spillway gate included the determination of the length of the stilling basin, a satisfactory arrangement and size of baffles, pressure distribution over the gate and sill, and the effects of scouring in the channel bed downstream from the structure. The study of the lock tainter gates will consist of determination of pressures over the gates and sill, and the operation of the gates in filling and emptying of the locks.

(f) The model studies on the lower tainter gate and a draft of the final report have been completed. A model of the lower lock has been constructed to a scale of 1:22.4, simulating the upper tainter gate and a complete hydraulic filling and emptying system.

(h) "Laboratory test on hydraulic model to determine navigation conditions in approaches to St. Anthony Falls locks." Hydraulic Laboratory Report 44. November 1944.

"Laboratory tests on hydraulic models of a submergible tainter lock gate for St. Anthony Falls lower lock." Hydraulic Laboratory Report 51.

(412) ST. ANTHONY FALLS LOCKS.

(b) St. Paul District, Corps of Engineers, Department of the Army, St. Paul, Minn.

(d) Experimental; for design.

(e) The model study includes two locks, an upper lock with a lift of 50 feet and a lower lock with a lift of 25 feet, both locks being 56 feet wide and 400 feet long, at a scale ratio of 1:22.4. The proposed lower lock is to be filled and emptied through a single culvert lock chamber lateral system. The upper lock will utilize a culvert in each wall and a system of lock chamber laterals for both filling and emptying.

(f) The model of the lower lock has been completely constructed, and the testing program has been started.

(h) "Laboratory test on hydraulic model to determine navigation conditions in approaches to St. Anthony Falls locks." Hydraulic Laboratory report 44. November 1940.

(413) STUDY OF BALDHILL DAM, SHEYENNE RIVER, NORTH DAKOTA.

(b) Department of the Army, Corps of Engineers, St. Paul District, St. Paul, Minn.

(d) Experimental; for design.

(e) A half model at a scale of 1:51 was constructed to check the prototype design and to suggest possible revisions in design for improved operation. The model simulated an approach section, ogee, and spillway sections, one and one-half tainter gates, stilling basin, and movable channel bed downstream from the structure.

(f) Completed. The final report on model studies is being edited.

(g) A correlation of a variety of flows for various tainter gate openings with the resulting upper pool elevations was obtained. The alignment of the training wall was adjusted until satisfactory flow distribution was obtained in the stilling basin and scour in the downstream channel was minimized.

(414) A STUDY OF HOMME RESERVOIR AND DAM SPILLWAY STRUCTURE, SOUTH FORK OF PARK RIVER, NORTH DAKOTA.

(b) Department of the Army, Corps of Engineers, St. Paul District, St. Paul, Minn.

(d) Experimental; for design.

(e) A model at a scale of 1:36 simulated the reservoir approach area, spillway, stilling basin, and downstream area. Studies were made to verify the design and to suggest possible improvements.

(f) Completed. First draft of final report on model studies has been completed.

(g) The studies indicated that vertical parallel chute walls were more satisfactory than converging walls. However, trapezoidal chute and stilling basin also operated satisfactorily and, due to economy in construction, were adopted for the prototype.

(415) STUDY OF HOMME RESERVOIR CONDUIT OUTLET, SOUTH FORK OF PARK RIVER, NORTH DAKOTA.

(b) Department of the Army, Corps of Engineers, St. Paul District, St. Paul, Minn.

(d) Experimental; for design.

(e) The model, on a scale of 1:20, simulated a short section of the conduit, a transition from the circular conduit to a rectangular section, a chute section, a stilling basin, and a movable channel bed downstream from the structure. The side walls of the chute were adjustable to study the effects of the various degrees of expansion. The tests were conducted to observe the performance of the structure as designed.

(f) Completed. First draft of final report has been completed.

(g) A satisfactory chute and stilling basin design was developed and adopted.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station, Vicksburg, Miss.

Inquiries concerning Projects Nos. 201, 204 to 206, 211, 213, 214, 216 to 219, 221, 224, 226, 227, 230, 233 to 237, 239, 243, 245, 249, 251 to 253, 255, 257, 416, 417, 419 to 421, 423 to 426, 428 to 430, and 672 to 683, incl., should be addressed to The Director, Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, Miss.

(201) MODEL STUDIES OF SPILLWAY, STILLING BASIN, AND SLUICE, CONEMAUGH DAM, CONEMAUGH RIVER, PENNSYLVANIA.

(b) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh, Pa.

(d) Experimental; for design.

(e) Tests were conducted on three models to determine a suitable design for stilling facilities below the spillway, shape of crest, and allied features, and to develop an adequate design for the conduits. The models were: (1) a 1:60 comprehensive model, reproducing the entire problem area, including about 1000 feet of approach channel, the entire dam, and about 1500 feet of exit channel below the dam; (2) a 1:24 section model for determining the best design of each type stilling basin produced by tests conducted on the comprehensive model; and (3) a 1:15 model of one of the sluices for selecting the most favorable invert elevation, intake and trash-rack design, and outlet design.

(f) 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.

(d) Experimental; for design.

(e) Model tests were conducted to determine scouring action and flow characteristics below the stilling apron and at the lock entrances, and to devise indicated corrective measures or improvements. A 1:80 comprehensive model reproduced 2300 feet of approach area and 2500 feet of exit channel, the full width of the channel and overflow area, the spillway, stilling basin, and locks. A 1:40 section model reproduced a 40-foot section of the spillway and stilling basin and a portion of the exit channel.

(f) Completed.

(g) Currents at the lock approaches were satisfactory for all conditions of discharge. However, for improved hydraulic performance and economy of construction, the following alterations were made: (a) the spillway approach to the right of the river channel was excavated to elevation 68.0; (b) the portion of the intermediate training wall extending above the spillway crest was removed, as it would constitute a navigation hazard, and the training wall downstream from the crest was shortened and the end sloped to prevent concentration of flow from the overbank portion of the spillway; (c) the stilling basin in the river channel section of the spillway was shortened, and the sill height was increased; (d) the stilling basin in the overbank portion of the spillway was lowered, and the height of the end sill increased to prevent spray action at low flows; and (e) a collecting trough was used downstream from the overbank portion of the spillway, and four pilot channels were located through the exit area to insure

even distribution of flow.

(h) "Spillway and lock approach currents, Demopolis Lock and Dam, Tombigbee River, Alabama; model investigation." Waterways Experiment Station Technical Memo. No. 2-252. April 1948. (Available for sale or loan.)

(205) MODEL STUDY OF SPILLWAY AND CONDUITS, DETROIT DAM, NORTH SANTIAM RIVER, OREGON.

(b) The District Engineer, Portland District, Corps of Engineers, Portland, Ore.

(d) Experimental; for design.

(e) Tests were conducted to analyze the hydraulic characteristics of the spillway and stilling basin, and the flood-control conduits, and to develop means of correcting any undesirable conditions. The models were: (1) a 1:60 general model reproducing the spillway and stilling basin, the dam, the flood-control conduits, and the power structures; and (2) a 1:15 model of the flood-control conduits.

(f) Tests of the conduits are in progress; tests of the spillway have been completed.

(g) Tests of the spillway demonstrated that performance of the original stilling basin was unsatisfactory. A stilling basin with a 225-foot long horizontal apron, two rows of baffle piers, and an end sill proved superior in performance. Hydraulic jump action in the stilling basin was not dependent upon the baffle piers, but their use was recommended as a stabilizing measure for conditions of maximum flow.

(h) "Spillway for Detroit Dam, North Santiam River, Oregon; model investigation." Waterways Experiment Station Technical Memo. No. 2-260. September 1948. (Available for sale or loan.)

(206) MODEL STUDY OF SPILLWAY, DILLON DAM, LICKING RIVER, OHIO.

(b) The District Engineer, Huntington District, Corps of Engineers, Huntington, W.Va.

(d) Experimental; for design.

(e) Tests were performed to determine the 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; and to determine whether the ogee-type spillway with its deeper channel will provide better performance than the less expensive broad-crested spillway. A 1:50 model reproduced 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.

(f) Completed.

(g) Alterations found desirable involved the deposition of rock spoil on top of the right approach to the spillway, elimination of side wall berms in the approach and exit areas of the spillway proper, and development of smooth transitions between the training walls of the spillway and the side slopes of upstream and downstream excavated areas. Both types of crests resulted in satisfactory performance. The capacity of the 280-foot wide broad-crested spillway was practically the same as the 220-foot wide spillway with ogee crest. A directive channel was necessary to alleviate undesirable currents along the toe of the dam. A narrow pilot channel was as satisfactory as wider channels.

(h) "Spillway for Dillon Dam, Licking River, Ohio; model investigation." Waterways Experiment Station Technical Memo. No. 2-264. November 1948. (Available on loan.)

(211) MODEL STUDY OF OUTLET STRUCTURES, GARRISON DAM, MISSOURI RIVER, NORTH DAKOTA.

(b) The District Engineer, Garrison District, Corps of Engineers, Bismarck, N. D.

(d) Experimental; for design.

(e) Tests will be conducted to determine the hydraulic performance of the proposed

system of conduits under diversion as well as reservoir-operation conditions, and to correct any unsafe conditions. A 1:50 model will simulate the downstream 600 feet of the eight tunnels, the flood-control stilling basin, the temporary stilling basin for diversion flows formed by the powerhouse foundations, and 1000 feet of the outlet channel; and a 1:25 model will reproduce one 22-foot conduit, including intake, gate, upstream and downstream transitions, and upstream portion of the stilling basin. The 26-foot tunnel will also be tested in this model by substituting an alternate transition, conduit, and upstream section of the stilling basin.

(f) Active.

(213) MODEL STUDY OF CONTROL STRUCTURE, MORGANZA FLOODWAY, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.

(d) Experimental; for design.

(e) Tests have been conducted to determine discharge coefficients, head-discharge relationships, effect of stilling basin design on the hydraulic jump, and effect of crest shape on hydraulic efficiency. A 1:20 model reproduced about 375 feet of approach area and 500 feet of exit area, five gate bays, and a portion of the levee on the right end of the structure.

(f) Tests have been completed; preparation of final report 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.

(d) Experimental; for design.

(e) Tests were conducted on a 1:60 model of the entire spillway structure for the purpose of insuring the adequacy of the design.

(f) Completed.

(g) It was found that the spillway and bucket as designed would function satisfactorily. Tests indicated the desirability of two small baffle walls, spaced to divide the bucket width into three equal parts, to reduce the transference of overburden resulting from sluice flow or from unbalanced operation of crest gates. An alternate bucket design was developed equal in performance to the original design and probably more economical to construct.

(h) "Spillway for Osceola Dam, Osage River, Missouri; model investigation." Waterways Experiment Station Technical Memo. No. 2-261. October 1948. (Available for loan.)

(216) MODEL STUDY OF IRRIGATION TUNNEL, ST. MARY DAM, ST. MARY-MILK RIVER PROJECT, ALBERTA, CANADA.

(b) The Chief Engineer, Prairie Farm Rehabilitation, Department of Agriculture, Saskatchewan, Canada.

(d) Experimental; for design.

(e) A 1:25 model, reproducing 200 feet of the approach channel, the entire tunnel, and 300 feet of exit channel, was used for tests of the overall performance. Supplementary tests were conducted in a 1:15 model of one of the pressure conduits and intake to permit a more detailed study of flow through the high-pressure conduits. This latter model was installed in a steel vacuum tank for investigation at reduced pressure.

(f) Completed.

(g) Tests verified the predicted overall performance. The capacity was found to be approximately that computed, a hydraulic jump formed in the tunnel for all operating conditions, and flow lines in the tunnel were approximately as anticipated.

However, tests demonstrated (a) the need for increasing the length of the intake curves to the high-pressure conduits to prevent cavitation; (b) the desirability of eliminating proposed air vents except those immediately downstream from the gates; and (c) modification of the outlet portal to obtain better flow distribution into the exit channel.

(h) "Irrigation tunnel for St. Mary Dam, St. Mary-Milk River Project, Alberta, Canada; model investigation." Waterways Experiment Station Technical Memo. No. 2-262. October 1948. (Available for sale or loan.)

(217) SECTION MODEL STUDY OF SPILLWAY AND BUCKET, WHITNEY DAM, BRAZOS RIVER, TEXAS.

(b) The District Engineer, Galveston District, Corps of Engineers, Galveston, Tex.

(d) Experimental; for design.

(e) Tests were conducted to determine the performance of the gated crest and to select a stilling basin operating satisfactorily with tailwater depths insufficient for ideal performance of a bucket-type basin and excessive for ideal performance of a conventional hydraulic jump type basin. The 1:30 model reproduced 500 feet of the approach area, one central gate bay plus adjacent half gate bays, a 98-foot wide section of the stilling basin, and 600 feet of exit channel. For investigation of conduit discharges, three conduits were reproduced, and the width of the stilling basin section increased from 98 feet to 147 feet.

(f) Completed.

(g) Results indicated that, while the spillway weir functioned satisfactorily, the bucket-type energy dissipator was inadequate. Three alternate basin designs were then investigated, incorporating an apron-type basin with two rows of baffle piers and an end sill. Tests of these indicated that, while tailwater conditions were slightly higher than required for ideal basin performance, flow conditions in the basin and exit area were superior to those observed with the bucket-type basin. The most satisfactory design consisted of an apron 126 feet long, two rows of 10-foot high baffle piers, and a 10-foot high end sill.

(h) "Spillway design for Whitney Dam, Brazos River, Texas; model investigation." Waterways Experiment Station Technical Memo. No. 2-263. November 1948. (Available for sale or loan.)

(218) CONDUIT INTAKE MODEL TESTS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.

(d) Experimental; applied research.

(e) A general study is being made by means of small-scale models of the hydraulic characteristics of entrance curves for (a) rectangular conduits in which the entrance is flared in four directions, and (b) a gated tunnel having a rectangular entrance section in which the floor is at the same elevation as the approach channel (entrance flared in three directions). 1:20 models are being used. Eleven intakes for a 5-foot 8-inch by 10-foot conduit have been tested in a steel pressure tank to determine conditions with the 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. Additional tests will be conducted on a conduit 5.67 feet wide by 10.0 feet high under a range of heads up to 300 feet prototype.

(f) Active.

(g) Tests indicated that with the conduit at an angle of greater than 10 degrees with the face of the dam, undesirable pressure conditions resulted; for an angle less than 10 degrees good conditions resulted.

(219) SLIDE GATE MODEL TESTS.

(b) The Chief of Engineers, Department of the Army, Washington, D. C.

(d) Experimental; applied research.

(e) A general study is being made by means of model and prototype tests to determine (a) the best shape of gate lip to reduce the downward hydraulic pull on the gates and any vibration tendencies during the opening or closing procedure; and (b) to determine the optimum shape for the gate slots to eliminate or reduce cavitation tendencies. A 1:6 model is being used, reproducing the gate slots, the slide gate, a portion of the conduit upstream and downstream from the gate section, and the air vent. Also a 1:10-scale gate with a 45° lip is designed to fit the 1:6-scale gate slots for study of effect of conduit height on pressure conditions on the gate lip.

(f) Active.

(g) A 1-on-12 tapered gate slot with lip beveled at an angle of 45° on the upstream side with a 2-inch wide sealing surface at the base has given most satisfactory results to date.

(221) ANALYSIS OF RESULTS OF MODEL TESTS AND PROTOTYPE OBSERVATIONS.

(b) The Chief of Engineers, Department of the Army, Washington, D. C.

(d) Experimental and field investigations; for design.

(e) Procurement and analysis of prototype observations and results of model tests, with the ultimate objective of furnishing accurate design data, and thus effecting economies and efficiency in future design work. The investigation includes hydraulic structures, open channels, harbors, and tidal estuaries.

(f) Active.

(g) Data are being collected and analyzed.

(224) HYDROLOGICAL RESEARCH PROJECT, WATERWAYS EXPERIMENT STATION LAKE WATERSHED, MISSISSIPPI.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.

(d) Field investigation; applied research.

(e) To augment pertinent data and to advance the knowledge of the hydrological characteristics of any drainage basin, a comprehensive study of the hydrology of the Waterways Experiment Station Lake Watershed was conducted. Two investigations were included: (1) a study of the rainfall-runoff relation, using the unit-hydrograph methods; and (2) a study of evaporation.

(f) The study has been completed; preparation of final report is in progress.

(226) POTAMOLOGY INVESTIGATIONS.

(b) The President, Mississippi River Commission, Vicksburg, Miss.

(d) Experimental and field investigation; applied research.

(e) The investigation includes: (1) development of a suitable material and model operating technique to obtain an erodible-bank, movable-bed model responding to the laws of channel meandering in the same degree as its counterpart in nature, 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. A large flume has been constructed to permit the modeling of a specific reach of the Mississippi River to linear scale ratios of 1:100 vertically and 1:400 horizontally, for use in adapting these erodible materials in modeled bends of unstable

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reaches of the river. For the study of revetment failures on erodible banks, a section of a typical bend of the Mississippi River is reproduced to an undistorted scale of 1:50. The mass and strength of the revetment and all forces affecting its stability are reproduced as nearly to scale as possible. The construction of a flume to contain a typical bend of the Mississippi River to an undistorted scale of 1:50 was continued.

(f) Active.

(227) MODEL STUDY OF FLOOD CONTROL PROJECT, BRADY CREEK, BRADY, TEXAS.

(b) The District Engineer, Galveston District, Corps of Engineers, Galveston, Tex.

(d) Experimental; for design.

(e) Tests were conducted to verify and supplement hydraulic design computations for the proposed improvement channel and to determine means of eliminating any undesirable flow conditions. The model was of the fixed-bed type with scales of 1:150 horizontal, and 1:100 vertical. Reproduced were 11,000 feet of improved channel, adjacent sections of the unimproved channel upstream and downstream, and pertinent overbank features.

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

(230) MODEL STUDY OF FLOOD PROTECTION PROJECT FOR CUMBERLAND, MARYLAND.

(b) The District Engineer, Washington District, Corps of Engineers, Washington, D. C.

(d) Experimental; for design.

(e) Tests are in progress to study and develop proposed plans for the protection of Cumberland from floods. The model is of the fixed-bed type with an undistorted scale ratio of 1:60. Reproduced are approximately 1.5 miles of Wills Creek, and 4 miles of the North Branch of the Potomac River.

(f) Active.

(233) MODEL STUDY OF CHANNEL IMPROVEMENTS, JOHNSTOWN, PENNSYLVANIA.

(b) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh, Pa.

(d) Experimental; for design.

(e) Tests were used to determine the most economical and effective design for the improvements of the channels of the Conemaugh River, Stony Creek, and the Little Conemaugh River, in the vicinity of Johnstown, Pa., so that floods of the magnitude of that of March 17-18, 1936, would be carried within banks. The model was of the fixed-bed type with scales of 1:200 horizontal, and 1:80 vertical, reproducing 5.8 miles of Stony Creek, 2.6 miles of Little Conemaugh River, and 4.7 miles of Conemaugh River, including all areas considered in danger of possible flooding.

(f) 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.

(d) Experimental; for design.

(e) Tests were used to determine the effects of the proposed closure of Tennessee Chute on flood heights and channel configurations. The model was a combination movable-bed fixed-bed type, with scales of 1:600 horizontal, and 1:150 vertical. Reproduced were the channel and overbank area of the Mississippi River from Redman Point to Cow Island.

(f) All tests have been completed; preparation of final report 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.

(d) Experimental; for design.

(e) Tests were used to determine the effects of proposed plans for maintenance of navigable depths in the low-water channel of the middle Mississippi River. The model was of the fixed-bed type with scales of 1:2000 horizontal, and 1:100 vertical. Reproduced were the main channel and overbank area of the Mississippi River from Grand Tower, Ill., to Cottonwood Point; the Ohio River from Dam 50 to the mouth; the Cumberland River from the vicinity of Kuttawa, Ky., to the mouth; the Tennessee River from the foot of Gilbertsville Dam to the mouth; the Cache River Basin; and the Birds Point-New Madrid Floodway.

(f) Completed.

(g) Eight or nine cross weirs averaging about 10,000 or 12,000 square feet in effective cross-sectional area and with sill elevations set about 11 or 12 feet below either the 1937 low-water profile or the "ideal" low-water profile caused only a slight rise in the water surface at the mean low-water discharge of 54,000 cfs. The influence of each cross weir decreased progressively in the upstream direction and practically disappeared just below the next upstream structure. Decreasing the average sectional areas of the cross weirs to about 8,000 or 9,000 square feet with the sills set to elevations about 6 or 7 feet below the furnished "ideal" low-water profile and with side slopes of 1 on 1 produced the largest average increase in water-surface elevations for the discharge of 54,000 cfs; for this condition, however, a definite swellhead of about 4 or 5 feet obtained at each cross weir. Increasing the mean low-water discharge from 54,000 cfs to 64,000 cfs caused an average increase of approximately 1.0 foot in water-surface elevations. In each plan tested, the maximum changes in water-surface elevations occurred at the cross weirs. The effects of the cross-weirs decreased progressively with increasing stages and were insignificant at the bankfull flow.

(h) "Model study of cross weirs for maintenance of 12-ft waterway in the Middle Mississippi River." Waterways Experiment Station Technical Memo. No. 2-257. July 1948. (Available for loan.)

(236) MISSISSIPPI BASIN MODEL.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.

(d) Experimental; for design.

(e) Plans provide for 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. Model tests will be used 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. The model will be built to a horizontal scale of 1:2000, and a vertical scale of 1:100.

(f) Active.

(237) MISSISSIPPI RIVER FLOOD-CONTROL MODEL.

(b) The President, Mississippi River Commission, Corps of Engineers, Vicksburg, Miss.

(d) Experimental; for design.

(e) This series of tests is a part of the comprehensive investigation to evaluate the relative merits of various plans for flood control below Morgan City, La. Tests have also been performed to determine the effect of various widths of openings in the Morganza Floodway Control Structure on distribution of discharge at latitude of Old River for project- and 1927-flood flows. The model is of the fixed-bed

type with scales of 1:2000 horizontal, and 1:100 vertical. Reproduced are the main channel of the Mississippi River from Helena, Ark., to Donaldsonville, La.; 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.

(f) Tests of Alternate Plan 1 are completed; tests of widths of openings, Morganza Floodway Control Structure, are completed.

(g) The results indicate that Alternate Plan 1 produces a lowering of project-flood crest stages behind the levee at Lake Bridge and Gibson, La., of about 1.3 foot, and a lowering at Amelia and Magazelle, La., of about 3 feet. Project-flood crest stages were increased about 1 foot at Morgan City, and about 0.5 foot at other gaging stations below the levee. The effect of the plan on crest stages of the 1945 flood was negligible. Results indicate that increases beyond 3000 feet in width of openings in the Morganza Floodway Control Structure would have slight effect on project-flood discharges of the Mississippi River.

(h) "Model study of widths of openings, Morganza Floodway Control Structure, Mississippi River." Waterways Experiment Station Technical Memo. No. 2-258. July 1948. (Available for loan.)

(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.

(d) Experimental; for design.

(e) Tests were used to determine flow conditions through and below trestles of proposed high-level crossings of floodways; the possibility of improvements in design; and the effects on stages upstream from the embankments of the high-level crossings. A model of the Atchafalaya Floodway has been postponed until the results of the Morganza Floodway tests are reviewed. The Morganza Floodway model was of the fixed-bed type, with scales of 1:600 horizontally and 1:50 vertically.

(f) Morganza Floodway tests are completed, and preparation of final report is in progress.

(g) Morganza Floodway tests indicated that revision of the original design of the Texas and Pacific Railroad main line crossing was required. Tests of proposed alterations showed definite improvement of flow conditions along the high-level crossing embankments; an appreciable lowering of velocities along each side of the main line crossing can be effected by the use of spur dikes located at the ends of the embankments and at several intermediate points along the center embankment section.

(243) MODEL STUDY OF SALT WATER INTRUSION, CALCASIEU RIVER, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.

(d) Experimental; for design.

(e) Tests were used 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. The model was of the fixed-bed type, with scales of 1:1000 horizontal, and 1:50 vertical. All of the Calcasieu River and Lake, from the head of tide above Lake Charles to Calcasieu Pass in the Gulf of Mexico, was reproduced in the model, and approximately 10 miles each of the Calcasieu River-Sabine River and the Calcasieu River-Mermentau River sections of the Gulf Intracoastal Waterway. The model was equipped with automatic tide controls. 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.

(f) 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.

(d) Experimental; for design.

(e) Tests were conducted to determine the effectiveness of various proposed improvement plans in eliminating or reducing maintenance dredging in the Delaware River ship channel. The model was of the fixed-bed, silt-injection type, with scale ratios of 1:800 horizontal, and 1:80 vertical. Tides and currents were reproduced by automatic tide gates. Plans tested consisted of: (1) installing structures designed to reduce shoaling by directing tidal currents into conformity with the dredged channel; (2) realigning the navigation channel to conform more nearly to the alignments of existing tidal currents; and (3) constricting the cross-sectional area of the channel to increase flood and ebb velocities in the channel reach subject to excessive shoaling.

(f) Completed.

(g) Tests indicated that any of four of the plans tested would decrease to some extent the present rate of shoaling in the channel, and would improve the alignments of flood and ebb currents in the problem area. It is doubtful, however, that the benefits accruing from installation of any of these plans in the river would be commensurate with the cost of construction.

(h) "Plans for elimination of shoaling in New Castle-Finns Point Ranges, Delaware River; model investigation." Waterways Experiment Station Technical Memo. No. 2-259. August 1948. (Available for sale or loan.)

(672) MODEL STUDIES OF LYNNHAVEN BAY AND INLET, VIRGINIA.

Formerly reported as separate studies "(246) Model Study of Lynnhaven Bay, Virginia", and "(248) Model Study of Lynnhaven Inlet, Virginia".

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.

(d) Experimental; for design.

(e) Tests are being conducted to develop the most efficient design of inlet and interior channels to provide the desired volume of tidal flow into and out of Lynnhaven Bay and to determine the effectiveness of jetties in preventing reshoaling of the inlet channel and the effects of jetties on the beaches adjacent to the inlet. Two models are being used: (1) a fixed-bed model, 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, with scales of 1:800 horizontal, and 1:80 vertical; and (2) a 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 -25-foot contour of depth in Chesapeake Bay, with scales of 1:400 horizontal, and 1:80 vertical. Provisions are made for reproducing prototype tides in both models; for varying the widths, depths, and locations of channels in the fixed-bed model; and for reproducing waves, tidal currents, littoral currents, and bed movement in the movable-bed model.

(f) Active; fixed-bed model tests have been completed.

(249) MODEL STUDY OF WAVE AND SURGE ACTION, MONTEREY HARBOR, CALIFORNIA.

(b) The District Engineer, San Francisco District, Corps of Engineers, San Francisco, Calif.

(d) Experimental; for design.

(e) Tests were used to determine the most effective location for the proposed companion breakwater and breakwater extension to afford maximum protection against wave and surge action. The model was of the fixed-bed type, with a scale ratio 1:100. It included all of Monterey Harbor and a sufficient area of Monterey Bay

to permit reproduction of wave action from critical directions.

(f) 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.

(d) Experimental; for design.

(e) Tests were used 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. The model was of the fixed-bed type, with scales of 1:1000 horizontal, and 1:150 vertical. Reproduced 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. Automatic tide controls were used. 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.

(f) 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.

(d) Experimental; for design.

(e) A pilot model was constructed to develop special model appurtenances and operating technique required to reproduce prototype density currents in Southwest Pass by the simultaneous 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 the comprehensive model study of plans for improving Southwest Pass. The pilot model is of the movable-bed type, with scales of 1:500 horizontal, and 1:100 vertical. Provisions have been made for reproducing prototype tides and tidal currents in the Gulf of Mexico, density flow and fresh-water flow in Southwest Pass, and the movement of bed load material in lower Southwest Pass and the bar channel.

(f) Active.

(253) MODEL STUDY FOR CHANNEL IMPROVEMENT, ST. JOHNS RIVER, FLORIDA.

(b) The District Engineer, Jacksonville District, Corps of Engineers, Jacksonville, Fla.

(d) Experimental; for design.

(e) Tests were used to determine the best location and alignment of the cutoff in St. Johns River and the effect on navigation of the cutoff and the deepening of the present channel to 34 feet. The model was of the fixed-bed type, with scales of 1:1000 horizontal, and 1:100 vertical. The model included 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. It was equipped with automatic tide controls. 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.

(f) Completed.

(g) Tests indicated that (1) installation of the improvements had no significant effect upon the regimen of the river. A straight cutoff with a wide flare at its downstream end appears to be the most satisfactory alignment tested. This cutoff would be more costly and more difficult to build than the other two tested; and its right-of-way harder to procure. If its merits are ougweighed by these considerations, a modified straight cutoff appears to be more desirable

than the curved one tested. (2) Provision must be made to reduce cross currents from Mill Cove and Back River into the cutoff without causing stagnation in Mill Cove and without preventing navigation therein by small craft. (3) Tests made of the effect of elongating Wards Bank Training Wall and moving it to a position parallel with Bar Cut Range indicated that such a plan could be expected to alleviate materially the shoaling situation along the west end of the north jetty.

(h) "Plans for the improvement of the St. Johns River, Jacksonville to the Atlantic Ocean; model investigation." Waterways Experiment Station Technical Memo No. 2-233. December 1947. (Available for sale or loan.)

(255) MODEL STUDY OF SHOALING IN THE BAR CHANNEL, UMPQUA RIVER, OREGON.

(b) The District Engineer, Portland District, Corps of Engineers, Portland, Ore.

(d) Experimental; for design.

(e) Tests are being used 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. The model is of the movable-bed type. The river is reproduced from the mouth to a point above Winchester Bay. Scale ratios are 1:400 horizontal, and 1:80 vertical. Provisions are made for reproducing waves from any direction from northwest to southwest, tides of any type, and littoral currents either up or down the coast.

(f) Active.

(257) MODEL STUDY OF STABILITY OF RUBBLE-MOUND BREAKWATERS.

(b) The Chief, Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C.

(d) Experimental; for design.

(e) Various types of rubble-mound breakwaters in progressive stages of construction are tested to determine the stability and displacement of material when the breakwaters are subjected to wave action. The breakwaters are constructed of crushed rock with specific gravities of about 2.9, 2.65, and 2.1 in a 5-foot by 18-foot by 117-foot concrete tank, to linear scale ratios of 1:70, 1:45, and 1:60. The appurtenances of the tank include a wave-generating machine, electrical wave-height measuring rods, a recording oscillograph, and electrical pressure cells. The breakwater material is sized in accordance with specifications established for hypothetical prototype breakwaters.

(f) Active.

(416) MODEL STUDY OF STILLING BASIN, BUGGS ISLAND DAM, ROANOKE RIVER, VIRGINIA.

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.

(d) Experimental; for design.

(e) Tests were used to determine the angle of bucket lip which will deflect bottom flow away from the exit channel sufficiently to prevent scour in the area immediately downstream from the bucket lip.

(f) Tests have been completed; preparation of final report 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.

(d) Experimental; for design.

(e) Tests were used to study the feasibility of filling the lock through the sector gates and gate recesses, thus eliminating the need for a culvert system. A 1:20 model reproduced a portion of the approaches to the lock and the lock chamber including the sector gates and gate recesses.

(f) Testing is completed; preparation of final report is in progress.

(673) GENERAL SPILLWAY MODEL TESTS.

Formerly reported as separate studies, "(418) Calibration of Spillway Tainter Gates", and "(422) Model Tests of Roller Type Spillway Bucket".

(b) The Chief of Engineers, Department of the Army, Washington, D. C.

(d) Experimental; applied research.

(e) Tests are used to study hydraulic characteristics of the standard spillway shape, including the effect of crest piers and gates, and to establish general rules for design of roller-type energy dissipators. Tests to study the hydraulic characteristics of a standard spillway crest will be conducted on a 1:40 section model reproducing a minimum of three gates. The tainter gates will be 40 feet wide and curved to a radius of 38 feet. Tests to develop design criteria for roller-type energy dissipators will be conducted on the same model. The energy dissipator will be of the bucket type with a radius of 50 feet and a lip slope of 1 on 1. The drop from spillway crest to bucket will be varied to study the effect of nappe thickness.

(f) Active.

(419) SLIDE GATE TESTS, NORFORK DAM, ARKANSAS.

(b) The District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.

(d) Experimental; for design.

(e) Tests are being used to determine the most desirable shape of the bottom of the gate 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. Four types of gates have been tested. A 1:6 model reproduced the gate slots, the sluice gate, a portion of the conduit upstream and downstream from the gate section, and the air vent. Also 1:10 gates with 60-degree and 45-degree lips were designed to fit the 1:6 gate slots for study of the effect of conduit height on pressure conditions on the gate lip.

(f) Active.

See also Project No. 670, "Prototype Tests of Slide Gates", page 108, for prototype tests.

(420) MODEL STUDY OF CONDUITS AND HOWELL-BUNGER VALVES, NARROWS DAM, LITTLE MISSOURI RIVER, ARKANSAS.

(b) The District Engineer, Vicksburg District, Corps of Engineers, Vicksburg, Miss.

(d) Experimental; for design.

(e) Tests were used to determine discharge coefficients of the Howell-Bunger valves, and to study stilling basin action below the valves with special emphasis on pressures at the end sill. A 1:16 model reproduced the two conduits, the Howell-Bunger valves, the stilling basin, and a portion of the exit channel.

(f) Testing is completed; preparation of final report is in progress.

(421) MODEL STUDY OF SLUICES, HULAH DAM, CANEY RIVER, OKLAHOMA.

(b) The District Engineer, Tulsa District, Corps of Engineers, Tulsa, Okla.

(d) Experimental; for design.

(e) Tests were used to examine the hydraulic performance of the sluices. A 1:20 model reproduced a 256-foot wide section of the spillway, stilling basin, and exit channel. The section reproduced was through the center of the spillway and included three sluices.

(f) Completed.

(g) Performance of the basic design was satisfactory. However, tests showed that the roof construction in the outlet portal could be eliminated, thus increasing the discharge capacity without producing undesirable pressure or flow conditions.

(h) "Sluices, Hulah Dam, Caney River, Oklahoma; model investigation." Waterways Experiment Station Technical Memo. No. 2-253. March 1948. (Available for loan.)

(423) MODEL STUDY OF SPILLWAY, BENBROOK DAM, TRINITY RIVER, TEXAS.

(b) The District Engineer, Galveston District, Corps of Engineers, Galveston, Tex.

(d) Experimental; for design.

(e) Tests were used to investigate and correct any objectionable flow characteristics 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. A 1:60 model reproduced 900 feet of the approach area, the spillway, and 2000 feet of exit channel.

(f) Testing is completed; preparation of final report 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.

(d) Experimental; for design.

(e) Tests were conducted to check the overall performance of the sluices, and to determine the adequacy of the stilling basin, developed from consideration of spillway flow, with respect to dissipation of energy of sluice flow. Tests were also conducted to determine the capacity of several schemes proposed for a low monolith through which flow will be diverted during a certain stage in the construction of the dam. For the sluice and stilling basin tests, a 1:20 model was used, reproducing two complete sluices, including bellmouth intakes, gates and exit portals, a portion of the spillway face, half of the stilling basin, and 130 feet of exit channel. For the diversion tests, a 1:25 model reproduced half of the dam and stilling basin, including the low monolith, the cofferdam inclosing the other half of the dam, and sufficient portions of the approach and exit channels to simulate flow conditions therein.

(f) Completed.

(g) Tests indicated that the performance of the sluice of basic design was adequate. The secondary end sill of the previously-developed stilling basin was lowered by 5 feet to eliminate spray action when only one or two of the sluices were discharging. Eight schemes for the diversion monolith, which was required to pass 21,500 cfs, were tested. A simplified ogee-crest control passed the required discharge and, from the standpoint of ease of initial construction and ultimate closure, was found to be the most desirable.

(h) "Sluices and diversion scheme for Allatoona Dam, Etowah River, Georgia; model investigation." Waterways Experiment Station Technical Memo. No. 214-2. November 1948. (Available for loan.)

(425) COMPREHENSIVE MODEL STUDY, DELAWARE RIVER, PENNSYLVANIA.

(b) The District Engineer, Philadelphia District, Corps of Engineers, Philadelphia, Pa.

(d) Experimental; for design.

(e) Tests will be used to develop and test plans for reduction of shoaling in several ranges of the navigation channel. The model will be of the fixed-bed, silt-injection type, with 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 Lear 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.

(f) Active.

(426) MODEL STUDIES OF EAST BRANCH RESERVOIR, CLARION RIVER BASIN, PENNSYLVANIA.

(b) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh, Pa.

(d) Experimental; for design.

(e) Tests are being conducted 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, and to study hydraulic forces acting on the control gate by determination of gate lip pressures. Three models are involved: (1) a 1:50 model of the spillway, including the overflow section, the chute, the dispersion bucket, and a portion of the exit channel; (2) a 1:25 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; and (3) a 1:12 model of one of the control gates for the outlet tunnel.

(f) Active.

(674) MODEL STUDIES OF FORT RANDALL DAM, MISSOURI RIVER, SOUTH DAKOTA.

This report includes the two studies previously reported as "(210) Model Study of Intake Structures, Garrison and Fort Randall Dams, Missouri River, North Dakota", and "(427) Comprehensive Model Study, Fort Randall Dam, Missouri River, South Dakota".

(b) The District Engineer, Omaha District, Corps of Engineers, Omaha, Nebr.

(d) Experimental; for design.

(e) A comprehensive model, to scale of 1:100, is used to determine the effects on velocities of depth and curvature of the approach channel; to investigate flow over the spillway, and develop a good stilling basin design; and to study general overall flow conditions in the exit area. An outlet stilling basin model, to scale of 1:50, is used to develop a stilling basin below the power conduits which will dissipate satisfactorily the energy of diversion flow, and which can be used to simplify construction of the powerhouse; to verify the design of the flood-control conduits stilling basin to insure satisfactory operation under present-day tailwater ratings and through various lower stages to ultimate retrogression; and to determine the limit of required tailrace paving and necessity for protective bank works by study of currents and wave action. An intake and flood-control conduits model, to scale of 1:25, is used to determine the character of flow for various reservoir levels; measure by piezometric pressures the loss coefficients of the intake structure; investigate the pressures in critical regions of the transition section; and determine the effects of partial gate operation upon downpull and oscillation of the gates and upon air requirements. Supplementary tests were conducted on a 1:30 model of a portion of the intake, one service gate, air vent, and portion of the tunnel to provide preliminary data on gate performance and to develop instrumentation for use on the 1:25 model.

(f) Active.

(428) MODEL STUDY OF WAVE AND SURGE ACTION, OSWEGO HARBOR, NEW YORK.

(b) The District Engineer, Buffalo District, Corps of Engineers, Buffalo, N. Y.

(d) Experimental; for design.

(e) Tests were used to determine the storm directions causing maximum wave action in

the existing harbor, and the most effective position of a breakwater to improve harbor protection. Effects of spending-beach construction were also investigated to determine the most economical means of reducing wave action inside the harbor. The model was of the fixed-bed type, with a scale of 1:100. It included all of Oswego Harbor and sufficient area of Lake Ontario to the west, north, and northeast to permit reproduction of wave action from critical directions.

(f) Testing is completed; preparation of final report is in progress.

(429) MODEL STUDY OF WAVE AND SURGE ACTION, LONG BEACH HARBOR, CALIFORNIA.

(b) The City of Long Beach, Calif.

(d) Experimental; for design.

(e) Tests were used to study the effects on wave and surge action of the proposed installations in the Navy-Long Beach Harbor and the proposed Southeast Basin. In the Southeast Basin, data were desired to assist in the selection of pier alignment and location of navigation opening most suitable for shipping. The fixed-bed model was constructed to scales of 1:300 horizontally, and 1:60 vertically. Reproduced 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.

(f) Testing has been completed; preparation of final report is in progress.

(430) MODEL STUDY OF BREAKWATER LOCATION, EAST BEAVER BAY HARBOR, LAKE SUPERIOR, MINNESOTA.

(b) Oglebay Norton and Company, Cleveland 15, Ohio.

(d) Experimental; for design.

(e) Tests were used to determine the best type of breakwater design and the most effective location for the navigation opening which will provide maximum protection against short-period wave action existent in Lake Superior. The model for studying the breakwater location was of the fixed-bed type, with a scale of 1:150. It included 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. The model for studying breakwater stability was a section of the prototype breakwater constructed of sized (to scale of 1:30) prototype breakwater materials.

(f) Tests are completed; preparation of final report is in progress.

(675) MODEL STUDY OF FLOOD-CONTROL TUNNEL, BLAKELY MOUNTAIN DAM, OUACHITA RIVER, ARKANSAS.

(b) The District Engineer, Vicksburg District, Corps of Engineers, Vicksburg, Miss.

(d) Experimental; for design.

(e) Tests are being used to analyze the hydraulic characteristics of all elements in design of the structure, and to correct unsatisfactory conditions. Special consideration will be given to flow conditions through the drop in the tunnel immediately below the control structure. The model, to a scale of 1:25, reproduces the intake structure containing three gate passages with vertical-lift gates; the transition; the entire tunnel; and the stilling basin.

(f) Active.

(676) MODEL STUDIES OF JIM WOODRUFF DAM, APALACHICOLA RIVER, FLORIDA.

(b) The District Engineer, Mobile District, Corps of Engineers, Mobile, Ala.

(d) Experimental; for design.

(e) Tests are being used to investigate the hydraulic performance of the spillway and lock structure as originally designed, and to effect necessary revisions. Particular attention will be given to the currents at the upstream and downstream lock approaches and flow through the draw span some 0.7 miles below the structure, and the determination of submergence coefficients for the spillways. Four models are involved: (1) a 1:100 comprehensive model reproducing 1500 feet of the approach area and 3200 feet of the exit channel, 4200 feet of the dam which includes the controlled and uncontrolled portion of the spillway, the power structure, the lock structure and 1400 feet of the overbank area; (2) a 1:38.4 section model reproducing one full gate bay plus adjacent half gate bays of the controlled portion of the spillway; (3) a 1:30 section model reproducing a 30-foot portion of the uncontrolled spillway; and (4) a 1:30 section model reproducing a 30-foot portion of the overflow dike.

(f) Active.

(677) MODEL STUDY OF PHILPOTT DAM, SMITH RIVER, VIRGINIA.

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.

(d) Experimental; for design.

(e) Tests are being used to analyze the hydraulic characteristics of the spillway and stilling basin, and flood-control conduits, and to correct any undesirable conditions. The 1:40 comprehensive model includes the spillway, 100 feet of the non-overflow section on each side of the spillway, the flood-control conduits, the stilling basin, and 480 feet of the outlet channel.

(f) Active.

(678) CHARLESTON HARBOR MODEL STUDY.

(b) The District Engineer, Charleston District, Corps of Engineers, Charleston, S. C.

(d) Experimental; for design.

(e) Tests are used to determine whether channel realignment, the provision of channel control works, or other remedial measures will be effective in reducing the present heavy rate of shoaling in certain reaches of the navigation channels. The model reproduces 46.2 square miles of the Atlantic Ocean adjacent to the jetty channel, the Cooper River to the dam of the Santee-Cooper project, the Ashley River to the head of tide, and the Wando River to Horlbeck Creek. It is of the fixed-bed type, with scales of 1:800 horizontally, and 1:80 vertically. Automatic tide controls are used to reproduce tides and tidal currents. Shoaling studies will be made by injecting finely-ground gilsonite into the model channels.

(f) Active.

(679) RARITAN RIVER MODEL STUDY.

(b) The District Engineer, New York District, Corps of Engineers, New York, N. Y.

(d) Experimental; for design.

(e) Tests are being used to determine some means whereby the excessive rate of shoaling in the 25-foot reach of the south channel can be minimized. The model reproduces a portion of Raritan Bay, the Raritan River to the head of tide, and a short section of South River. It is of the fixed-bed type, with scales of 1:600 horizontally, and 1:100 vertically. Tides and tidal currents are reproduced by means of automatic tide control machines. Shoaling studies will be made by injecting finely-ground gilsonite into the model channels.

(f) Active.

(680) VACUUM TANK TEST OF TAINTER VALVE McNARY DAM, COLUMBIA RIVER, OREGON.

(b) The District Engineer, Portland District, Corps of Engineers, Portland, Ore.

(d) Experimental; for design.

(e) Tests were made in a vacuum tank to determine whether cavitation will occur in the low pressure region just downstream from the valve, and whether lowering the valve some 20 feet will eliminate such cavitation. The 1:20 model reproduced the tainter valve, valve chamber, and approximately 113 feet of the 11-foot by 12-foot conduit.

(f) Testing has been completed; preparation of final report is in progress.

(681) TAINTER TEST GATES FOR SLUICES, NORFORK DAM.

(b) The District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.

(d) Experimental; for design.

(e) Model tests will be performed on a 1:6 model reproducing as nearly as possible the actual operating conditions of the prototype. Piezometer measurements will be made at the same locations as on the prototype.

(f) Active.

See Project No. 669, "Test of Tainter Gate for Control of Conduit Flow", page 107, for prototype tests.

(682) HYDRAULIC CAPACITY OF MEANDERING CHANNELS IN STRAIGHT FLOODWAYS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.

(d) Experimental; applied research.

(e) This investigation comprises a general study of meandering channels in straight floodways. Model tests are used to study the effect of such variable factors as radius of curvature of bends; sinuosity of channel; depth of overbank flow; valley slope; water-surface slope; and ratio of overbank area to channel area. The model will consist of a flume 30 feet by 100 feet with provisions for controlling and measuring the flow through it. A trapezoidal channel will be molded in fixed-bed material which can be changed to any desired alignment, slope, etc. Scales will be proportionate to average conditions in nature so the data obtained can be applied to natural problems.

(f) Active.

(683) MODEL STUDIES OF FLOW CONDITIONS IN PUMPING PLANT SUMP AND SURGES IN SEWERS.

(b) The District Engineer, Louisville District, Corps of Engineers, Louisville, Ky.

(d) Experimental; for design.

(e) Tests are used to make a general study of surges in a sewer system due to sudden arrest of flow at the pumping plant and effect of surcharging the sewer upon the concentration time for flow to the pumping plant, and to make a study of flow conditions in the transition and sump of the subject pumping plant. For study of flow conditions in the pumping plant, the lower end of the main sewer, the transition section, the sump, and the pump intakes will be modeled to a scale of 1:16. For study of surges and concentration time, a general model to a scale of 1:32 will reproduce about 10,000 feet of main sewer 16 feet in diameter, five laterals each about 250 feet long, and numerous manholes. A quick-acting mechanized valve will be attached at the location of the sump to suddenly arrest the flow. Pressure cells will be installed throughout the system, and automatic stage recorders will be installed in the manholes.

(f) Active.

U. S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS, National Hydraulic Laboratory, Washington, D. C.

Inquiries concerning Projects Nos. 154, 155, 159 to 163, incl., 166, 431 to 434, incl., and 684 should be addressed to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C.

(154) AGING TESTS OF PIPES.

(b) U. S. Treasury Department. (d) Experimental; for design and operation.

(e) Data are obtained to determine the effects of long-continued service on the hydraulic friction of pipes. Specimens of 1-1/2 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.

(f) Tests were started in 1936. They have been suspended since 1942. An additional set of tests is planned for the near future

(155) MATHEMATICAL THEORY OF FLOOD WAVES.

(b) U. S. Weather Bureau. (d) Theoretical; basic research.

(e) American and foreign literature on the theory of waves which is applicable to the theory of flood waves is being reviewed. Present theory is being coordinated and extended by new proofs and additional material to form an integrated series of papers.

(f) The third paper of the series is partly completed.

(159) MODEL LAWS FOR DENSITY CURRENTS.

(b) Office of the Chief of Engineers, Department of the Army, Washington, D. C.

(d) Theoretical and experimental; basic and applied research.

(e) The immediate purpose is to determine model laws for models involving the motion of stratified liquids. The project has been subdivided into about a dozen specific problems. The first problem concerns the motion of a heavy liquid, initially confined in a "lock", when suddenly released into a long channel filled with a lighter liquid. Tests are being made in a channel 4.5 inches wide, and in a channel 2 inches wide. A third channel, 9 inches wide, is under construction.

(f) Active. Experimental work on a second problem, on the damping of a solitary wave in the interface between two non-moving liquids of different densities, has been completed.

(160) EFFECT OF STORM WINDS ON LAKE LEVELS.

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

(e) The purpose is to determine frictional forces of wind on lake surfaces. The study is based on data on storms over Lake Erie.

(f) Completion of paper has been temporarily suspended.

(161) EXTINCTION OF SOLITARY WAVES.

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

(e) A theoretical determination of dissipation was made and compared with the experimental results of Scott Russell.

(f) Completed.

(h) "Gradual damping of solitary waves", G. H. Keulegan, Journal of Research, National Bureau of Standards, RP1895, Vol. 40: 487-498. 1948.

(162) FLOW PATTERNS AT PUMP INTAKES.

(b) Laboratory project. (d) Theoretical; applied research.

(e) The study is being made to determine flow patterns around bell-mouthed pump intakes. Patterns are obtained theoretically by superposition of fields of circular vortices, and sources and sinks.

(f) Completion of paper has been temporarily suspended.

(163) SHORT PIPES AND INTAKES.

(b) Laboratory project.

(d) Theoretical and experimental; applied research.

(e) In order to determine methods of computing energy losses, a theoretical analysis has been made of the variation of the friction coefficient in the portion of a pipe where the boundary layer develops. The results have been applied to concrete and to corrugated steel pipes.

(f) Experimental work has been suspended; paper on theoretical results is nearly completed.

(h) "Theory of flow through a short tube with square-edged entrance with smooth or corrugated surface", G. H. Keulegan. Proc. Highway Research Board, Research Report 6-B, "Surface drainage in highways". December 1948.

(166) WET VENTING, STACK VENTING, AND SELF-SIPHONAGE TESTS OF PLUMBING SYSTEMS.

(b) Housing and Home Finance Agency.

(d) Experimental; applied research.

(e) One two-story and two one-story house drainage systems were erected to investigate stack and wet venting of plumbing fixtures and fixture self-siphonage. The drainage systems were constructed of transparent plastic pipe and fittings, so that motion pictures of the flow could be obtained.

(f) Completed except for reports and publications.

(h) A 16-mm motion picture with sound commentary was prepared by the Motion Picture Service of the Department of Agriculture. For loan of the film, communicate with the Housing and Home Finance Agency, Washington 25, D. C.

(431) GREASE DEPOSITION IN PLUMBING FIXTURE DRAINS.

(b) Housing and Home Finance Agency and National Bureau of Standards.

(d) Experimental; applied research.

(e) To obtain data for code-making authorities, the effects of length and slope of fixture drains and of the type of vent fitting on deposition of grease in sink drains were studied.

(f) This project has been discontinued.

(432) FROST CLOSURE OF THE STACK VENTS OF PLUMBING SYSTEMS.

(b) Housing and Home Finance Agency. (d) Experimental; applied research.

(e) To obtain data for code-making authorities, studies were made of the factors affecting frost closure.

(f) Completed except for report.

(433) CAPACITIES OF PLUMBING STACKS.

(b) Housing and Home Finance Agency. (d) Experimental; applied research.

(e) To determine the capacities of plumbing stacks, vertical stacks about 60-feet high having diameters ranging from 2 to 5 inches are being tested. Detailed observations are being made to determine flow conditions at points where horizontal drains join the vertical stack.

(f) Active.

(g) A theoretical analysis supplemented by the experimental data has made it possible to compute the back pressure on the horizontal drains at intermediate floors of multi-story buildings when the rate and velocity of flow from higher floors and the rate of flow from the drain are known for the case of a 3-inch stack and with the horizontal drain connected to the stack with a sanitary tee fitting. The experimental work is about to be extended to the use of long-turn T-Y stack fittings.

(434) PLUMBING VENTS.

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

(e) To determine the load on and the capacities of main plumbing vents, conventional venting systems will be attached to the stacks described under Project 433, "Capacities of Plumbing Stacks", immediately preceding. Demand on the vents for stacks of different sizes and different loadings on the stacks will be observed.

(h) Inactive.

(684) OCONTO FALLS DAM, STILLING BASIN.

(b) Rural Electrification Administration. (d) Experimental; design.

(e) A 1:40 model of the spillway, stilling basin, and pertinent downstream areas was studied to determine the action of the stilling basin and the effects of a proposed diversion wall running downstream between the turbine tailrace and the river channel below the spillway.

(f) Completed.

(g) A modified design of the spillway and elimination of the diversion wall were recommended.

(685) ORIFICE METERS.

(b) Cooperative sponsors: American Gas Association; American Society of Mechanical Engineers; Bureau of Ships, U.S. Navy Department; National Bureau of Standards.

(c) Howard Bean, Chairman, Joint A.G.A., A.S.M.E. Committee on Orifice Meters, National Bureau of Standards, Washington 25, D. C.

(d) Experimental; applied research.

(e) To obtain added information on installation requirements of orifices, flow nozzles, and venturi tubes, with special reference to (1) using shorter meter runs than now recommended; (2) the particular effects of globe valves and plug valves preceding an orifice; and (3) possible development of a field method of evaluating pipe roughness. Experimental work will be carried on with steam at the Naval Boiler & Turbine Laboratory (Philadelphia Navy Yard); with natural gas at the Rockville, Maryland, measurement station; and with water at the National Hydraulic Laboratory, National Bureau of Standards, Washington, D. C.

(f) Preparations are being made for the tests at Philadelphia and Rockville.

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU, Washington, D. C.

Inquiries concerning Projects Nos. 167, 168, 686, and 687 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. (d) Experimental; applied research.

(e) The project is intended to develop techniques for short range forecasts of streamflow and stage required by the forecasting services of the Bureau. Work involves correlation of recorded data by graphical and analytical means. Four broad problems are recognized: (1) forecasting the runoff from rainfall; (2) predicting the shape of the basin outflow hydrograph; (3) predicting the downstream movement of flood waves; and (4) predicting hydrographs resulting from melting snow.

(f) Continuing.

(g) Techniques under items (1), (2), and (3) have been developed, but studies toward improvement continue.

(168) WATER SUPPLY FORECASTING INVESTIGATIONS.

(b) U. S. Weather Bureau. (d) Experimental; applied research.

(e) The project is intended to develop techniques for (1) forecasting total annual water supply from streams draining mountain snow fields; and (2) predicting the time distribution of runoff from mountain snow packs. Techniques involve statistical analysis of recorded meteorological data by graphical and analytical means.

(f) Continuing.

(g) Practical methods for (1) above have been developed and are in use in forecasting. Studies under (2) are in the preliminary stage.

(h) "Recent developments in water supply forecasting from precipitation", R. K. Linsley and M. A. Kohler. U. S. Weather Bureau, (mimeograph) 24 pp, 1948. (To be published in Trans. American Geophysical Union.)

"The long-term precipitation-runoff relation as a basis for forecasting water supply", Merrill Bernard. (To be published in Trans. American Geophysical Union.)

(686) DEVELOPMENT OF ELECTRONIC FLOOD ROUTING DEVICE.

(b) U. S. Weather Bureau. (d) Experimental; applied research.

(e) To develop a high-speed electronic device for solution of flood routing problems.

(f) Continuing.

(g) A pilot model using readily available commercial parts has been constructed and proven satisfactory in tests. Steps are now being taken to develop a practical working model incorporating certain special features necessary for convenient operation.

(687) SNOW INVESTIGATIONS.

(b) Department of the Army, Corps of Engineers; and U. S. Weather Bureau.

(c) Chief, U. S. Weather Bureau, Washington 25, D. C.; or Forrest L. Rhodes, Director, Cooperative Snow Investigations Program, Corps of Engineers, South Pacific Division, Oakland Army Base, Oakland 14, Calif.

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

(e) The project is investigating the physics of snow to develop means of improved estimates of snow melt for design, operations, and forecasting. Laboratories are situated near Marias Pass, Mont., in the Upper Willamette Basin, Ore., and near Soda Springs, Calif. Each has one or more intensively instrumented small

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basins, and in addition numerous experimental projects on instrument design, and point measurement studies of snow physics are conducted.

(f) Continuing.

(h) Partial results on some phases are available in reports published by the program. For details contact the Program Director.

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, Civil Engineering Department, page 33.

(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 62.

(568) SCOUR AT BRIDGE PIERS AND ABUTMENTS.

(b) Iowa State Highway Commission and U. S. Public Roads Administration.

For a complete report on this project, refer to Project No. 568, listed under Iowa Institute of Hydraulic Research, page 41.

U. S. DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY, Washington, D. C.

(169) UNSATURATED FLOW OF WATER IN RELATION TO GROUND-WATER RECHARGE.

(b) U. S. Geological Survey, Water Resources Branch.

(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.

(d) Experimental and theoretical; basic research.

(e) Mechanics of nonsaturated flow of water in porous bodies.

(f) Active.

(g) Certain definite relations between discharge and time have been found for uniform sand. The results appear to be independent of the grain radius. A preliminary paper is in preparation.

(170) THE SPECIFIC YIELD OF ROCKS FOR WATER.

(b) U. S. Geological Survey, Water Resources Branch.

(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.

(d) Experimental and theoretical; basic research.

(e) Mechanics involved in the determination of specific yield of porous media. Specific yield of soils and sediments as related to drainage problems.

(f) Active.

(436) SEDIMENTATION STUDIES IN INLAND WATERS.

(b) U. S. Geological Survey, Water Resources Branch.

(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.

(d) Field investigation; experimental and theoretical; applied research.

(e) (1) To investigate the factors which govern the deposition and distribution of bottom sediments; (2) determine their physical properties; and (3) develop accurate techniques to determine storage and ascertain what factors govern changes in storage. Extensive studies for Lake Mead, the storage reservoir behind Hoover Dam, have begun. Complete determination of bottom contours with echo sounding methods, determination of thermal and salinity structures, investigation of density current phenomena and density current patterns, physical properties of sediments, development of underwater photographic techniques, and underwater coring are included in the program.

(f) Active.

(437) STAGE-DISCHARGE RELATIONS UNDER BACKWATER CONDITIONS.

(b) U. S. Geological Survey.

(c) W. D. Mitchell, U. S. Geological Survey, Champaign, Ill.

(d) Experimental; applied research.

(e) Analyses are being made of backwater data obtained in Project 64, "The Backwater Profile for Steady Flow in Open Channels", page 25, Vol. 12, to test and develop methods for obtaining discharge ratings for rivers under conditions of changing backwater for use in stream gaging practice.

(f) Active.

(g) Preliminary results indicate that present methods of preparing backwater ratings are in need of revision.

(h) Progress report is on file.

(439) EFFECT OF REFORESTATION ON STREAM FLOW.

(b) U. S. Geological Survey.

(c) A. W. Harrington, U. S. Geological Survey, Albany, N. Y.

(d) Field investigation; basic research.

(e) To study effect on stream flow of growing trees on abandoned farm land. Observations of stream flow, precipitation, ground-water levels, and evaporation at three small reforested drainage basins and adjacent controls were begun in 1935.

(f) Active. (h) Progress reports on file show very little effect to date.

(440) MULTIPLE-STEP DRAWDOWN TEST.

(b) U. S. Geological Survey.

(c) M. L. Brashears, Jr., U. S. Geological Survey, Jamaica, N. Y.

(d) Field investigation; applied research.

(e) Multiple-step drawdown tests of ground-water wells are being explored, to develop means for determining well and screen head losses.

(f) Active. Additional field data are being collected and assembled.

(441) GEOLOGY OF CACHE VALLEY.

(b) U. S. Geological Survey.

(c) H. E. Thomas, U. S. Geological Survey, Salt Lake City, Utah.

(d) Field investigation; basic research.

(e) Identification and correlation of aquifers, faults, ground-water dams, and other pertinent hydrologic features in Cache Valley, where there are exceptional exposures of the Cenozoic rocks.

(f) Active. Report is in preparation.

(445) SMALL RESERVOIRS IN ARID REGIONS.

(b) U. S. Geological Survey.

(c) H. V. Peterson, U. S. Geological Survey, Los Angeles, Calif.

(d) Field investigation; applied research.

(e) To determine runoff, evaporation, seepage, and sedimentation in arid regions. Readings are being obtained on staff gages installed on a number of representative stock-watering reservoirs in western states.

(f) Active. (g) Progress reports are on file.

(447) THERMO-TRANSFER AND ELECTRO-TRANSFER PHENOMENA IN SOILS AND SEDIMENTS AND THEIR RELATION TO GROUND-WATER RECHARGE.

(b) U. S. Geological Survey.

(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.

(d) Experimental and theoretical; basic research.

(e) Relation of the phenomena to flow of liquids in porous bodies.

(f) Active.

(448) UNDERWATER PHOTOGRAPHY IN INLAND WATERS.

(b) U. S. Geological Survey, Water Resources Branch.

(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.

(d) Experimental and field investigation; applied research.

(e) Development of techniques of underwater photography and their use in identifying rock structures.

(f) Active.

(449) SONIC PROPERTIES OF SOILS AND SEDIMENTS.

(b) U. S. Geological Survey, Water Resources Branch.

(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.

(d) Experimental and theoretical; basic research.

(e) Development of techniques for determining sonic properties of soils and sediments and their application to problems of fluid flow.

(f) Active.

(450) ELECTROLYTIC POTENTIAL MODELS FOR SOLUTION OF PROBLEMS IN GROUND-WATER HYDRAULICS.

(b) U. S. Geological Survey, Water Resources Branch.

(c) W. O. Smith, U. S. Geological Survey, Washington 25. D. C.

(d) Experimental and theoretical; applied research.

(e) Development of electrolytic potential techniques for model studies.

(f) Active.

(451) ELECTRIC AND MAGNETIC PROPERTIES OF SOILS AND SEDIMENTS.

(b) U. S. Geological Survey, Water Resources Branch.

(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.

(d) Experimental and theoretical; basic research.

(e) (1) Development of methods to measure electrical resistance, the electrical capacitance, and the magnetic susceptibilities of soils and sediments for a wide range of frequencies; (2) application of basic knowledge to problems in fluid flow in porous bodies.

(f) Active. Preliminary experimental work is in progress.

(688) HYDROLOGY OF SINKHOLE PONDS.

(b) U. S. Geological Survey and Emory University.

(c) E. L. Hendricks, U. S. Geological Survey, Baton Rouge, La.

(d) Field investigation; applied research.

(e) Study of fluctuations in level of sinkhole ponds in relation to precipitation, evaporation, and ground-water levels; study of water temperatures; and study of ground-water movement.

(f) Completed. Reports are in preparation.

(689) SANTA CLARA VALLEY SUBSIDENCE.

(b) U. S. Geological Survey.

(c) J. F. Poland, U. S. Geological Survey, Santa Barbara, Calif.

(d) Field investigation; applied research.

(e) To examine physical properties of sediments; to construct maps showing change in water pressure level; to compute theoretical compaction, and compare with observed subsidence; to develop relationship between changes in water pressures (or levels) and land subsidence, and to determine to what extent process is reversible.

(f) Active.

(h) "Ground water in Santa Clara Valley, Calif.", C. F. Tolman and J. F. Poland. Trans. American Geophysical Union, Pt. I, 1940, pp 23-25.

(690) DISCHARGE THROUGH MULTIPLE OPENINGS.

(b) U. S. Geological Survey.

(c) Tate Dalrymple, U. S. Geological Survey, Washington 25, D. C.

(d) Field investigation; applied research.

(e) Crest-stage gages are installed on upstream and downstream sides of all openings of selected bridge and valley crossings, so that study can be made of the drop through each opening and of the transverse water-surface profiles. Current-meter measurements made during the floods will be used to study relationships of discharge through each opening to the total discharge, the drop, and the conveyance.

(f) Active. (g) A large number of data are being collected.

(691) COMPUTING PEAK DISCHARGES BY INDIRECT METHODS.

(b) U. S. Geological Survey.

(c) Tate Dalrymple, U. S. Geological Survey, Washington 25, D. C.

(d) Field investigation; applied research.

(e) Establishment of maximum stage gages on slope-reaches or suitable contracted openings, computing flood discharges and comparing with measured discharge; to test adequacy of slope-area method of computing flood discharge.

(f) Active. (g) A large number of data are being collected.

U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, Denver, Colo.

Inquiries concerning Projects Nos. 452 to 465, incl., and 692 to 708, incl., should be addressed to the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

(452) WELDED HOLLOW-JET VALVE.

(b) Laboratory project. (d) Experimental; for design.

(e) 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; model tests on a 12-inch model.

(f) Suspended for work of higher priority. Studies of initial plan completed.

(453) HOOVER DAM INTAKE CYLINDER GATE.

(b) Laboratory project. (d) Experimental; for design.

(e) Hydraulic tests performed on a 1:24 model of the intake tower and cylinder gate assembly to check the adequacy of the suspension under severe adverse conditions. Drawdown and hydrostatic pressures were measured for various operating heads, gate openings, and rates of opening or closure.

(f) Completed.

(g) Data were procured and a memorandum report prepared as a basis for analytical study.

(454) CHERRY CREEK OUTLET WORKS.

(b) The District Engineer, Denver District, Corps of Engineers, Denver, Colo.

(d) Experimental; for design.

(e) Tests were made on a 1:28 model of the tunnels and stilling pool to check the adequacy of design; two outside tunnels are controlled with slide gates; middle tunnel is controlled with hollow-jet valve.

(f) Completed. (g) Satisfactory design developed.

(h) "Hydraulic model studies of the Cherry Creek Dam outlet works and the proposed irrigation inlet, Cherry Creek Project, Colorado", E. J. Rusho. Report 241. April 1948.

(455) ENDERS DAM OUTLET WORKS.

(b) Laboratory project.

(d) Experimental; for design.

(e) Tests were made on a 1:20 model to determine the adequacy of design of river outlet works, using two hollow-jet control valves.

(f) Completed except for reproduction of report.

(g) Stilling pool was shortened by use of deep, covered pool into which valves

discharge.

(h) "Hydraulic model studies of the Enders Dam spillway and outlet works, Missouri Basin Project", E. J. Rusho and A. J. Peterka.

(456) ENDERS DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) Tests were made on a 1:72 model of the spillway and outlet works to determine the adequacy of the proposed design and to prepare gate operating schedules.

(f) Completed except for reproduction of report.

(g) Satisfactory proportions of the features of the design were determined.

(h) "Hydraulic model studies of the Enders Dam spillway and outlet works, Missouri Basin Project", E. J. Rusho and A. J. Peterka.

(457) SOLDIER CANYON OUTLET WORKS.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:4 model of basin and valve was used to determine the adequacy of stilling basin for high head operation. Various types of valves and stilling basin arrangements were investigated.

(f) Work completed; report written but not reproduced.

(g) A wide variety of high head single valve outlet stilling basins were tried and evaluated.

(458) OLYMPUS DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:36 model of the overflow section, outlet section, and stilling pool was used to study the design.

(f) Suspended.

(459) SURGE TANK ORIFICE STUDIES.

(b) Laboratory project. (d) Experimental; for design.

(e) A series of 1:50 model orifice pieces and mouthpieces were tested in a system simulating surge tank operation.

(f) Work completed; report written but not reproduced.

(g) A pipeline orifice having a relatively low coefficient of discharge with flow in one direction, and a relatively high coefficient with flow in the other, were adapted to practical problems.

(460) HEART BUTTE DAM SPILLWAY AND OUTLET WORKS.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:21.5 model was used to study the critical features of the uncontrolled morning-glory spillway combined with outlet gates and tunnel.

(f) Observations completed; report in progress.

(g) The chief subjects of investigation were the prevention of serious vortices and cavitation erosion in the spillway throat and transition.

(461) BOYSEN DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:48 model was used for gate, chute, and stilling basin studies.

(f) Studies completed; report prepared but not reproduced.

(g) Adequacy and efficiency of the hydraulic design as modified by exigencies of construction conditions were determined.

(462) BOYSEN DAM OUTLET WORKS.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:16 model was used to conduct the studies of the discharge of two hollow-jet valves into a stilling pool.

(f) Studies completed; report not completed.

(g) Directing the valves downward at an angle into a relatively deep pool, together with special shaping of the basin walls, develops an effective outlet works.

(463) DAVIS DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:72 model was used in the investigation of roller buckets, sloping aprons, and stilling basins to determine the most effective and economical design of the spillway, the possible retrogression of streambed in the future being taken into consideration. The model was used to test diversion scheme for construction purposes.

(f) Studies completed; report suspended.

(g) The chief attainments were determining type and proportions of spillway stilling device; rectangular-type stilling basin proved most feasible for the receding tailwater which could be expected.

(464) MEDICINE CREEK DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:60 model was used to determine the adequacy of the proposed design of spillway for the earth-fill dam.

(f) Laboratory studies completed; report being written.

(g) Approach to spillway gates was only slightly modified.

(465) FRIANT-KERN CANAL TURNOUT.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:24 model of a section of the canal is being used to procure design data for prevention of collection of debris at turnouts; to determine best proportions for various features of turnouts.

(f) Active.

(692) ARROWROCK DAM OUTLET VALVE.

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

(e) Tests were made on a 6-inch model of the Ensign-type valve to determine whether minor alterations to the throat would present cavitation at high heads.

(f) Completed except for the written report.

(g) It was determined that the valves now in place could not be made to operate cavitation-free by minor alterations alone.

(693) CEDAR BLUFF DAM OUTLET WORKS.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:12 model was used to determine the adequacy of the irrigation outlet works, controlled by a single slide gate.

(f) Studies completed, report being written.

(g) Studies revealed that the efficiency of the stilling basin was affected by the shape of the cross-section of the slide gate and the relative proportions of the gate slots.

(694) CANAL DRAIN FLAP VALVES.

(b) Laboratory project. (d) Experimental; for design.

(e) Tests on 4-inch models of flap valves are being made to determine the hydraulic characteristics which would affect their behavior in seepage drains in large canals. Modification of these valves is made to improve operating characteristics.

(f) Active.

(695) SOAP LAKE SIPHON BLOWOFF STILLING POOL.

(b) Laboratory project. (d) Experimental; for design.

(e) Tests were made on a 1:24 model of a drain turnout at the low point of an inverted siphon to develop the most effective and economical means of dissipating energy of high pressure waste water which flows into an unlined canal. The pertinent feature of the outlet is a valve in the vertical pipe discharging down into a stilling well, the top of which is below the grade of the canal. The proportions of the well and its shape were the pertinent subjects of investigation.

(f) Laboratory work completed; report being written.

(696) PLATORO DAM OUTLET WORKS.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:9.55 model was used to study the adaptability of the jet-flow high pressure regulating valve to application in an outlet tunnel; principal point of study was ventilation.

(f) Suspended.

(697) MASONVILLE SIPHON TURNOUT.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:6 model was used to develop a stilling-well and weir basin for a turnout structure which releases water from an inverted siphon. The principal problem was quieting high-velocity flow in a vertical stilling-well which discharges into a weir pond.

(f) Completed; report being written.

(698) SPRING CREEK DAM OUTLET WORKS.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:7.43 model was used to study the applicability of a jet-flow valve in controlling medium head normal flow discharging into the elbow of the combination spillway and outlet works. Aeration was the principal subject of investigation.

(f) Suspended.

(699) DICKINSON DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) Tests on a 1:36 model of the earth dam spillway with an uncontrolled crest were made to determine hydraulic characteristics of the crest and to determine suitability of the stilling basin. Experiments were made to determine effect of moderate negative pressure on the downstream area of the crest.

(f) Studies completed; report not yet written.

(700) HORSESHOE DAM SPILLWAY.

(b) Salt River Water Users Association.

(c) Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.; or Leeds, Hill, Barnard and Jewett, consulting engineers, Los Angeles, Calif.

(d) Experimental; for design.

(e) A 1:36 model of the uncontrolled crest of the spillway was tested to determine the effect of mounting piers and gates on the maximum floor discharge capacity of the spillway.

(f) Studies completed.

(g) A unique design of piers and gates allowed a very favorable discharge over the crest with a minimum of disturbance downstream.

(701) HORSETOOTH OUTLET WORKS.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:24 model was used to develop a satisfactory stilling pool which would accommodate two 72-inch medium-head hollow-jet valves. The principal problem was to quiet the flow before it enters the irrigation distribution canal.

(f) Completed; report being written.

(702) BONNY DAM OUTLET WORKS.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:8 model is being used to develop a stilling pool of proportions to quiet the flow from one 72-inch hollow-jet valve before entering an unlined canal.

(f) Active.

(703) BONNY DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:60 model is being used to study the operating characteristics of the uncontrolled spillway crest, normal flow short tube outlet, and the stilling basin.

(f) Active.

(704) CEDAR BLUFF DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:48 model is being used to determine the hydraulic characteristics of an uncontrolled spillway crest, a short tube for outlet of normal flow, and the attendant stilling basin.

(f) Active.

(705) HUNGRY HORSE DAM SPILLWAY.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:36 model of a morning-glory-type spillway is being tested to develop satisfactory hydraulic characteristics of critical features such as the crest, elbows, tunnels, and stilling pool.

(f) Active.

(g) The principal problems have been in connection with the determination of a satisfactory crest shape and aeration to prevent cavitation erosion.

(706) SAND HOLLOW WASTEWAY TRAPEZOIDAL DROP.

(b) Laboratory project. (d) Experimental; for design.

(e) A 1:6 model of a canal drop, trapezoidal in cross-section, has been used to develop a structure less costly than the heretofore conventional drop which is rectangular in cross-section.

(f) Completed; report being written.

(g) A successful solution was attained by installing a ridge in the chute and stilling basin bottom to divide the flow up into two streams. Baffle piers in the stilling basin were used to improve pool action.

(707) WYOMING CANAL DROPS.

(b) Laboratory project. (d) Experimental; for design.

(e) 1:6 models were used in developing canal drops, trapezoidal in cross-section, thereby reducing cost of the structures from that of conventional rectangular cross-section.

(f) Completed; report being written.

(g) Ridges dividing the flow down the chutes were adopted to maintain stability in the stilling basin. Baffle piers in the basin were used also.

(708) BEAR CREEK FLOOD CHANNEL.

(b) District Engineer, Denver District, Corps of Engineers, Denver, Colo.

(d) Experimental; for design.

(e) A 1:60 undistorted model was used to determine the effectiveness of several alternate designs of a floodway proposed at the juncture of Bear Creek Canyon and Mt. Vernon Canyon in the town of Morrison, Colo.

(f) Completed.

(g) A superelevated curved entrance of Mt. Vernon Canyon flood channel into the main channel, Bear Creek, was the most effective.

U. S. NAVY DEPARTMENT, DAVID TAYLOR MODEL BASIN, Washington, D. C.

Inquiries concerning Projects Nos. 174, 175, 177, 178, 466 to 470, incl., and 709 to 712, incl., should be addressed to The Director, David Taylor Model Basin, U. S. Navy Department, Washington 7, D. C.

(174) CIRCULATING WATER CHANNEL.

(b) Laboratory project.

(d) Experimental; for design.

(e) The design, construction, and calibration of a circulating water channel to be used as a test facility. 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.

Three 1:22 models of the 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.

(f) Active. Studies are continuing in the 1:22 model on alterations to the full-scale channel. Due to other higher priority work, these studies have not been completed.

(h) "The circulating water channel of the David W. Taylor Model Basin", H. E. Saunders and C. W. Hubbard. Trans. Society of Naval Architects and Marine Engineers, Vol. 52: 325-364. 1944.

"The characteristics and utilization of the David W. Taylor Model Basin circulating water channel", C. A. Lee. Proc. Third Hydraulics Conference, University of Iowa, pp 277-297. 1946.

(175) VARIABLE PRESSURE WATER TUNNEL - 60 INCH.

(b) Laboratory project. (d) Experimental; for design.

(e) The design of a variable pressure water tunnel to be used as a test facility, 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.

(f) Discontinued.

(g) A search of literature on all existing water tunnels has been made, and many of the existing tunnels have been visited. 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. A 1:10 model under construction at St. Anthony Falls 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 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) The following reports are available for study by writing to the Director, David Taylor Model Basin:

"Model experiments for the design of a sixty-inch water tunnel", prepared by St. Anthony Falls Hydraulic Laboratory, University of Minnesota, September 1948.

1. "Description of apparatus and test procedures", H. D. Purdy.
2. "Contraction studies", J. F. Ripken and J. S. Holdhusen.
3. "Test section and cavitation index studies", J. S. Holdhusen.
4. "Diffuser studies", J. S. Holdhusen.
5. "Vaned elbow studies", J. S. Holdhusen and D. P. Lamb.
6. "Pump studies", J. S. Holdhusen.

See also Project No. 105, "Water Tunnel Design Studies", St. Anthony Falls Hydraulic Laboratory, page 64.

(177) BENTONITE CHANNEL.

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

(e) To develop a new means for quantitative and qualitative studies of flow around underwater bodies. 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.

(f) Discontinued.

(178) VORTEX-EXCITED VIBRATIONS OF CIRCULAR CYLINDERS.

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

(e) To obtain correlations of drag, side force, and vortex configurations of vibrating cylinders, including the effect of forced vibrations on the resultant vortex formation. The preliminary phases of the project will include investigations of the relation between imposed lateral motion and the resultant drag with a time correlation of the vortex pattern behind smooth cylinders at low Reynolds numbers. The work will progress to instantaneous time correlations of the side forces, drag forces, and velocity distributions in the wake to determine the strength and geometrical configuration of vortices shed from a smooth circular cylinder. These data will then be correlated with the instantaneous pressure distribution about a vibrating cylinder. Specialized phases of the project will follow, with investigations of the effect of surface roughness and more complicated shapes and modes of vibration.

A special "miniature" model basin is being designed in which tests will be made of free and forced oscillations with continuous recording of the forces. A glass test section will be used for photographing the vortex pattern at the lower Reynolds numbers. Instrumentation for velocity measurements in the wake will be considered at a later date. The pressure distributions on a vibrating cylinder will be made in the large model basins at the Taylor Model Basin.

(f) Active. Because of the greater urgency of other work, the design for the miniature model basin and its auxiliary equipment are still not completed. It is hoped that the facility will be ready late in 1949 and that the research program may be started shortly thereafter.

(466) VARIABLE PRESSURE WATER TUNNEL - 36-INCH (ORIGINALLY 24-INCH).

(b) Laboratory project. (d) Experimental; design.

(e) The design, construction, and calibration of a 36-inch variable-pressure water tunnel, to provide a jet of water approximately 36 inches in diameter and traveling at a speed of 50 knots. Provisions will be made to vary the pressure of a jet from pressures approaching vapor pressures to at least 2 atmospheres. A 1:6 model study of the proposed design of the 36-inch variable-pressure water tunnel is being made at the St. Anthony Falls Hydraulic Laboratory, University of Minnesota. The test section will be provided with proper fittings so that the tunnel may be operated as an open or closed jet.

(f) Active. The preliminary hydraulic design of the tunnel has been completed. A dynamometer is being developed for propeller tests.

See also Project No. 105, "Water Tunnel Design Studies", St. Anthony Falls Hydraulic Laboratory, page 64.

(467) MEASUREMENT OF TURBULENCE IN WATER.

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

(e) To investigate experimental and theoretical methods of describing turbulence in

water. The first phases have been primarily concerned with the development of experimental methods for measuring the turbulence parameters. A hot-wire instrument has been developed, which in exploratory tests gave excellent results in measurements behind grids. The dye diffusion technique has also been used with success and is being developed as a check for the hot-wire measurements. Measurements have also been obtained from photographs of neutrally-buoyant oil-base particles injected into a stream. The development of the first two methods is continuing. Because of the lengthy computations required with the third method, and because of the success of the first, the third will not be continued. An electromagnetic method of observing velocity fluctuations is also under consideration.

(f) Active.

(h) "The measurement of turbulence in water", M. S. Macovsky. TMB Report 670. October 1948.

(468) FRICTIONAL RESISTANCE RESEARCH.

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

(e) An extensive research program has been set up to find more precise relationships between the frictional resistance of a ship model and the prototype. Particular emphasis will be given to studies of the boundary layer about hydrodynamic forms and the means for stimulating turbulence to simulate full-scale boundary layer conditions on the model. Instrumentation is being developed for detecting transition in a boundary layer, for measuring boundary layer thickness, and for measuring the scale of turbulence in the boundary layers of flat plates and model ship hulls. Tests with hot wire anemometers and Pitot tubes of hypodermic tubing are proving useful for these measurements. Once means of measuring boundary layers are fully developed, studies will be made of the nature of the boundary layer about ship models when the flow is disturbed by turbulence stimulators of various kinds in an effort to separate the effects of frictional resistance from form and wave-making resistance.

(f) Active.

(g) Preliminary investigations of the boundary layer along a flat plate and along the hull of a ship model are being made, using the hot wire technique and fine Pitot tubes. The hot wire technique has proved successful for measuring the inception of transition and turbulent velocity fluctuations.

(469) PANAMA CANAL, RESTRICTED CHANNEL TESTS.

(b) Special Engineering Division, The Panama Canal.

(d) Experimental; for design.

(e) The model tests, conducted at scales of 1:45 and 1:86, 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.

(f) Completed.

(h) "The performance of model ships in restricted channels in relation to the design of a ship canal", R. S. Garthune, B. Rosenberg, D. Cafiero, and C. R. Olsen. TMB Report 601. August 1948.

"Ship performance in restricted channels", C. A. Lee and C. E. Bowers. Proc. A.S.C.E., Vol. 74, No. 4: 521-549. April 1948.

(470) ELECTROLYTIC TANK.

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

(e) An electrolytic tank has been built for studying the flow and pressure distribution about hydrodynamic forms using the method of electric analogy. Equipotential lines may be mapped with a searching probe and pantograph, or the velocity distribution may be obtained directly, using a double-electrode probe. The apparatus is adaptable to both two- and three-dimensional forms.

(f) Active. The tank has been built, but no experimental work has been done with it.

(709) THEORY OF WAVE RESISTANCE.

(b) Laboratory project. (d) Theoretical and experimental; basic research.

(e) The mathematical theory of wave resistance is being studied and correlated for the purpose of establishing methods whereby the theory may be used to guide and extend the analysis of ship resistance.

(f) Active.

(g) Using known equations, the wave resistance of ellipsoids of revolution, with ratios of length to diameter of 5 and 10, has been calculated for Froude numbers ranging from 0 to 25 and depths of 2 and 4 diameters. These results will be checked by experiment in order to obtain a direct comparison between theory and experiment.

(710) TEST OF MAIN INJECTION SCOOPS AND OVERBOARD DISCHARGES.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) Tests are to be conducted on models of condenser scoops to improve the design of main injection scoops and overboard discharges for greater efficiency of operation. Measurements will be made of the flow through the system, the velocity head developed, and the drag for different boundary layer conditions. Attempts will be made to scale the boundary layer on the model to simulate the velocity distribution along the keel of the ship. Plans are being made for a systematic study of different designs of scoops. Preliminary two-dimensional studies will be made of entrance and ejection forms in a bentonite channel.

(f) Active; equipment is being built for the tests.

(711) CAVITATION RESEARCH.

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

(e) To investigate the mechanism of cavitation, work is under way on the effects of air content and quality of water on cavitation phenomena. This work is now being conducted in a specially designed apparatus utilizing Venturi type test sections. Both fresh water and sea water have so far been studied.

Another phase of the program is concerned with the steady-state cavity such as is formed behind a bluff obstacle in a stream. The shape of the bubble, the pressure gradients within the bubble, and temperatures within the bubble have

been measured. The drag of various shapes in a cavity have also been measured. The work, in general, will include two- and three-dimensional cavity studies, the questions of history of the flow (i.e., type of cavitation that will be obtained in a given pressure field, and the time element with regard to preliminary settling and also rate of acceleration), as well as the associated problem of pressures developed at collapse.

(h) "Water tunnel investigations of steady state cavities", Phillip Eisenberg and H. L. Pond. TMB Report No. 668. October 1948.

(712) VARIABLE-PRESSURE FREE-SURFACE TEST FACILITY.

(b) Laboratory project. (d) Experimental; design.

(e) Design studies and research are being conducted for the purpose of constructing either a variable-pressure circulating water channel or a variable-pressure model basin. This facility will provide a test section water speed of 10 knots or a carriage speed of 10 knots, depending on the type of facility selected. Provisions will be made to vary the test section pressure, at the free water surface, from about vapor pressure to 1 atmosphere.

(f) Active; the preliminary planning and design studies have just been started.

U. S. NAVY DEPARTMENT, NAVAL ORDNANCE LABORATORY, White Oak, Silver Spring, Md.

(713) PRESSURE FIELD SURROUNDING HIGH-VELOCITY SPHERES IN WATER.

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

(c) Dr. J. Howard McMillen, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.

(d) Experimental and theoretical; basic research.

(e) Measurements of the pressure field ahead of a sphere traveling with velocity 0.2 that of sound is being measured by spark shadowgram method. Pressures range from 500 to 50 atmospheres. A grid is used to measure deflection of optical rays in the pressure field surrounding the sphere. Measurements are being compared with steady-state potential flow theory after it has been corrected for finite velocity of pressure adjustment.

(f) Active.

(g) Preliminary results show that the pressure falls off more slowly with the radial distance than the perfect fluid theory predicts.

(h) Brief report contained in Proc. Seventh Underwater Ballistics Conference, October 21, 1948, distributed by Fluid Mechanics Section, Office of Naval Research, Washington 25, D. C.

(714) ENTRY OF HYPER-VELOCITY SPHERES INTO WATER.

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

(c) Dr. J. Howard McMillen, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.

(d) Experimental; basic research.

(e) Shadowgrams are being taken of 1/8-inch steel spheres entering and traversing water at velocities of about 7000 fps. Refraction of the light rays and their relationship to the impact pressure and shock wave is being investigated.

(f) Active.

(g) It was found that immediately after entry, the shock wave is opaque to light. After immersion to about ten sphere diameters, the refracted light from the shock-wave front breaks up into lines and bands.

(h) "Spark shadowgrams of spheres at supersonic speeds in water", J. H. McMillen and R. L. Kramer. Abstract, Phys. Rev. 73: 1255. 1948.

"Method for shooting spheres at velocities of seven thousand feet per second", J. H. McMillen and R. L. Kramer. Naval Ordnance Laboratory Memo. No. 9188. July 1947.

(715) WATER-ENTRY CAVITY FORMATION.

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

(c) Dr. Albert May, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.

(d) Experimental; basic and applied research.

(e) An investigation of the size, shape, and development of the cavity when objects enter water is being carried out. The velocity range is that used in model studies for weapons and is below 200 fps. For the most part, spheres and cylinders are being used, and emphasis has been on vertical entry.

(f) Active.

(g) Information has been obtained on times of deep-closure and surface-seal, velocity of cavity wall, splash characteristics, and behavior of jets.

(h) "The size, shape, and pressure of attached cavities for spheres at vertical entry", J. H. McMillen and B. M. Wallace. Naval Ordnance Laboratory Memo. No. 8735. September 1946.

"Influence of atmospheric pressure on the phenomena accompanying the entry of spheres into water", D. Gilbarg and R. A. Anderson. Journal of Applied Physics, Vol. 19, No. 2: 127-139. February 1948.

"Suitability of certain measurements on the water-entry cavity", A. May. Naval Ordnance Laboratory Memo. No. 9720. July 1948.

"Transient cavities attached to missiles" A. May. Proc. Seventh Underwater Ballistics Conference, distributed by Fluid Dynamics Section, Office of Naval Research, Washington 25, D. C.

(716) SCALING LAWS OF WATER ENTRY.

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

(c) Dr. Albert May, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.

(d) Experimental; basic and applied research.

(e) An investigation is being made to determine how the various hydrodynamical events, which accompany water-entry, scale. The hydrodynamic events include surface closure, deep closure, size and shape of the cavity and trajectory. Parameters being varied are velocity, model size, pressure and density of atmosphere above the water. Entry velocities range from 15 to 250 fps. Most of the work has been with spheres at vertical entry.

(f) Active.

(g) Results so far have shown the general trend of the scaling behavior, but more data are required before definite scaling relationships can be established.

(h) "Entrance cavities", A. May and J. H. McMillen. Abstract in Proc. Sixth Underwater Ballistics Conference, November 6, 1947, distributed by Fluid Mechanics Section, Office of Naval Research, Washington 25, D. C.

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(717) DRAG COEFFICIENTS OF SPHERES AND CYLINDERS AT WATER ENTRY.

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

(c) Dr. Albert May, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.

(d) Experimental; basic research.

(e) Determination of drag coefficient while a cavity is attached, and its dependence on the state of the cavity, and the velocity of the body.

(f) Active.

(g) Drag coefficient for low-velocity spheres during cavity stage depends significantly on the Reynolds and Froude numbers, as well as on gas density above the water. Preliminary data at velocities above 5000 fps (supersonic) indicate that the drag coefficient is higher than for subsonic spheres.

(h) "Calculation of drag coefficients from distance-time data", Albert May. Naval Ordnance Laboratory Memo. No. 8694. August 1946.

"Drag coefficients of steel spheres entering water vertically", Albert May and J. C. Woodhull. Journal of Applied Physics, Vol. 19, No. 12. December 1948.

U. S. DEPARTMENT OF THE NAVY, BUREAU OF SHIPS, U. S. Naval Engineering Experiment Station, Annapolis, Md.

Inquiries concerning Projects Nos. 472, 473, and 718 to 722, incl., should be addressed to the Director, U. S. Naval Engineering Experiment Station, Annapolis, Md.

(472) COMPARATIVE INVESTIGATION OF CONDENSER TUBE ALLOYS IN EXPERIMENTAL CONDENSERS.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) To determine the corrosion resistance of various condenser tube alloys under controlled conditions in sea water. Five experimental condensers, each containing 20 tubes approximately 4 feet long, are to be installed at the Marine Testing Station, Kure Beach, N. C. These units are to be used to determine the effectiveness of plastic inserts for preventing inlet end erosion and the comparative corrosion resistance of various alloys. This investigation will provide information as to alternate materials for condenser tubes should conservation demands require that less-highly alloyed materials be utilized.

(f) Active. The test units are under construction.

(473) AN INVESTIGATION OF SALT WATER PIPING AND COMPONENTS.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) To determine the most satisfactory materials and design features for salt water piping systems for shipboard use, utilizing thin-wall tubing as a means for reducing weight. Three piping systems, consisting of thin-wall tubing 3-inch to 1/2-inch IPS, and appropriate valves and fittings, have been installed at the Marine Testing Station, Kure Beach, N. C. Natural sea water is pumped through these systems at a nominal velocity of 15 fps. The tubing of the systems consists of 70:30 copper-nickel alloy with about 0.5 percent iron; 70:30 copper-nickel alloy with less than 0.15 percent iron; red brass; and copper-nickel alloy containing aluminum. Some of the fittings are fabricated of copper-nickel alloy

while others are of the silver-brazing type. Special means for protecting the pipes for a short distance downstream of fittings are being investigated.

(f) Active.

(h) A preliminary test report C-3176 has been submitted to the Bureau of Ships, Navy Department, Washington, D. C. Test report C-3176-B presenting results of examination of the piping system consisting of 70:30 copper nickel alloy containing 0.5 percent iron after nine months operation is in preparation.

(718) AN INVESTIGATION OF MULTIPLE ORIFICE FITTINGS FOR BY-PASSING A SMALL PERCENTAGE OF WATER AROUND HIGH PRESSURE FEED PUMPS.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) To investigate materials and design of multiple orifice fittings for by-passing a small percentage of water from the discharge to the suction of high pressure feed pumps for protection at closed discharge. Four multiple orifice fittings of varying designs were tested. Tests were conducted until failure through erosion occurred, or for about 2000 hours operation if no failure was experienced.

(f) Inactive.

(h) Test reports C-1917 and C-2805 have been submitted to the Bureau of Ships, Navy Department, Washington, D. C.

(719) COMPARATIVE CHARACTERISTICS OF WATER-OPERATED EDUCTORS WITH PERIPHERAL JETS.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) To determine the characteristics of various eductors and the suitability of materials of construction. In these tests several peripheral jet eductors were tested to determine operating water requirements, discharge head versus capacities, efficiencies, and ability of parts to resist erosion.

(f) Inactive.

(h) Test reports C-2485 and C-3740 covering the above have been submitted to the Bureau of Ships, Navy Department, Washington, D. C.

(720) CORROSION STUDIES OF HEAT EXCHANGERS.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) To investigate the effectiveness of zinc protectors for prolonging the service life of heat exchangers utilizing sea water as the transfer medium, and to determine whether hot tinning of the tubes is beneficial. Four heat exchangers, one with zinc protectors and one without; and one with tin-coated tubes, and one without coating are to be installed at the Marine Testing Station, Kure Beach, N. C., and tested under similar conditions in natural sea water. In addition, a number of small units are to be tested in order to investigate a number of minor variables.

(f) Active. The heat exchangers and necessary materials for this investigation have been ordered, and it is expected that the units will be installed during February 1949.

(721) INVESTIGATION TO DETERMINE THE FEASIBILITY OF CONTROLLING MARINE FOULING WITH HOT WATER.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) To determine the feasibility of employing hot water for controlling fouling in salt water piping systems.

(f) Active. Material for the investigation has been procured. The investigation will not be started until the summer months, when marine fouling is abundant.

(722) COMPARATIVE TEST OF PLUMBING FIXTURES IN SEA WATER.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) To determine suitable materials including design considerations for water closets and urinals for shipboard use. A simulated service test is being made of water closets and urinals operated intermittently in sea water.

(f) Active. The units are being assembled for test.

U. S. NAVY DEPARTMENT, OFFICE OF NAVAL RESEARCH, Washington, D. C.

(15) STUDIES OF CAVITATION PHENOMENA.

(279) FLOW IN ROTATING CHANNELS.

The above projects, sponsored by the Office of Naval Research, U. S. Navy Department, are being carried on at the California Institute of Technology. For a complete report, refer to the numbers indicated, listed under California Institute of Technology, pages 5 and 6.

(69) RELATION OF SEDIMENT CHARACTERISTICS TO BED EROSION.

(72) ELECTRICAL ANALOGY OF THREE-DIMENSIONAL FLOW.

(73) MEASUREMENT OF TURBULENCE IN FLOWING WATER.

(75) DIFFUSION OF SUBMERGED JETS.

(76) GRAVITATIONAL PHENOMENA IN STRATIFIED FLOW.

(79) CAVITATION.

(80) TURBULENCE BEHIND SCREENS.

(81) MATHEMATICAL ANALYSIS OF PRESSURE DISTRIBUTION.

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

(569) DESIGN AND CONSTRUCTION OF SEDIMENT TRANSPORT FLUME.

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

(572) DESIGN AND CONSTRUCTION OF A LOW-VELOCITY AIR TUNNEL.

The above projects, sponsored by the Office of Naval Research, U. S. Navy Department, are being carried on at the Iowa Institute of Hydraulic Research. For

complete reports, refer to the numbers indicated, listed under Iowa Institute of Hydraulic Research, pages 35 to 42, incl.

(577) CHARACTERISTICS OF SOLITARY WAVES.

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

The above projects, sponsored by the Office of Naval Research, U. S. Navy Department, are being carried on at the Massachusetts Institute of Technology. For complete reports, refer to the numbers indicated, listed under Massachusetts Institute of Technology, Department of Civil and Sanitary Engineering, page 46.

(100) AIR ENTRAINMENT RESEARCH.

The above project is being carried on at the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, in cooperation with the Office of Naval Research, U. S. Navy Department. For a complete report, refer to the number indicated, listed under St. Anthony Falls Hydraulic Laboratory, page 63.

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.

(c) The Supervising Engineer, Special Engineering Division, The Panama Canal, Diablo Heights, Canal Zone.

(d) Field investigation; applied research; design and operation.

(e) 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 hydraulic flow problems that would arise in the design and operation of such a canal.

Investigations were completed on a model with undistorted scale of 1:100. The half-mile long model reproduces the Atlantic and Pacific entrances and harbors to deep water. The connecting channel at sea level originally followed the alignment of the present canal. Final tests were made with a 60 by 600 foot connecting channel at sea level, having the alignment proposed in the Report of the Governor, under Public Law 280, 79th Congress, 1st Session.

Several alternate designs of tidal regulating structures were investigated, and gate-opening schedules were developed for various tolerances of current velocity. Prototype measurements of hydraulic roughness in Gaillard Cut and of current velocities in the Pacific entrance were checked in the model in verification tests. Other tests involved comparison of canal velocities for tidal flow and steady flow under equivalent heads, observation of currents in bends, determination of effects of tributary flood flows on tidal flow in the canal, and investigations as to the nature and magnitude of surges created by the filling and emptying of tidal-lock chambers of different dimensions.

(f) Indefinitely suspended.

(g) Actual velocities were found to agree very closely with computed velocities. Gate schedules were developed for the limitation of velocities to desired values. Surges were found to be insignificant except those created by lock chambers of

extreme size (750 feet by 6,000 feet, Janssen Plan).

(h) Isthmian Canal Planning Memorandum (ICPM) 102. (Available on request.)

TENNESSEE VALLEY AUTHORITY, Hydraulic Data Branch, Knoxville, Tenn.

Inquiries concerning Projects Nos. 723 to 787, incl., should be addressed to Albert S. Fry, Chief, Hydraulic Data Branch, Tennessee Valley Authority, Knoxville, Tenn.

Hydraulic Laboratory Section, Norris, Tenn.

(723) FONTANA DAM, SPILLWAY MODEL STUDIES.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests on models at scales of 1:100 and 1:51 were made to develop spillway structures for Fontana Dam that would dissipate the energy of flood overflows without danger of damage to the dam or adjacent structures.

(f) Tests completed; report in preparation.

(g) The tests resulted in development of a spillway utilizing the two tunnels that were constructed for diversion of river flow during construction. The water enters these tunnels through tainter gates back of inclined tunnels intersecting the diversion tunnels. Curved buckets at the outlet ends of the diversion tunnels throw the spillway discharge into the air and spread this over the entire width of the river for a distance of several hundred feet downstream. A small, curved, emergency spillway discharging through a short tunnel under the reservoir rim to a gulley on the adjacent hillside provides for excess discharge.

(724) FONTANA DAM, LOW-LEVEL OUTLET, HOWELL-BUNGER VALVE MODEL STUDIES.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests on a 1:42.35 model were made to develop a structure that would safely and efficiently dissipate part of the energy in the Howell-Bunger valve discharge.

(f) Tests completed; report in preparation.

(g) The tests resulted in the development of structures in the neighborhood of the Howell-Bunger valve which dissipated a sufficient amount of energy to give satisfactory flow conditions in the 15-foot diameter tunnel below this area. These structures were also designed to keep to a minimum quantity the air required when the valve is discharging.

(725) FONTANA DAM, LOW LEVEL OUTLET, OUTLET STRUCTURE MODEL STUDIES.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests on a 1:100 model were made to develop a structure that would perform satisfactorily under all operating conditions without danger of damage to any adjacent structures.

(f) Tests completed; report in preparation.

(g) The tests resulted in the development of a comparatively simple outlet structure which operated satisfactorily under all conditions.

(726) FONTANA DAM, CAVITATION STUDIES.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests were made to develop specifications for permissible variation in tunnel alignment so as to prevent cavitation damage to the walls of the Fontana spillway tunnels. They were conducted in open and closed channels having obstructions on the floors or sides in the form of portions of circular curves of known radii and height. The reduction in pressure at various points on the obstructions was measured for various depths and velocities of flow.

(f) Tests completed; report in preparation.

(g) Data were obtained to formulate specifications setting up the maximum permissible height and length of irregularities on the tunnel surface.

(727) HALES BAR DAM, SPILLWAY MODEL STUDIES.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests were made on a 6-bay 1:34.76 model of the spillway to develop a modification of the existing apron to prevent erosion and to aid in reconstruction and raising of the dam.

(f) Tests completed; report in preparation.

(g) The necessary modifications to the existing spillway were determined.

(728) SOUTH HOLSTON AND WATAUGA DAMS, SPILLWAY MODEL STUDIES.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests on 1:100 and 1:51 models were made to develop a morning-glory type of spillway which would safely handle the flood overflows.

(f) Tests completed; preliminary report prepared.

(g) The tests resulted in modifications to the usual type of morning-glory structure which produced satisfactory operating characteristics. These consist primarily of properly located piers on the spillway crest and a deflector in the vertical shaft which deflects the flow against the outside of the 90° vertical bend at the bottom of the shaft.

(729) SOUTH HOLSTON AND WATAUGA DAMS, SLUICEWAY MODEL STUDIES.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests on 1:34 and 1:51 models were made to develop structures that would dissipate the energy from the discharge through two 96-inch Howell-Bunger valves located in a tunnel 34 feet in diameter. Structures were also developed to produce satisfactory flow conditions at a 29° Y intersection where the discharge from the Howell-Bunger valves entered the tunnel leading from the morning-glory spillway.

(f) Tests completed; report prepared.

(g) The tests resulted in the development of a roof section and a heavy weir placed just below the Howell-Bunger valves, which resulted in sufficient dissipation of energy to give satisfactory flow conditions. These structures, combined with those developed at the Y intersection, gave satisfactory operation through the entire tunnel system. The Y structures consisted of a small weir and two vertical piers, all specifically shaped to give the proper operating characteristics.

(730) SOUTH HOLSTON DAM, SPILLWAY OUTLET MODEL STUDIES.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests on a 1:51 model were made to develop an outlet structure that would dissipate the energy from the morning-glory spillway and the Howell-Bunger valve sluiceway without danger of damage to the tunnel or outlet structures.

(f) Tests completed; report prepared.

(g) The tests resulted in a spillway outlet which dissipated the energy within the stilling basin. This was accomplished by flaring the 34-foot diameter tunnel outlet, depressing the roof, and placing a spreader pier and deflecting block in the center of the outlet. A stilling basin, 350 feet long and flaring to a width of 125 feet with a 6-foot end sill, was used beyond the outlet structure.

(731) SOUTH HOLSTON DAM, SURGE TANK MODEL STUDY.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) A 1:50 model of the penstock and surge chamber was constructed and operated (a) to determine the orifice size and characteristic shape necessary to produce favorable pressure and water surface elevation changes for the best governor operation; (b) to determine the maximum and minimum water surface elevations to be expected in the surge chamber; and (c) to determine the operational characteristics of the selected design. The model included the entrance section, butterfly valve, penstock, riser, surge chamber, and the equivalent of the turbine, turbine scroll case, and turbine draft tubes.

(f) Tests are nearly completed; report in preparation.

(g) The results indicate that with the proper orifice between the riser and the surge chamber as satisfactory results can be obtained as with the differential riser type of surge tank.

(732) WATAUGA DAM, BED LOAD STUDY.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) A fixed-bed 1:70 model of the river in the vicinity of the powerhouse was built to determine whether bed load moved by the spillway discharge would be deposited in the powerhouse tailrace and, if so, how such deposition could be prevented. The deposition of sand in the neighborhood of the powerhouse at various discharges with different types of deflection structures was investigated.

(f) Tests completed; report in preparation.

(g) A small wall located along the upstream edge of the tailrace channel was found sufficient to keep the bed load from depositing in the draft tubes and the tailrace immediately below.

(733) HENDERSON COUNTY WEIR CALIBRATION.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Studies were made on a 1:5 model of a modified Columbus deep-notch weir approximately 40 feet wide with a silting basin approximately 150 feet long, upstream from the weir.

(f) Tests completed; preliminary report prepared.

(g) The ratings for various amounts of silt in the silting basin were determined, and a modification of the silting basin developed.

(734) WHITE CREEK SILT SAMPLER.

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Full-scale studies were made to develop a continuous sampling device which would collect 1/100,000 part of any discharge between 0.7 and 244 cubic feet per second.

(f) The major features of the design have been determined. The details are being worked out.

(735) TURBINE DISCHARGE RATINGS.

(b) Tennessee Valley Authority. (d) Field tests; applied research.

(e) Field measurements of turbine discharges are being made in an attempt to rectify discrepancies and increase accuracy in the reported discharges at many of the Authority's dams. Gibson tests, made at Norris Dam to rate the turbines, gave excellent verification of the accuracy of current-meter measurements made under normal conditions. For dams on tributary rivers with only one or two units, the discharges are to be determined by current-meter measurements in the river a short distance below the dam. On the main river, with several units in operation at each dam and river stages not easily stabilized, discharges are to be determined for individual turbines by obtaining velocity traverses in the turbine intakes. Propeller type current-meters, mounted to swing freely in the horizontal and vertical directions and equipped with a device for transmitting the magnitudes of the angular motions to the deck, will be used. The results are to be used in obtaining discharge coefficients for the scroll case pressure taps. Hourly and daily discharges can then be obtained by standard flow-meter methods.

(f) The Norris and Fontana units have been rated. Equipment is being developed for measurements at the main-river dams. Testing at the tributary installations is being carried forward as rapidly as possible.

(g) To develop the instruments for the turbine intake measurements, enough necessary equipment to allow the use of one meter was built at the Laboratory. This meter and auxiliary equipment was rated at the National Bureau of Standards and then field-tested at Watts Bar Dam. These tests proved that the basic ideas are sound and practical, but some redesign and expansion are desirable.

(736) APALACHIA DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority. (d) Experimental; operation.

(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.

(f) Model studies are completed.

(737) CHATUGE AND NOTTELY DAMS, SLUICE RATING.

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) Field measurements of discharge and pressures were made on the Howell-Bunger valve used to control the discharge through this sluiceway. These measurements were then used to compile tables which gave the discharge for any valve opening at any gross head value within the expected operating range.

(f) Field tests completed; discharge tables completed and issued.

(738) CHEROKEE DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority. (d) Experimental; operation.

(e) Tests are to be used in determining the spillway discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for

operating purposes will be prepared from the combined model and field test data.

(f) Model studies are completed.

(739) CHEROKEE DAM, SLUICE RATING.

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) Field measurement of discharges and differential pressures in the sluices, supplemented by model test data, will be used to establish the discharge ratings for the eight sluices. Tables showing the discharge for any gate opening at any headwater elevation within the operating range are to be prepared.

(f) Discharge and pressure measurements are partially completed. Work is continuing.

(740) CHICKAMAUGA DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority. (d) Experimental; operation.

(e) Tests were used in determining the spillway discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.

(f) Testing completed; tables prepared and issued.

(741) DOUGLAS DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority. (d) Experimental; operation.

(e) Tests are to be used in determining the spillway discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.

(f) Model studies are completed.

(742) DOUGLAS DAM, SLUICE RATING.

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) Field measurement of discharges and differential pressures in the sluices, supplemented by model test data, will be used to establish the discharge ratings for the eight sluices. Tables showing the discharge for any gate opening at any headwater elevation within the operating range are to be prepared.

(f) Discharge and pressure measurements are partially completed. Work is continuing.

(743) FONTANA DAM, LOW-LEVEL OUTLET RATING.

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) Field measurements of discharge and pressures were made on the Howell-Bunger valve used to control the discharge through this sluiceway. These measurements were used to compile tables of the discharge for any valve opening at any gross head value that lies within the expected operating range.

(f) Field tests completed; discharge tables completed and issued.

(744) FONTANA DAM, LOW-LEVEL OUTLET, AIR DEMAND STUDIES.

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) Field measurements of the air demanded by the operation of the 84-inch Howell-Bunger valve were made by the use of a portable anemometer in the access gallery leading to the valve chamber. The valve was operated through its entire range of openings and at heads ranging from 168 to 309 feet.

(f) Tests completed; report in preparation.

(g) The results, when plotted as air demand versus water discharge, gave a family of curves varying with head but of unpredictable shape. It was also found that a constant ratio of air to water exists at each valve opening position.

(745) FONTANA DAM, SLUICE RATING.

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) Field measurement of discharges and differential pressures in the sluices, supplemented by model test data, will be used to establish the discharge ratings for the six sluices. Tables showing the discharge for any gate opening at any headwater elevation within the operating range are to be prepared.

(f) Discharge and pressure measurements are partially completed. Work is continuing.

(746) FORT LOUDOUN DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.

(d) Experimental and field investigation; operation.

(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.

(f) Model studies are completed.

(747) GUNTERSVILLE DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.

(d) Experimental and field investigation; operation.

(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.

(f) Testing completed; tables prepared and issued.

(748) HALES BAR DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.

(d) Experimental and field investigation; operation.

(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.

(f) Model studies completed; preliminary rating tables issued.

(749) HIWASSEE DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.

(d) Experimental and field investigation; operation.

(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.

(f) Testing completed; tables prepared and issued.

(750) HIWASSEE DAM, SLUICE RATING.

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) Field measurements of discharge were used to establish the discharge ratings for the four sluices. Tables showing the discharge for a wide-open gate at any headwater elevation within the operating range were prepared.

(f) Tests completed; tables computed and issued.

(751) KENTUCKY DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.

(d) Experimental and field investigation; operation.

(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.

(f) Testing completed; tables prepared and issued.

(752) NORRIS DAM, SLUICE RATING.

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) Field measurement of discharges and differential pressures in the sluices were used to establish the discharge ratings for the eight sluices. Tables showing the discharge for any gate opening at any headwater elevation within the operating range were prepared.

(f) Tests completed; tables computed and issued.

(753) OCOEE NO. 3 DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.

(d) Experimental and field investigation; operation.

(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.

(f) Model studies are completed.

(754) PICKWICK LANDING DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority. (d) Experimental; operation.

(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.

(f) Testing completed; tables prepared and issued.

(755) WATTS BAR DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority. (d) Experimental; operation.

(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.

(f) Model studies are completed.

(756) WILSON DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.

(d) Experimental and field investigation; operation.

(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.

(f) Testing completed; tables prepared and issued.

(757) APALACHIA DAM, TUNNEL FRICTION.

(b) Tennessee Valley Authority. (d) Field investigation; for design.

(e) Field test measurements were made to determine the friction and roughness coefficients for three different surfaces. The sections tested were an 18-foot diameter steel pipe coated with bituminous paint, an 18-foot diameter concrete-lined tunnel, and unlined rock tunnel of 20- and 22-foot nominal diameters. Discharges during the tests varied from 975 to 3210 cubic feet per second.

(f) Project completed.

(h) "Friction coefficients in a large tunnel", G. H. Hickox, A. J. Peterka, and Rex A. Elder. Proc. A.S.C.E., Vol. 73, No. 4: 451. April 1947.

(758) CHEROKEE DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) Field measurements of pressures in sluices are being obtained when operating conditions will allow. These are to be compared with the pressures measured during the model tests.

(f) Work continuing.

(759) DOUGLAS DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) Field measurements of pressures in sluices are being obtained when operating conditions will allow. These are to be compared with the pressures measured during the model tests.

(f) Work continuing.

(760) FONTANA DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) Plaster surface impressions of carefully located sections are taken after each

interval of extended tunnel discharge operation. These are inspected and compared to determine if there is any evidence of damage to the tunnel surface.

(f) Work continuing.

(761) KENTUCKY DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) Field measurements are made, when operating conditions will allow, of lateral pressures on the face of the spillway piers and on the submerged baffle piers on the spillway apron. These are to be compared with the results of the model tests.

(f) Work continuing.

(762) SOUTH HOLSTON DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) An electrical pressure cell is being installed in the South Holston penstock. This will be used to obtain pressure data during turbine operation, which can then be compared with the data obtained from the model tests. The relative accuracy of the surge tank model can thus be determined.

(f) Design for the installation of the cell is complete. Construction of the penstock and installation of the cell is anticipated during the next year.

(763) HIWASSEE DAM, PROTOTYPE CHECK TESTS (Project No. 1217 in Vol. IX).

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) Field measurements of pressures in sluices are being obtained when operating conditions will allow. These are to be compared with the pressures measured during the model tests.

(f) Work continuing.

The following ten projects have not been reported since Volume IX (Volume X for Nos. 1324 and 1326). Inasmuch as this work has been completed and no further report will be made, no new numbers have been assigned. The numbers in parenthesis following the title refer to the numbers in the old series as previously assigned.

PICKWICK LANDING DAM, SPILLWAY DESIGN (494, Vol. IX).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Tests were made on models built to three different scales, to determine a satisfactory and economical design of apron below the dam in order to dissipate energy, and to determine the best shape of spillway crest. Action of stilling basin for 1:50 and 1:25 sectional models was observed through glass panels. Results were checked on 1:100 model of entire dam. Discharge coefficients, pressures on face of spillway, and on spillway gate piers for various combinations of gate operation were measured on a 1:25 model. Supplementary studies were also made to determine the size of air passages necessary for satisfactory aeration of the nappe.

(f) Tests and report completed.

(h) "The Pickwick Landing project", Technical Report No. 3, Tennessee Valley Authority.

HIWASSEE DAM, SPILLWAY DESIGN (574, Vol. IX).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) Investigation of stilling basin and spillway discharge coefficients for Hiwassee Dam, to determine the most satisfactory and economical design of stilling basin at the toe of the dam, and to measure spillway discharge coefficients. Tests were made on a 1:55 model.

(f) Tests and report completed.

(h) "The Hiwassee Valley Projects", Technical Report No. 5, Vol. I, The Hiwassee Project, Tennessee Valley Authority.

GUNTERSVILLE DAM, SPILLWAY DESIGN (708, Vol. IX).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) To determine a satisfactory and economical design of apron below the dam for dissipation of energy and prevention of bed erosion, and to determine spillway discharge coefficients. Tests of the apron design were made on a 1:25 model of three spillway bays. The final design was checked on a 1:100 model of the entire spillway. Discharge coefficients were determined on models at scales of 1:25 and 1:50.

(f) Tests and report completed.

(h) "The Guntersville Project", Technical Report No. 4, Tennessee Valley Authority.

CHICKAMAUGA DAM, SPILLWAY DESIGN (709, Vol. IX).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) To determine a satisfactory and economical design of apron below the dam for dissipation of energy and prevention of bed erosion, and to determine spillway discharge coefficients. Tests of the apron design were made on a 1:25 model of three spillway bays. The final design was checked on a 1:100 model of the entire spillway. Discharge coefficients were determined on models at scales of 1:25 and 1:50.

(f) Tests and report completed.

(h) "The Chickamauga Project", Technical Report No. 6, Tennessee Valley Authority.

WATTS BAR DAM, SPILLWAY DESIGN (1135, Vol. IX).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) To develop an apron which will cause a minimum of disturbance to navigation and eliminate scouring where it will be harmful to structures. The shape of crest and tentative apron design were developed on a three bay model built at a scale of 1:25. The effects of the apron design and various methods of gate operation on navigation were observed on a 1:121 model of the entire dam. Particular attention was paid to the presence and size of waves which might have an adverse effect on navigation.

(f) Tests and report completed.

CHICKAMAUGA DAM, WAVE ACTION BELOW LOCK WALL EXTENSION (1214, Vol. IX).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) To measure wave heights existing in the navigation channel below the lock for the purpose of supplying information to bidders on proposed dredging and to provide a check on the results of model tests. Gages were installed at suitable locations in the channel. Observations were made at selected river discharges by means of motion pictures. Comparison with results of model tests were made.

(f) Tests and report completed.

FORT LOUDOUN DAM, SPILLWAY MODEL (1216, Vol. IX).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) To determine a satisfactory and economical design of apron below the dam for dissipation of energy and prevention of erosion. Tests of the apron design were made on a 1:25 model of three spillway bays. A tentative design of apron was selected. Additional tests were made on a 1:130 model of the entire dam to study special conditions which exist at the ends of the spillway.

(f) Tests and report completed.

CHEROKEE DAM, SPILLWAY MODEL (1218, Vol. IX).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) To determine a satisfactory and economical design of apron below the dam for dissipation of energy and prevention of erosion. Tests of four spillway bays at a scale of 1:30 were made. A tentative design developed on the 1:30 model was tested further on a 1:70 model of the entire dam. On this model it was possible to study the effects of unsymmetrical spillway-gate and sluice operation, and to make such modifications of the stilling basin as seemed desirable. The 1:70 model was also used to investigate special conditions existing at the ends of the apron.

(f) Tests and report completed.

(h) "The Cherokee Project", Technical Report No. 7, Tennessee Valley Authority.

CHATUGE DAM, SPILLWAY DESIGN (1324, Vol. X).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) To determine spillway coefficients; to investigate the form of chute below the spillway; and to develop a stilling basin that would dissipate the energy at the foot of the chute. Discharge coefficients were measured on a 1:10 model of three spillway bays. The form of the chute and the stilling basin were studied on a 1:45 model of the entire spillway. It was found necessary to distort the slope of the chute to produce correct velocities at the entrance of the stilling basin.

(f) Tests and report completed.

NOTTELY DAM, SPILLWAY DESIGN (1326, Vol. X).

(b) Tennessee Valley Authority. (d) Experimental; for design.

(e) To determine spillway coefficients; to investigate the form of chute below the spillway; and to develop a stilling basin that would dissipate the energy at the foot of the chute. Discharge coefficients were measured on a 1:10 model of three spillway bays. The form of the chute and the stilling basin were studied on a 1:45 model of the entire spillway. It was found necessary to distort the slope of the chute to produce correct velocities at the entrance of the stilling basin.

(f) Tests and report completed.

Hydro-Meteorological Section, in collaboration with Field Investigations Section, Knoxville, Tenn.

(764) DETERMINATION OF SILT CARRIED IN SUSPENSION BY TENNESSEE RIVER AND TRIBUTARIES (950, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) To provide data for estimating effective life of storage reservoirs, and loss of soil from the land. Samples of water were collected periodically at stream

gaging stations in the watershed, analyzed to determine the silt content, and correlated with river discharge to determine the suspended silt load at each station.

(f) Field work completed; report in preparation.

(g) The project furnishes positive data on the quantity of silt carried into each reservoir and on the relative erosion of various areas.

(765) EVAPORATION IN THE TENNESSEE BASIN (951, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) Purpose is to provide data for estimating reservoir losses. A corollary purpose is to derive a general rule, applicable to the Tennessee River Basin, that will permit the computation of evaporation from known meteorological phenomena. Accurate daily measurements are made of evaporation from a pan at six locations in the Basin, together with readings of standard meteorological equipment.

(f) Continuous records are being kept.

(766) GROUND WATER INVESTIGATIONS (955, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) Hydrologic study to determine effect of filling of reservoirs upon adjacent water table. Observation wells are dug, and the record of the level of the water in these wells is compared with rainfall and river stages for periods before and after reservoir filling.

(f) Observations have been discontinued.

(g) Preliminary reports have been prepared for internal use; conditions have been found to be normal at all sites studied.

(767) RESERVOIR RIM INVESTIGATIONS.

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) To determine the leakage, if any, through reservoir rims of new reservoirs, and to check conditions for other reservoirs. Ground water levels are observed in observation wells, and post-impoundage levels are compared with pre-impoundage records; stream flow from rim areas is likewise measured by gaging stations and weirs, and volumes of flow are compared to determine whether any increase has occurred after creation of a reservoir. Observations are being made at Kentucky, Guntersville, Watts Bar, Fort Loudoun, Norris, Cherokee, Douglas, and Watauga Reservoirs.

(f) Active.

(g) Preliminary report has been prepared for internal use. No serious leakage conditions have been found.

(768) PRECIPITATION IN TENNESSEE RIVER BASIN (959, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) A comprehensive study of rainfall and other weather phenomena in and adjacent to the watershed for purposes of water dispatching and improvements in water-control techniques; also for storm studies as related to maximum precipitation, rainfall-runoff relation, spillway design and operation, and other purposes. Records from approximately 550 TVA, U. S. Weather Bureau, and private rain gages in the Tennessee Valley are used to furnish meteorological data for planning and operating water-control projects and for agricultural and other purposes. Special investigations are made of unusual storms.

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(f) Continuous records are kept.

(h) The bulletin, "Precipitation in Tennessee River Basin", is issued monthly by the Hydraulic Data Branch, Tennessee Valley Authority. An annual summary bulletin is also issued.

(769) RESERVOIR AND STREAM TEMPERATURES (960, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) Study of water utilization and water movement as concerns industrial plant locations and stream pollution. Variations in water temperature from surface to bottom throughout the year are determined by soundings taken with Bathythermograph or resistance thermometer along established ranges across reservoirs, and by continuous recording temperature gages at selected stations on natural streams. Observations have been completed in Norris, Cherokee, Douglas, Hiwassee, and all main-stream reservoirs. They are being continued in Watts Bar and Fort Loudoun Reservoirs and at certain water levels in Fontana Reservoir. Recorders are in service below the major projects on all principal tributaries of the Tennessee River above Chattanooga.

(f) Active.

(h) "Discharge, temperature, turbidity, and chemical quality of Clinch River near Clinton, Tennessee." Report No. O-1816-1, March 1947. Issued for limited distribution by Hydraulic Data Branch, Tennessee Valley Authority.

(770) INVESTIGATION OF WINDS AND WAVE HEIGHTS (1222, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) Investigation for obtaining factual data on occurrence of waves of various heights as concerns navigation on TVA lakes; also to develop relationship of wave heights to winds for design purposes. Three installations which measure and record wave heights and wind velocities and directions were placed in TVA reservoirs at water depths of 40 feet, 30 feet, and 10 feet. Special apparatus capable of measuring waves 7 feet in height was designed. Records collected over a period of several years will be correlated to show the relation between winds and wave heights and the frequency of occurrence of high waves. Observations have been discontinued in Wheeler Reservoir and are now being made in Kentucky Reservoir.

(f) Active.

(g) Records are analyzed currently, and special requests are answered by reference to the available data.

(771) GALLERY DRAINAGE IN LARGE DAMS.

(b) Tennessee Valley Authority. (d) Field investigation; design.

(e) Weirs are placed in main galleries, and drainage is measured as a check on tightness and stability of dams. Observations are made in Pickwick Landing, Watts Bar, Fort Loudoun, Hiwassee, Fontana, Norris, Cherokee, and Douglas Dams.

(f) Active.

(g) Reports are prepared annually for internal use.

Field Investigations Section.

(772) FLOOD INVESTIGATIONS, TENNESSEE RIVER AND TRIBUTARIES (956, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) Survey to obtain data for hydraulic studies and for planning flood-control projects. High-water marks are set and observations made as floods occur; field search is made for high-water marks of past floods. Data are collected on rainfall, runoff, and damages incurred by floods.

(f) Active reports on certain tributaries are in progress.

(h) Reports of specific floods are published as supplements to the monthly bulletin, "Precipitation in Tennessee River Basin", issued by the Hydraulic Data Branch, Tennessee Valley Authority.

(773) INVESTIGATIONS OF SPRINGS AND RUNS BELOW DAMS (958, Vol. X).

(b) Tennessee Valley Authority.

(d) Field investigation; design and operation.

(e) Hydrologic investigation related to construction activities. Flows from springs and in small streams below dam sites are measured before and after construction of dams to determine leakage. Observation weirs are observed regularly and the records are analyzed to account for current rainfall.

(f) Active.

(g) Records have shown no appreciable leakage through any dam which has been constructed to date.

(774) RADIO GAGES FOR REPORTING RAINFALL AND RIVER STAGES (1220, Vol. X).

(b) Tennessee Valley Authority. (d) Experimental; development.

(e) To effect a practical and economical method for obtaining and rapidly reporting hydraulic data from relatively inaccessible locations. Mechanical devices were developed for translating rainfall depths and stream stages into electrical impulses which are broadcast by short-wave radio transmitters for reception in a central office. Twenty-one radio rain gages and twenty-one radio stream gages are now being operated with a high degree of reliability. At 32 stations, A-C converters are being installed with stand-by batteries charged automatically and switched into operation in event of a power failure.

(f) Active.

(g) The gages have provided a prompt means of obtaining reports when other forms of communication have been disrupted, and from localities where other forms of communication or the services of observers are unavailable.

(775) BACKWATER EFFECT OF RESERVOIRS ON SMALL TRIBUTARIES (1223, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; operation.

(e) On small tributaries where backwater from reservoirs might conceivably cause tributaries to flood adjacent lands at elevations higher than level pool, automatic crest markers were located to record the crest elevations reached by the tributary floods. Profiles obtained before filling of a reservoir are compared with those for similar discharges after filling to determine the effect of backwater. Crest markers are in service in Kentucky, Chickamauga, Watts Bar, and Hales Bar Reservoirs.

(f) Active.

(776) MEASUREMENT OF VISIBILITY IN FOGS (1224, Vol. X).

(b) Tennessee Valley Authority. (d) Experimental; development.

(e) To obtain practical equipment for measuring and securing a continuous record of fogs, devices are being developed for measuring visibility by recording photo-

electric equipment. An instrument to measure the free water in the air has also been under study.

(f) Discontinued.

Hydraulic Investigations Section.

(777) RUNOFF-SILT INVESTIGATIONS ON SMALL WATERSHEDS (961, Vol. X).

(b) Tennessee Valley Authority.

(d) Field investigation; basic and applied research.

(e) The purpose of these studies is to evaluate hydrologically existing or changed land-use practices or management. Data are obtained on rainfall, runoff, and soil loss, and in some instances include ground-water levels and soil moisture.

(f) Active.

(g) The projects in most instances have not been in operation a sufficient period for publication of final results.

(h) "Report on initial phases - Chestuee Water Project." Report No. O-3736, Tennessee Valley Authority, February 1945.

(778) EFFECT OF ALTITUDE UPON RAINFALL.

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) At three locations, rainfall data have been or are being collected for the purpose of determining the effect of altitude upon rainfall. The stations are arranged in series at varying elevations, up one side of a ridge and down the other, so that exposure as well as altitude will be reflected in the result.

(f) Active.

(779) MAXIMUM POSSIBLE PRECIPITATION IN TENNESSEE VALLEY.

(b) Tennessee Valley Authority, in cooperation with U. S. Weather Bureau.

(d) Theoretical; applied research.

(e) Hydrometeorological analysis of large storms with upward adjustments of controlling factors to maximum limits as applied to the Tennessee Valley and subdivisions.

(f) Active.

(g) Results will be published as one of the current series of hydrometeorological reports by the U. S. Weather Bureau and cooperating agencies.

(780) MONTHLY EVALUATION OF GROUND-WATER STORAGE.

(b) Tennessee Valley Authority. (d) Theoretical; operation.

(e) By analysis of current records of stream discharge, the volumes of runoff in ground-water and channel storage are determined for use in operation of multipurpose reservoirs.

(f) Active.

(g) Results are reported monthly within the organization.

(781) RAINFALL DATA FOR IRRIGATION PROJECTS.

(b) Tennessee Valley Authority.

(d) Field investigation; applied research.

(e) A statistical study of rainfall data for the growing season in the Tennessee Valley and of the duration of deficient precipitation. Results are summarized in charts and maps.

(f) Current studies completed.

(g) Studies indicated the high frequency and long duration of deficient precipitation in a humid region.

(782) SNOWFALL IN GREAT SMOKY MOUNTAINS.

(b) Tennessee Valley Authority, in cooperation with U. S. Weather Bureau and National Parks Service.

(d) Field investigation; basic research.

(e) Daily observations are made of snowfall, its water equivalent, temperature, and relative humidity data over a range with altitude variations from 1400 to 6300 feet in the Great Smoky Mountains National Park.

(f) Active.

(h) Processed data are available currently through cooperating agencies.

(783) WHITE AND RICHLAND CREEKS - DETERMINATION OF ROUGHNESS COEFFICIENT.

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) Determination of roughness coefficients in several river reaches of known discharge is being made to extend the knowledge of relation between roughness coefficient and physical characteristics of river channels.

(f) Active.

River Forecasting Section.

(784) WAVE TRAVEL IN NATURAL RIVER CHANNELS (1221, Vol. IX).

(b) Tennessee Valley Authority. (d) Theoretical; applied research.

(e) To verify by data observed in natural river channels the published theoretical studies on phenomena of translatory wave travel, translatory waves resulting from stream flow regulation were analyzed, and the observed wave velocities were compared with velocities computed by theoretical formulas.

(f) Completed.

(h) "Translatory waves in natural channels", J. H. Wilkinson. Trans. A.S.C.E., Vol. 110, Paper No. 2254: 1203-1225. 1945.

Hydrographic Surveys and Construction Staff.

(785) SILTING OF EXISTING RESERVOIRS (952, Vol. X).

(b) Tennessee Valley Authority. (d) Field investigation; basic research.

(e) Selected ranges across reservoirs were probed and sounded for original and present bottom elevations, volumetric samples of deposited silt are collected and analyzed, and the quantity and distribution of silt are computed to determine the quantity of silt deposited by the stream, the probable life of the reservoir, the effect of silt storage upon navigation channels and upon the silting of downstream reservoirs, and to obtain data for estimating the probable silting in comparable future developments. Echo sounding equipment has been used. Special mobile equipment has been developed for this work.

(f) Active. Field work is continuing in all reservoirs operated by the Authority.

Office Engineering Unit.

(786) WATER TRAVEL IN NATURAL STREAMS.

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) Studies are made for observing and measuring the sanitary and chemical changes taking place in water during its passage downstream. A given mass of water is identified by its electrical conductivity characteristics, or in special cases by means of titration for varying chemical concentration.

(f) Observations have been made since 1943 and are being continued.

(h) Some results appear in a discussion by M. A. Churchill of the paper, "Translatory waves in natural channels", Trans. A.S.C.E., Vol. 110: 1229-1234. 1945.

(787) MOVEMENT OF WATER THROUGH LARGE RESERVOIRS.

(b) Tennessee Valley Authority. (d) Field investigation; applied research.

(e) Same as Project No. 786,"Water Travel in Natural Streams", page 170, except that the investigator must travel through the reservoir collecting samples rather than wait for the water to pass a certain station, due to slower water travel.

(f) Studies have been made in Cherokee, Douglas, Fort Loudoun, and Watts Bar Reservoirs, and are being continued.

(g) It is found that water entering a reservoir does not intermix with the rest of the reservoir, but remains as a density current as a result of the difference in temperature between the inflowing water and that in the reservoir. For example, during certain seasons of the year, in Watts Bar Reservoir the cold water released from Norris Reservoir passes upstream along the bottom of the Emory River arm of the former reservoir.

THE UNIVERSITY OF BRITISH COLUMBIA, Department of Civil Engineering, Vancouver, Canada.

(788) FISHWAY MODEL STUDIES.

(b) International Pacific Salmon Fisheries Commission.

(c) Edward S. Pretious, Professor of Civil Engineering, University of British Columbia, Vancouver, Canada.

(d) Experimental; basic research and for design.

(e) Basic research on the limitations of vertical-slot fishways and weir-type fishladders. Model studies to determine the best design of a vertical rectangular channel and diffusion chamber to convey auxiliary water to the entrance of the proposed low-level fishways at Hell's Gate Canyon, Fraser River, B. C.

(f) Completed.

(g) Vertical slot fishways are best suited for large variations in river stage. Weir type fishladders operate best with controlled headwater conditions as in dams.

(789) MOVABLE-BED, TIDAL MODEL OF THE FRASER RIVER, B. C.

(b) In conjunction with the National Research Council of Canada for the Public Works Department of Canada.

(c) Edward S. Pretious, Professor of Civil Engineering, University of British Columbia, Vancouver, Canada.

(d) Experimental; applied research for design, operation, and development.

(e) To determine the best means of maintaining navigational channels in the main channel and north arm of the Fraser River extending from New Westminster to the Strait of Georgia, a distance of approximately 17 miles.

(f) Active.

(h) All findings will be released by the National Research Council, Ottawa, Canada.

McGILL UNIVERSITY, Department of Civil Engineering and Applied Mechanics, Montreal, Canada.

(790) STUDIES IN WATER HAMMER.

(b) Laboratory project.

(c) Prof. Carleton Craig, Department of Civil Engineering and Applied Mechanics, McGill University, Montreal, Canada.

(d) Experimental; for master's thesis.

(e) Tests are projected for the study of the pressure-time variation associated with direct and reflected pressure surges produced by various terminations of the pipe line.

(f) Active.

ECOLE POLYTECHNIQUE DE MONTREAL, Hydraulics Laboratory, Montreal, Canada.

(266) HYDRAULIC MODEL STUDIES OF DIFFERENT SPILLWAY PROFILES.

(b) Laboratory project.

(c) Prof. Raymond Boucher, Ecole Polytechnique de Montreal, Montreal 18, Canada.

(d) Experimental; applied research.

(e) To establish a comparison between the discharge capacities of different spillway designs. Studies are made on concrete models of existing and recommended spillway profiles. Pressure distribution on spillway faces and coefficients of discharge are determined for various heads up to the designed head. The effect of gate piers of various design is also investigated. Seven different profiles have been studied, including two modifications of the Creager-Justin profile upstream of crest line.

(f) Suspended until the Spring of 1949.

(267) MODEL TESTS OF A LOG FLUME CONTROL SECTION.

(b) The Shawinigan Engineering Company, Ltd., Montreal.

(c) Prof. Leonard Cartier, Ecole Polytechnique, Montreal 18, Canada.

(d) Experimental; for design.

(e) 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. Tests on a 1:7.5 model were made to determine discharge coefficients. Profiles of the nappe were also obtained.

(f) Completed.

(h) "Model tests of a log flume control section", Leonard Cartier. Laboratory report submitted to the Shawinigan Engineering Company, Ltd., Montreal, July 1948.

(268) CALIBRATION TESTS OF A SHARP-CRESTED PARABOLIC WEIR.

(b) Laboratory project.

(c) Prof. Raymond Boucher, Ecole Polytechnique de Montreal, Montreal 18, Canada.

(d) Experimental; applied research.

(e) To obtain the head-discharge curves and head-discharge coefficient curves for a sharp-crested parabolic weir (21-inch maximum width by 18-inch maximum height) having a capacity of 3 cfs. This weir is to be used in a new flume for model testing and open channel studies.

(f) Active. Additional tests are needed before preparing the final report.

(791) NEW METHOD OF UTILIZING THE WATER HAMMER FOR THE DETECTION OF LEAKS IN PIPES.

(b) Laboratory project.

(c) Prof. Andre Leclerc, Ecole Polytechnique de Montreal, Montreal 18, Canada.

(d) Experimental; applied research.

(e) To develop a very sensitive recorder for pressure waves in pipes to be used for the location of leaks in distribution systems.

(f) The apparatus is being designed.

NATIONAL RESEARCH COUNCIL, Division of Mechanical Engineering, Ottawa, Canada.

Inquiries concerning Projects Nos. 475 and 792 to 795, incl., should be addressed to The Director, Division of Mechanical Engineering, National Research Council, Ottawa, Canada.

(475) DESIGN OF TERMINAL DIFFUSERS.

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

(e) It was desired to install conical diffusers on the ends of the pipes supplying the laboratory flume to reduce turbulence and recover a portion of the velocity head. Space limitations precluded the use of conventional long cones, and experiments were begun on wide angle cones with vanes to induce rotation in the water.

(f) The project is suspended.

(g) Good efficiencies were obtained with wide angle cones fitted with guide vanes at the entrance. Other designs are to be investigated.

(792) DIVERSION OF LOGS FROM A POWER PLANT INTAKE.

(b) Laboratory project. (d) Experimental; for design.

(e) The hydro-electric power plant being studied obtains its water through a short canal which enters the storage pond near a log chute. Considerable difficulty is experienced in preventing logs from entering the canal when the plant is operating under full load, and conditions are expected to become much worse when the capacity of the plant is increased. A 1:100 model is being used for a general investigation of the problem.

(f) Active.

(g) Moving the entrance of the log chute away from the power canal produced some improvement, but the cost of such a modification would be prohibitive. The use of improved guide booms will be studied.

(793) MODEL TESTS OF SPILLWAY.

(b) Department of Agriculture, Canada. (d) Experimental; for design.

(e) A 1:60 model of a complete spillway comprising a 12-bay inlet, transition section, rectangular canal, and chute has been constructed to investigate the design with a view to making modifications which will reduce the cost.

(f) Active.

(g) A number of details have been investigated and minor modifications made.

(794) MODEL TESTS OF LOG CHUTE.

(b) Power Corporation of Canada, Ltd., Montreal.

(d) Experimental; for design.

(e) A 1:12 model of the entrance to a log chute was constructed to determine the characteristics of a proposed design.

(f) Experimental work is almost completed.

(g) A design has been obtained which has a smooth water surface over a range of operating heads and which will not be blocked by logs under severe operating conditions.

(795) SELF-PROPELLED SHIP MODEL TESTS.

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

(e) Two self-propulsion dynamometers have been constructed, and will be fitted in model hulls. Propeller casting apparatus is to be provided.

(f) Active.

UNIVERSITY OF TORONTO, Department of Mechanical Engineering, Toronto, Canada.

(796) EFFECT OF PIER SHAPE AND SPACING ON THE DISCHARGE OVER SPILLWAYS.

(b) Laboratory project.

(c) Prof. G. Ross Lord, Department of Mechanical Engineering, University of Toronto, Toronto, Canada.

(d) Experimental; for master's thesis and for design.

(e) Various shapes, sizes, and spacings of piers have been tested on the crest of a spillway.

(f) Active.

FOREIGN PUBLICATIONS

The foreign publications which have been received by the agencies listed below are available on loan, unless otherwise indicated. Requests should be directed to the agency indicated.

ILLINOIS STATE WATER SURVEY DIVISION, Urbana, Ill.

Direct inquiries to Max Suter, Engineer, Illinois State Water Survey Division, Urbana, Ill.

Schweiz. Bauzeitung (German and French).

Monatsbulletin Schweiz. Verein von Gas und Wasserfachmännern (German and French).

La Technique Sanitaire et Municipale (French).

ROCKY MOUNTAIN HYDRAULIC LABORATORY, Allenspark, Colo.

Direct inquiries to Prof. C.J. Posey, Director, University of Iowa, Iowa City, Ia.

The Central Board of Irrigation Journal, Silma S.W. (India).

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station, Vicksburg, Miss.

Direct inquiries to the Director, Waterways Experiment Station, Corps of Engineers, P.O. Box 631, Vicksburg, Miss.

AUSTRALIA

Australia Council for Scientific and Industrial Research, Journal, Vol. 20, No. 4, Nov. 1947; Vol. 21, No. 1, Feb. 1948.

Institution of Engineers, Australia, Journal, Vol. 19, No. 9/12, Oct.-Dec. 1947.

Caine, H.G. — "Rolled fill and rock fill dams in U.S.A." Melbourne and Metropolitan Board of Works, Water Supply Branch, 1947.

CANADA

Engineering Journal (Canada), Vol. 30, No. 10+, Oct. 1947+.

CHINA

Cotton, John S. — "Report on investigation and planning the development of the Yellow River Basin, China." Studies on Yellow River project, Pub. No. 11, Supreme Economic Council, Nanking, China, 1947. (In English.)

Huang, W.H. — "Water and soil conservation of the Yellow River Basin." Studies on Yellow River project, Pub. No. 5, Supreme Economic Council, Nanking, China, 1947. (In English.)

Ting, S. — "Geology and soils of the Yellow River Basin." Studies on Yellow River project, Pub. No. 3, Supreme Economic Council, Nanking, China, 1947. (In English.)

CZECHOSLOVAKIA

Bratránek, Alois — "Critical discharge in open channels." Statni Ustav Hydrologicky T.G. Masaryka. Práce a studie No. 56. Prague, 1946. (In Czech with summaries in Russian and English.)

Bratránek, Alois — "Velocity formulae for flow in open channels." Statni Ustav Hydrologicky T.G. Masaryka. Práce a studie No. 61. Prague, 1946. (In Czech with summaries in Russian, English, and French.)

Cabelka, Jar — "Locks filled under the sill." Statni Ustav Hydrologicky T.G. Masaryka. Práce a studie No. 59. Prague, 1946. (In Czech with summaries in Russian, English, and French.)

Lískovec, Ladislav — "The protection of the stop grooves in weir piers from the effects of discharge under lifting gates." Statni Ustav Hydrologicky T.G. Masaryka. Práce a studie No. 55. Prague, 1946. (In Czech with summaries in Russian, English, and French.)

Lískovec, Ladislav — "Spillway of a dam." Statni Ustav Hydrologicky T.G. Masaryka. Práce a studie No. 70. Prague, 1948. (In Czech with summary in English.)

Malíšek, Anselm — "Barrage-reservoir a Usti sur la riviere Orava plan d'exploitation." Statni Ustav Hydrologicky T.G. Masaryka. Práce a studie No. 67. Prague, 1947. (In Czech with summary in French.)

EGYPT

Hurst, H.E.
Phillips, P. — "The Nile basin." Vol. 2, "Measured discharges of the Nile and its tributaries." Ministry of Public Works, Physical Department paper No. 28. Cairo, 1932.

Hurst, H.E.
Black, R.P.
Simaika, Y.M. — "The Nile basin." Vol. 7, "The future conservation of the Nile." Ministry of Public Works, Physical Department paper No. 51. Cairo, 1946.

ENGLAND

"The civil engineer in war, a symposium of papers on war-time engineering problems." Institution of Civil Engineers, London, 1948.
Vol. 1, "Airfields, roads, railways, and bridges."
Vol. 2, "Docks and harbours."
Vol. 3, "Properties of materials, structures, hydraulics, tunnelling, and surveying."

Engineering (London), Vol. 164, No. 4262+, Oct. 1947+.

Institution of Civil Engineers (London), Journal, Vol. 29+, Nov. 1947+.

"Estuary of the River Mersey." Water pollution research, Technical paper No. 7, Great Britain Department of Scientific and Industrial Research. London, H.M.S.O., 1938.

Gibson, A.H.
Aspey, T.S.
Tattersall, Fred — "Experiments on siphon spillways." Institution of Civil Engineers, London, 1931.

FRANCE

Le Génie Civil, Vol. 124, No. 19+, Oct. 1947+.

La Houille Blanche, No. 5+, Sept.-Oct. 1947+.

"Automatic multiple level recorder developed at the Neyrpic Laboratory of Grenoble", by Yver. Neyrpic Hydraulic Laboratory, Grenoble, June 1948.

"Automatic regulation in model studies of the downstream flow

in open curves." Neyrpic Hydraulic Laboratory, Grenoble.

"Cathode surface level indicator." Neyrpic Hydraulic Laboratory, Granoble, June, 1948.

"Proportional flow divisor." Neyrpic Hydraulic Laboratory, Grenoble.

Biesel, F. "Wave filter (system Neyrpic)." La Houille Blanche, May-June 1948: 275-290.

Danel, P. "Siltometer. Measurement of suspension load." Neyrpic Hydraulic Laboratory, Grenoble, 1948. Translated by George F. Dixon, June 1948.

Dixon, G.F. "Model construction method." Grenoble, 1948.

Favre, Henry "Étude theorique et expérimentale des ondes de translation dans les canaux decouverts." (Theoretical and experimental study of waves of translation in open channels.) Paris, Dunod, 1935.

Goguel, Jean "Repartition des contraintes autour d'un tunnel cylindrique." Annales des Ponts et Chaussees, Vol. 117, No. 2: 157-183. Mar.-April 1947. (Photostatic copy.)

Langer, Charles "Quelques caracteristiques du sable boulant." (Some characteristics of quicksand.) Compte Rendu Recherches Effectues l'annee 1938. Laboratories du Batiment et des Travaux Publiques, Vol. 15: 28-32.

GERMANY

Bauplanung und Bautechnik, No. 5+, May 1948+.

Oesterhaus, Max "Mehrjährige periodische Schwankungen der Abflussmengen des Rheins bei Basel, versuch einer Vorausberechnung der mittleren jährlichen Abflussmenge." Summary. Eidg. Amtes für Wasserwirtschaft. Mitteilung No. 38. (In English.)

Proetel, H. "Modellversuche und Planungen für die Ausbildung der Schwingschleusen." (Model tests and studies for the design of locks utilizing the kinetic energy of the water.) Die Bautechnik, Vol. 25: 3-15, Jan. 1948. (Photostatic copy.)

Winkel, Richard "Besondere Wellenerscheinungen in Schiffahrtkanalen infolge von Schleusungen. (Unusual wave action in navigable channels caused by gates or locks.) Die Bautechnik, Vol. 9: 110-111. (Photostatic copy.)

INDIA

Central Board of Irrigation, Abstracts, No. 90+, Oct. 1947+.

Central Board of Irrigation, Journal, Vol. 5, No. 1+, Jan. 1948+.

"The standing wave or hydraulic jump." Central Board of Irrigation, Pub. No. 7, Simla, 1934.

Indian Engineering, Vol. 122, No. 4+, Oct. 1947+.

Khosla, A.N.
Bose, N.K.
Taylor, E.M. "Design of weirs on permeable foundations." Central Board of Irrigation, Pub. No. 12, Simla, 1936.

Lacey, Gerald "Regime flow in incoherent alluvium." Central Board of Irrigation, Pub. No. 20, Simla, 1939.

NETHERLANDS

De Ingenieur, Vol. 59, No. 40+, Oct. 1947+.

"Hydraulic research, 1938-1947." Vol. 3, Oct. 1947. International Assn. for Hydraulic Structures Research, Delft, 1947. (Text in French and English.)

SWEDEN

Teknisk Tidskrift, Vol. 77, No. 40-52, Oct.-Dec. 1947; Vol. 78, No. 25-38, June-Oct. 1948.

SWITZERLAND

Schweizerische Bauzeitung, No. 41-45, 47+, Oct. 1947+.

U. S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS, National Hydraulic Laboratory, Washington, D. C.

Direct inquiries to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C.

ARGENTINE

Langmann, F.F. — "Contribución al estudio del coeficiente de derrame de los orificios." (Contribution to the study of the coefficient of discharge of orifices.) Reprint, Publicaciones de la Facultad de Ciencias Fisicomatemáticas, No. 150, Revista, pp 183-205. La Plata, 1941. (In Spanish.)

AUSTRIA

Grzywienski, Anton — "Das Draukraftwerk Schwabeck." (The Schwabeck Hydroelectric Plant.) Reprint, Österreichische Bauzeitschrift, Heft 4-5-6. Verlag Springer, Vienna, 1948. (In German)

Grzywienski, Anton — "Flusskraftwerke und Stromwerke." (River power plants and power plants combined with navigation structures.) Springer-Verlag, Vienna, 1948. (In German.)

BELGIUM

Jorissen, André — "Conformation de l'écoulement autour d'une plaque plane placée normalement à la direction du courant. Tracé des lignes de courant et recherche de la vitesse en chaque point dans le cas d'un écoulement plan." (Conformation of discharge around a flat plate placed normally to the direction of the current. Tracing of lines of flow and evaluation of velocities at each point for the case of two-dimensional flow.) Hydraulique Générale No. 39, Université de Liége, Bruxelles, 1943. Reprint, Bulletin de la Société royale des Sciences de Liége, No. 6, June 1943, pp 496-506. (In French.)

Jorissen, André — "Considérations sur l'emploi du déversoir rectangulaire en mince paroi sans contractions latérales." (Considerations on the use of a sharp-crested rectangular weir without end contractions.) Cours d'Hydraulique Générale No. 30, Université de Liége, 1939. Reprint, Revue Universelle des Mines, 8e Série, Vol. XV, No. 9, Sept. 1939. (In French.)

Jorissen, André — "Contribution a l'étude du déversoir circulaire en mince paroi." (Contribution to the study of the sharp-crested circular weir.) Hydraulique Générale, Université de Liége, 1943. Reprint, Revue Générale de l'Hydraulique, No. 31, Jan.-Feb. 1943. (In French.)

Jorissen, André — "Étude expérimentale du transport solide des cours d'eau." (Experimental study of the transport of solids in streams.) Cours d'Hydraulique Générale No. 19, Université de Liége. Reprint, Revue Universelles des Mines, 8e Série, Vol. XIV, No. 3, March 1938. (In French.)

Jorissen, André — "L'analyse dimensionnelle et la similitude en hydraulique."

(Dimensional analysis and similitude in hydraulics.) Bulletin Scientifique de l'Association des Élèves des Écoles Spéciales, Université de Liége, 35me Année, No. 6: 171-204, April 1938. (In French.)

Jorissen, André — "La mesure des débits aux petits nombres de Reynolds." (Measurement of discharge for small Reynolds numbers.) Conférence du Cercle d'Études Mécanique, Section de Liége, April 4, 1944. (Mimeographed.) (In French.)

Jorissen, André — "Mesure des débits par déversoirs en mince paroi." (Measurement of the discharge over sharp-crested weirs.) Conférence du Cercle d'Études Mécanique, Nov. 9, 1943. (Mimeographed.) (In French.)

Jorissen, André — "La mesure des débits par la méthode chimique." (The measurement of discharge by the chemical method.) Conférence du Cercle d'Études Mécanique, Section de Liége, April 4, 1944. (Mimeographed.) (In French.)

Jorissen, André — "Le déversoir circulaire en mince paroi." (The sharp-crested circular weir.) Cours d'Hydraulique Générale No. 24, Université de Liége. Reprint, Revue Universelle des Mines, 8me Série, Vol. XIV, No. 12, Dec. 1938. (In French.)

Jorissen, André — "Note sur la répartition du débit de la conduite d'adduction dans un réseau maillé." (Note on the distribution of discharge from a supply conduit in a network.) Cours d'Hydraulique Générale No. 21, Université de Liége. Reprint, Revue Universelle des Mines, 8me Série, Vol. XIV, No. 9, Sept. 1938. (In French.)

Jorissen, André — "Réflexions sur l'emploi du tube de Pitot pour la mesure des vitesses des courants." (Reflections on the use of the Pitot tube for measuring velocities of currents.) Cours d'Hydraulique Générale No. 37, Université de Liége. Reprint, Mémoires de l'Association des Ingénieurs sortis de l'École de Liége, No. 1, 1943. (In French.)

Jorissen, André — "Sur le coefficient de débit des déversoirs en mince paroi." (On the coefficient of discharge of sharp-crested weirs.) Reprint, Assoc. Franç. P. Avanc. des Sciences, Liége, 1939, pp 73-81. (In French.)

Jorissen, André — "Sur le transport de particules solides par un courant fluide." (On the transport of solid particles by a fluid current.) Cours d'Hydraulique Générale No. 38, Université de Liége. Reprint, Mémoires de l'Association des Ingénieurs sortis de l'École de Liége, No. 1, 1943. (In French.)

Jorissen, André
Ledent, Pierre — "Tarage et utilisation des anémomètres a ailettes." (Calibration and use of vane anemometers.) Hydraulique Générale No. 50, Université de Liége. Reprint, Revue Universelle des Mines, 9e Série, Vol. II, No. 7, 1946. (In French.)

Lamoen, J. — "Essais sur modèles réduits pour des barrages-déversoirs. Première partie: Étude des effets d'échelle." (Model tests for dam spillways. First part: Study of scale effects.) Reprint, Bulletin du Centre d'Études, de Recherches et d'Essais scientifiques des Constructions du Génie civil et d'Hydraulique fluviale (Tome III, 1948), pp 359-503. (In French.)

Schlag, Albert
Jorissen, André — "Contribution a la normalisation des tubes venturi." (Contribution to the standardizing of venturi tubes.) Hydraulique Générale, Université de Liége. Reprint, Revue Générale de l'Hydraulique, Nos. 37-38, Jan.-Feb., Mar.-April 1947. (In French.)

Schlag, Albert
Jorissen, André — "Contribution a l'étude de l'écoulement en conduites de sections autres que circulaires." (Contributions to the study of discharge in conduits with sections other than circular.) Université de Liége. Reprint, Revue Générale de l'Hydraulique,

No. 33, May-June 1943. (In French.)

Schlag, Albert
Jorissen, André — "Essais sur modèles." (Model tests.) Reprint, Revue Universelle des Mines, 9e Série, Vol. IV, No. 1, Liége, 1948.

Schlag, Albert — "Les appareils déprimogènes de mesure des débits: le coefficient de débit des Venturi à tuyère normalisée." (Secondary means of measuring discharge: The coefficient of discharge of Venturis of standard form.) Reprint, L'Ouvrage, Hommage de la Faculté des Sciences appliquées à l'Association des Ingénieurs sortis de l'École de Liége à l'occasion de son centenaire, Liége, 1947.

CANADA

"Surface water supply of Canada, Atlantic Drainage (South of St. Lawrence River), New Brunswick, Nova Scotia, and Prince Edward Island, Climatic years 1942-43 and 1943-44." Dominion Water and Power Bureau Water Resources Paper No. 96, Canada Department of Mines and Resources. Ottawa, 1948.

CHINA

"Studies on Yellow River Project." Public Works Commission, Supreme Economic Council, Nanking, China: (In English.)

"Purpose and scope of the Yellow River project studies." Pub. No. 1, June 1947.

"General description of the Yellow River Basin." Pub. No. 2, June 1947.

"Geology and soil of the Yellow River Basin." Pub. No. 3, June 1947.

"Hydrology of the Yellow River." Pub. No. 4, June 1947.

"Water and soil conservation of the Yellow River Basin." Pub. No. 5, June 1947.

"Regulation of the Lower Yellow River." Pub. No. 9, June 1947.

"Preliminary report on Yellow River project." Pub. No. 10, May 1947.

"Report on investigation and planning the development of the Yellow River Basin." Pub. No. 11, May 1947.

CZECHOSLOVAKIA

"Sborník Státního Ústavu Hydrologického T. G. Masaryka v Praze." (Bulletin of the T. G. Masaryk National Hydrological Institute, Prague.) 1947. Prague, 1948. (In Czech.)

Novák, Pavel — "Stabilita hranolovitých těles na dně vodního proudu." (Stability of blocks on the bed of a stream of water.) Práce a studie No. 68, Státní Ustav Hydrologický T. G. Masaryka v Praze, Prague, 1948. (In Czech, with Russian, French, and English summary.) (The National Hydraulic Laboratory also has an English translation of this publication.)

ENGLAND

Bowden, K.F. — "Some observations of waves and other fluctuations in a tidal current." Reprint, Proc. Royal Society, A, London, Vol. 192, 1948, pp 403-425.

Docherty, A.C.
Ritchie, Mowbray — "Thermal diffusion in some aqueous solutions." Reprint, Proc. Royal Society of Edinburgh, Section A, Vol. LXII, Part III, No. 31: 297-304. London, 1948.

Guelke, R.W.
Schoute-Vanneck, C.A. — "The measurement of sea-water velocities by electromagnetic induction." Reprint, Journal of the Institution of Electrical Engineers, Vol. 94, Part II, No. 37, Feb. 1947. London.

Ritchie, Mowbray — "An elementary treatment of thermal diffusion in gaseous and liquid systems." Reprint, Proc. Royal Society of Edinburgh,

Section A, Vol. LXII, Part III, No. 32:305-315. London, 1948.

FRANCE

La Houille Blanche, Jan. 1947 to June 1948.

Liste I. Recherches theoriques et experimentales effectuees par les Laboratoires d'Hydraulique de l'Université de Toulouse de 1938 a 1947. (List of theoretical and experimental research at the hydraulic laboratories of the University of Toulouse from 1938 to 1947.) (Typed summary of projects.) (In French.)

Bibliographie des recherches d'hydraulique executees aux laboratoires de l'Institut Electrotechnique et de Mecanique Appliquee de l'Université de Toulouse. (List of publications covering work done at the laboratories of the National College of Engineering at Toulouse.) (Mimeographed; in French.)

Camichel, C.
Beau, M.
Escande, L.

"La similitude des ouvrages courts; expériences sur la grande forme de radoub du port du Havre." (The similitude of short structures (completely turbulent flow); tests of the large form of dock at the port of Havre.) Reprint, La Technique Moderne, Vol. XXIV, No. 24, Dec. 15, 1932, Paris. (In French.)

Camichel, C.
Crescent, C.
Escande, L.

"Les évacuateurs de crues a galerie souterraine." (Discharge of flood waters through tunnels.) Reprint, La Technique Moderne, Vol. XXV, Nos. 17-18, July.-Aug. 1933, Paris. (In French.)

Camichel, C.
duSablon, J.L.
Escande, L.

"Recherches sur la similitude des phénomenes hydrauliques." (Research on the similitude of hydraulic phenomena.) Reprint, Génie Civil, April 18-25, 1931, Paris. (In French.)

Coutagne, A.

"l'indice d'évaporation et le déficit d'écoulement aux États-Unis." (The coefficient of evaporation and the runoff deficiency in the United States.) Reprint, Revue Générale de l'Hydraulique, No. 29, Sept.-Oct. 1939, pp 263-274. Paris. (In French.)

Escande, L.

"Cavitations au départ des conduites forcées limiteurs de débit." (Cavitation at intakes of pressure conduits; discharge limiters.) Reprint, Revue Générale de l'Hydraulique, No. 17, Sept.-Oct. 1937. Paris. (In French.)

Escande, L.

"Méthodes nouvelles pour le calcul des chambres d'équilibre." (New methods for the calculation of surge tanks.) Reprint, Génie Civil, July-Oct. 1946, June-Oct. 1947. Paris. (In French.)

Escande, L.

"Étude théorique et expérimentale de l'écoulement par vanne de fond." (Theoretical and experimental study of discharge under a gate. Part I.) Reprint, Revue Générale de l'Hydraulique, Nos. 19-20-21, Jan.-Feb., Mar.-April, May-June 1938. Paris. (In French.)

Escande, L.

"Méthode graphique pour l'étude des oscillations dans une chambre d'équilibre dont le canal d'amenée collecte des apports de débit par des puits de section négligeable." (Application a l'usine d'olette de la S.N.C.F.) (Graphical method for the study of oscillations in a surge tank where the supply conduit collects discharge from wells (branches) of negligible cross-section.) Reprint, La Houille Blanche, Nos. 4-5, July-Oct. 1947. (In French.)

Escande, L.

"Détermination pratique du profil optimum d'un barrage-déversoir. Tracé des piles par les méthodes aérodynamiques. Application à un ouvrage déterminé." (Practical determination of the optimum profile for a dam spillway. Determining pier shapes by aerodynamical methods. Application to a particular project.) Reprint, Science et Industrie, Sept.-Oct. 1933. (In French.)

Escande, L.

"Recherches théoriques et expérimentales sur les oscillations

830893 O—49——13

de l'eau dans les chambres d'équilibre." (Theoretical and experimental research on the oscillations of water in surge tanks.) Publications Scientifiques et Techniques de la Direction des Industries Aéronautiques, Institut de Mécanique des Fluides de l'Université de Toulouse, No. 187, Paris, 1943. (In French.)

Escande, L. "Compléments d'hydraulique. Première partie." (Theoretical and experimental studies of various hydraulic problems.) Publications de l'Institut Electrotechnique et de l'Institut de Mécanique des Fluides de l'Université de Toulouse. Toulouse, 1947. (In French.)

Escande, L. "Hydraulique générale." 3 volumes. (A general theoretical treatise on hydraulics.) Édouard Privat, Libraire-Éditeur, 14, Rue des Arts, Toulouse, 1947. (In French.)

Léviant, I. "Étude sur les écoulements variés en canal découvert." (Study of varied flow in an open channel (hydraulic jump).) Reprint, Revue Générale de l'Hydraulique, Nos. 38-40, Mar.-April, July - Aug. 1947, Paris. (In French.)

Miche, Robert "Détermination par un principe variationnel du mouvement non lent des fluides visqueux. Application aux houles du large." (Determination of the rapid (or rapidly changing) movement of viscous fluids by a variational principle. Application to waves of large extent.) Reprint, Revue Générale de l'Hydraulique, Nos. 41-42, Sept.-Oct., Nov.-Dec. 1947, Paris. (In French.)

GERMANY

Böss, P.
Müller, H.P. "Experimentelle und theoretische Untersuchungen zur Ermittlung einer neuen Dachwehrform." (Experimental and theoretical researches for devising a new form of roof weir.) Reprint, Bauplanung und Bautechnik, Bd. 1, No. 2, Aug. 1947, pp 53-61, Brenz. (In German.)

HUNGARY

"Vízügyi Közlemények." (Hydraulic Proceedings.) Hungarian Ministry of Agriculture - Water Board. Budapest. Nos. 1-4, 1945. Nos. 1-4, 1947. No. 1, 1948. (In Hungarian, with English, French and German abstracts.)

Zoltán, Károlyi "Kísérletek a hordalékfogóval." (Experiments with bed load traps.) Reprint, Vízügyi Közlemények, Nos. 1-4, 1947. Budapest. (In Hungarian, with German and English abstracts.)

INDIA

Framji, K.K. "Annual report (technical) of work done during the year 1946." Research publication No. 11, Indian Waterways Experiment Station, Poona, 1947.

Vol. II. "Rain gauge station maps of India, Burma and Ceylon."

Inglis, Claude "Annual report (technical) of work done during the year 1944, and index for 1940-44." Research publication No. 9, Indian Waterways Experiment Station, Poona, 1945.

Iyer, V.G. "Annual report of work done during the year 1947." Research publication No. 2, Hydraulic Research Station, Krishnarajasagar, Government of Mysore, Bangalore, 1948.

ITALY

"Convegno di idraulica, promosso dal centro veneto di ricerche idrauliche del Consiglio Nazionale delle Ricerche, Padova, 13 Ottobre, 1947." (Convention on hydraulics, sponsored by the Central board of Hydraulic Research of the National Research Council.) (Papers on penstocks and supply conduits.) Società

Editrice Riviste Industrie Elettriche, Milan, 1948. (In Italian.)

Caloi, Pietro — "Notevoli onde interne (sesse termiche) nel lago di Garda." (Internal waves in Lake Garda.) Pubblicazioni No. 127, dell' Istituto Nazionale di Geofisica, Rome, 1947. (In Italian.)

Ghetti, Augusto — "Sul colpo d'ariete nelle condotte tra cui è inserita una turbina idraulica." (On surges in a conduit in which there has been inserted an hydraulic turbine.) Reprint, L'Elettrotecnica, Vol. XXXV, No. 3: 99-118, March 1948. (In Italian.)

Marchetti, Mario — "Efflusso da lancie e bocchelli antincendi; risultati sperimentali." (Efflux of jets and fire nozzles; experimental results.) Memorie e Studi No. 67, dell'Istituto di Idraulica e Costruzioni Idrauliche del Politecnico di Milano. Reprint, Il Pompiere Italiano, Fasc. 5-6, Milan, 1947. (In Italian.)

Marzolo, Francesco — "Gallerie a pressione con possibilità di sfioramenti lungo il percorso." (On pressure tunnels with the possibility of discharge along their course.) Reprint, L'Energia Elettrica, Fasc. VI, Vol. XXIII, 1946. (In Italian.)

Marzolo, Francesco — "Sul principio dell'idrogramma unitario nello studio delle portate dei corsi d'acqua naturali." (On the principle of the unit hydrograph in the study of the discharge of natural streams.) Reprint, L'Energia Elettrica, Fasc. VIII, Vol. XXIII, 1946. (In Italian.)

Ramponi, Francesco — "Sui pozzi piezometrici; muniti di strozzatura alla base." (On piezometric wells with constructions at the base.) Reprint, L'Energia Elettrica, Fasc. IX-X-XI-XII, Vol. XX, Sept.-Dec. 1943, Milan. (In Italian.)

Ramponi, Francesco — "Sulle oscillazioni nei pozzi piezometrici per manovre alterne ripetute." (On oscillations in piezometer wells caused by periodic actions.) Reprint, L'Energia Elettrica, Fasc. III, Vol. XXIII, March 1946, Milan. (In Italian.)

di Ricco, Guido — "Edificio di misura ad equazione di portata lineare." (Measuring apparatus with linear discharge relation.) Rivista del Catasto e dei Servizi Tecnici Erariali, Anno VII, No. 3, May-June 1940, XVIII: 293-309; Anno VII, No. 4, July-Aug. 1940, XVIII: 416-427. (In Italian.)

Scimemi, Ettore — "Sulla forma da assegnare alle dighe sfioranti." (On the form to be chosen for overflow spillways.) Reprint, L'Energia Elettrica, Fasc. VI, Vol. XXIII, June 1946, Milan. (In Italian.)

MONACO

Carruthers, J.N. — "Realism in current-measuring in the upper layers of the sea." Extract, International Hydrographic Review, Vol. XXIV, Monaco, 1947.

Doodson, A.T. — "Storm surges." Extract, International Hydrographic Review, Vol. XXIV, Monaco, 1947.

Doodson, A.T. — "Tide models." Extract, International Hydrographic Review, Vol. XXIV, Monaco, 1947.

Doodson, A.T. — "Tides in shallow water." Extract, International Hydrographic Review, Vol. XXIV, Monaco, 1947.

POLAND

Bergsten, Folke — "The seiches of Lake Vetter and of Lake Tornetråsk." III Hydrological Conference of the Baltic States, Warsaw, May 1930. (In English.)

SWEDEN

Bergsten, Folke — "Metoder för bestämning av vindens inflytande på havets vattenstånd och deras tillämpning vid landhöjningsberäkningar."

(Methods for determination of the effect of winds on the level of the sea and their use in computations for determining land elevations.) Statens Meteorologisk-Hydrografiska Anstalt, Communications, Series of Papers No. 49, Norrköping, 1945. (In Swedish, with English summary.)

Bergsten, Folke — "The seiches of Lake Vetter." Thesis for the degree of Doctor of Philosophy, presented to the faculty of science in Stockholm, May 27, 1926. Centraltryckeriet, Stockholm, 1926. (In English.)

Fellenius, W. — "Ekonomiska problem inom vattenbyggnadstekniken." (Economic problems in the techniques of hydraulic structures.) Vattenbyggnadsinstitutionen vid Kungl. Tekniska Högskolan. Med. No. 10, May 1943. Reprint, Teknisk Tidskrift, Vol. 48, 1943. (In Swedish.)

Forssblad, Lars — "Effects of wind, waves, and current on floating timber." Kungl. Tekniska Högskolans Handlingar, publication No. 17 of the Institution of Hydraulics. Trans. Royal Institute of Technology, Stockholm, No. 11, 1947. (In English.)

Furuskog, Valter — "En ny laxtrappa." (A new salmon-ladder.) Vattenbyggnadsinstitutionen vid Kungl. Tekniska Högskolan. Reprint, Svenska Vattenkraftföreningens publikation 383, 1946: 4. (In Swedish.)

Hellström, Bo — "Vattenbyggnadsteknisk forskning vid Kungl. Tekniska Högskolan 1943-1944." (Hydraulic structures research at Royal Technical Highschool 1943-1944.) Vattenbyggnadsinstitutionen vid Kungl. Tekniska Högskolan, Med. No. 12. Reprint, Svenska Vattenkraftföreningens publikation 377, 1945: 7. (In Swedish.)

Hellström, Bo
Nilsson, L. B. — "Kortfattad hydraulik." (Summary of hydraulics.) Vattenbyggnadsinstitutionen vid Kungl. Tekniska Högskolan, Med. No. 16. Reprint, Bygg. Handbok för Hus-, Väg-, och Vattenbyggnad. (In Swedish.)

Johnsson, O.H. — "Termisk-hydrologiska studier i sjön Klämmingen." (Thermal-hydrological studies in the lake Klämmingen.) Vattenbyggnadsinstitutionen vid Kungl. Tekniska Högskolan, Med. No. 15. Reprint, Geografiska Annaler, 1946, Häft 1-2. (In Swedish, with English summary.)

Melin, R. — "Undersökningar vid Sveriges Meteorologiska och Hydrologiska Institut över vattendragens isförhållanden." (Studies of ice conditions in lakes and rivers at the Meteorologic and Hydrologic Institute of Sweden.) Sveriges Meteorologiska och Hydrologiska Institut, Med. Serie D, No. 1, Stockholm, 1947. (In Swedish, with English summary.)

Tham, Percy — "Närbildsfotogrammetrins användning vid vattenbyggnadstekniska modellförsök." (Use of close-up photogrammetry in hydraulic structures model research.) Vattenbyggnadsinstitutionen vid. Kungl. Tekniska Högskolan. Reprint, Teknisk Tidskrift 1945, häfte 43, Stockholm.

Vogt, Fredrik — "Valvdammar." (Arch dams.) Vattenbyggnadsinstitutionen vid Kungl. Tekniska Högskolan, Med. No. 9, April 1943.

U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, Denver, Colo.

Direct inquiries to The Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

BELGIUM

Schlag, Albert — "Les appareils deprimogenes de mesure des débits: le coefficient de débit des Venturi a tuyere normalisee." (Measurement of losses: coefficient of friction of losses in Venturi tubes.) University de Liége, 1947.

Schlag, Albert
Jorissen, André — "Essais sur modeles." (Model studies.) University de Liége, July 1, 1948.

CHINA

"Studies on Yellow River Project." Public Works Commission, Supreme Economic Council, Nanking, China. Publications Nos. 1-5, 9-11, 1947.

HUNGARY

"Vízügyi Közlemények." (Hydraulic Proceedings.) 1945 (1-4), 1946, and 1947 (1-4).

ITALY

Citrini, Duilio — "Ricerca sperimentale sulla diffusione di una vena liquida effluente in un campo di liquido in quiete." (Experiments on the diffusion of a current flowing into a field of still liquid.)

Contessini, Felice — "Sull'applicazione della serie di Fourier allo studio delle osservazioni termometriche in una diga massiccia." (The application of the Fourier's series to the study of heat in a mass concrete dam.)

Franzi, G. — "Sul moto dei liquidi con materie solide in sospensione." (On the motion of liquids with solids in suspension.)

de Marchi, Giulio — "Determinazion delle portate che la regolazione dei deflussi dal Lago Maggiore rendera' disponibili per le utilizzazioni." (Determination of the discharge which the regulation of the Lake Maggiore outlets will make available.)

de Marchi, Giulio — "Statuto." (Laws forming the Committee for the regulation of the River Ticino.)

NATIONAL RESEARCH COUNCIL, Ottawa, Canada.

Direct inquiries to J. H. Parkin, Director, National Research Council, Ottawa, Canada.

FRANCE

Laurent, Jean — "Le Laboratoire Central d'Hydraulique. Ses nouveaux aménagements; quelques essais effectués." Le Laboratoire Central d'Hydraulique. (In French.)

GERMAN

Publications issued by the Hamburgische Schiffbau-Versuchsanstalt, Hamburg:

"Nachstrom-Messgeräte." Bericht 155. August 1932. (In German.)

"Die Eichung des Pendeldynamometers." Bericht 200. October 1933. (In German.)

Kempf, Gunther — "Bericht über Berechnung des Schiffwiderstandes aus dem Modellwiderstand." Bericht 332. June 1936. (In German.)

Kempf, Gunther	"Modelltank-Conferenz, Berlin 1937. Bericht zu Punkt 6 (VXI)." Bericht 369. April 1937. (In German.)
Remners	"Ein neues Verfahren zur Durchführung von Rudermessungen an frei fahrenden und stevernden Schiffsmodellen." Bericht 867. June 1944. (In German.)
Schmierschalski	"Einfluss des Modellmasstabes auf den Widerstand mit Anhägen." Bericht 96. September 1931. (In German.)
Schmierschalski	"Der Innenantrieb." Bericht 239. May 1934. (In German.)
Schmierschalski	"Uber den Einfluss der Drucklagerbelastung auf die Leerreibung des HSVA-Innenantriebes." Bericht 365. Feb. 1936. (In German.)

SWEDEN

Publications issued by the Statens Skeppsprovningsanstalt (The Swedish State Shipbuilding Experimental Tank), Göteborg, Sweden:

Edstrand, Hans	"The effect of the air content of water on the cavitation point and upon the characteristics of ships' propellers." Med. No. 6, 1946. (In English.)
Hammar, Hugo	"Statens Skeppsprovingsanstalt." Med. No. 1, 1942. (Summary in English.)
Lindblad, Anders	"Experiments with bulbous bows." Med. No. 3, 1944. (In English.)
Lindblad, Anders	"Further experiments with bulbous bows." Med. No. 8, 1948. (In English.)
Marstrand, Jorgen	"Nogle praktiske og teoretiske undersgelser om modelpropellere." (Some practical and theoretical investigations of model propellers.) Med. No. 5, 1945. (Summary in English.)
Nordström, H.F.	"Försök med fiskebåtsmodeller." (Tests with fishing boat models.) Med. No. 2, 1943. (Summary in English.)
Nordström, H.F.	"Propellers with adjustable blades. Results of model experiments." Med. No. 4, 1945. (In English.)
Nordström, H.F.	"Screw propeller characteristics." Med. No. 9, 1948. (In English.)
Nordström, H.F.	"Some systematic tests with models of fast cargo vessels." Med. No. 10, 1948. (In English.)
Nordström, H.F. Freimanis, E.	"Modellförsök med en färja." (Model tests with a small ferry.) Med. No. 7, 1947. (Summary in English.)

TRANSLATIONS

Translations of foreign articles have been prepared at the laboratories listed below, and are available on loan. Requests should be directed to the agency indicated.

UNIVERSITY OF CALIFORNIA, College of Engineering, Berkeley, Calif.

Direct inquiries to Prof. R. G. Folsom, Department of Engineering, University of California, Berkeley 4, Calif.

Ehring, H.	"Kennzeichnung des gemessenen Seegangs auf Grund der Häufigkeitsverteilung von Wellenhöhe, Wellenlänge und Steilheit." (Characteristics of measured wave action on the basis of the frequency distribution of wave length, wave height, and steepness.) Technische Berichte 4: 152-155, 1940.
Mewes, E.	"Beiträge zur Frage der Größe der in Nord-und Ostsee vorkommenden Wellen." (Wave dimensions in the North Sea and Baltic.) Deutsche Versuchsanstalt für Luftfahrt, E. V. Institut für Seeflugwesen, Berlin-Adlershof, 1937.
Iribarren, R. Cavanilles	"Una formula para el calcula de los diques de escollera." (A formula for the calculation of rock-fill dikes.) July 1938. The wave forces on rock-filled dikes are determined for varying wave characteristics. The pressure distribution on the structure is shown.

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

Direct inquiries to C. H. Hancock, Director, Hydraulic Laboratory, Newport News Shipbuilding and Dry Dock Company, Newport News, Va.

de Haller, P.	"Application of the electric analogy to the study of vane grills." (French)

ROCKY MOUNTAIN HYDRAULIC LABORATORY, Allenspark, Colo.

Direct inquiries to Prof. C. J. Posey, Director, Rocky Mountain Hydraulic Laboratory, State University of Iowa, Iowa City, Iowa.

Massau, Junius	"Graphical integration of partial differential equations with special applications to flow in open channels." Translated by Henri J. Putman. 129 pp, 48 figures. ($2.00)

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

Direct inquiries to Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn. Translations prepared by Meir Pilch.

Barth, W. "Verdrängungsströmungen bei Rotation zylindrischer Schaufeln in einer Flüssigkeit mit freier Oberfläche." (Displacement flows produced by rotation of cylindrical blades in a liquid with free surface.) Mitteilungen des Institutes für Strömungsmaschinen der Technischen Hochschule Karlsruhe, Heft 1: 39-62. Verlag von R. Oldenbourg, München und Berlin. 1930.

Escande, Leopold "Sur la similitude des phénomènes d'entraînement d'air par l'eau en mouvement." (On the similitude of phenomena of air entrainment by water in motion.) Comptes rendus, 209: 626-627. 1939.

Hadamard, J. "Mouvement permanent lent d'une sphère liquide et visqueuse dans un liquide visqueux." (Steady slow motion of a liquid and viscous sphere in a viscous liquid.) Comptes rendus de l'Academie des Sciences, 152: 1735-1738. 1911.

Hahn, Karl "Die Untersuchung der Strömung durch eine Flügelradturbine bei verschiedenen Schaufelzahlen." (The investigation of the flow through a propeller turbine at various blade numbers.) Mitteilungen des Instituts für Strömungsmaschinen der Technischen Hochschule Karlsruhe, Heft 4: 1-40. Kommissions, Verlag des V.D.J. - Verlages, Berlin. 1939.

Karteweg, D. J. "Sur la forme que prennent les équations du mouvement des fluides si l'on tient compte des forces capillaires causées par des variations de densite considerable mais continues, et sur la théorie de la capillarité dans l'hypothèse d'une variation continue de la densité." (The form taken by the equations of motion of fluids if the capillary forces caused by variation of density are regarded as considerable but continuous, and the theory of capillarity based on the hypothesis of continuous variation of the density.) Archives Néerlandaises des Sciences Exactes et Naturelles, Ser. 2, 6: 1-27. 1901.

Rybczinski, W. "Über die fortschreitende Bewegung einer flüssigen Kugel in einem zähen Medium." (The progressive motion of a fluid sphere in a viscous medium.) Bulletin International de l'Academie des Sciences de Cracovie, Ser. A: 40-46. 1911.

Schmidt, Ernst "Über die Bewegungsverhältnisse von Gas-Flüssigkeitsgemischen." (Flow characteristics of gas-liquid mixtures.) V.D.I. 72, Hauptversammlund Trier. 1934.

Smoluchowski, Maryan "Über die Wechselwirkung von Kugeln, die sich in einer zähen Flüssigkeit Bewegen." (The interaction of spheres moving in a viscous fluid.) Academie des Sciences de Cracovie, 28-39. 1911.

Spannhake, W. "Eine strömungstechnische Aufgabe der Kreiselradforschung und ein Ansatz zu ihrer Lösung." (The presentation and solution of a hydraulic problem of turbo-machine research.) Mitteilungen des Institutes für Strömungsmachinen der Technischen Hochschule Karlsruhe, Heft 1: 1-38. München und Berlin. 1930.

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Reclamation, Denver, Colo.

Direct inquiries to The Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Arkhengelsky, B.V. "Eksperimentalnoe Issledovanie Tochnosti Skal Gidravlicheskoi Krupnosti Chastits." (Experimental investigation of the accuracy of elutriation scales used in grain-size distribution analysis.) Trans. Scient. Research Inst. of Hydrotech.,

A.S. Moscow, U.S.S.R., Vol. XV, 1935. Translated by I. Mittin and H. Marek, Jr., Oct. 1948. (Rough draft)

Discussion of the differences in the results of elutriation scales of different authors in the analysis of grain-size distribution of quartz particles and soils; comparison with the results of the scale by Stoke's formula; influence of water temperature on settling velocities. Development of author's sedimentation scale based on the results of numerous experiments with quartz sands.

Bratranek, Alois — "Dlouhodobe Predpovedi Vodnich Prutoku na Vltave ve Stechovicich pro Obdobi Sucha." (Long-term forecasts of discharges of the Moldrau (Vltava) River at Stechovice, Czechoslovakia, for dry periods.) Bulletin "Work and Studies" (Práce a Studie), National Hydrol. and Hydrotech. Institutes of T.G. Masaryk, Prague-Podlaba, Czechoslovakia. No. 29, 1938. Translated by H. Marek, Jr., Oct. 1948. (Rough draft)

Long-term forecasting of probable river discharges for dry seasons, especially summer and fall months, by means of curves under conditions of normally decreasing flow undisturbed by major precipitations.

Corbonell, A. y Trillo-Figueroa — "Antecedentes Para el Analisis en Hidrologia Subterranea. Notas sobre el movimiento de las aguas subterraneas." (Antecedents for analysis of ground-water hydrology. Notes on the movement of ground water.) Ingenieria y Construccion (Engineering and Construction), Madrid, Spain, Vol. 6: 25-30, 144-147, 426-429. 1929. Translated by H. Marek, Jr., Oct. 1946.

The permeability of water-bearing beds is determined by means of a "permeameter" and a careful evaluation of the water supply, velocity of percolation, particularly velocity of descent through beds, etc., for the comparison of its results with those furnished by rain gage in that area.

Drath, A. — "Pomiar z Praktyczne Znaczenie Porowatosci z Przepuszcalnosci Skal Roponosnych." (Measurement and practical importance of porosity and permeability of oil-bearing rocks.) Przemysl Naftovy (Oil Industry), Nat. Oil Assn., Lvov, Poland, Vol. IX, Nos. 4-5, Feb. 25-March 10, 1934. Translated by H. Marek, Jr., July 1946.

Description and measuring procedures of the hydrogen and air porozimeters for the determination of the volume of confined interconnected voids in rocks. Also Melcher's apparatus for permeability determinations.

Kastalsky, A.A. — "Raschet Otstoinikov Po Grafiku Kharakteristiki Nanosov." (The application of the sediment-characteristic graph in the design of settling tanks.) Gidrotekhnicheskoe Stroitelstvo (Hydrotech. Construction), Ind. Tech. and Econ. Journal of the Ministry of Hydrotech. Power Systems of the U.S.S.R., Moscow, No. 9: 14-17. Translated by H. Marek, Jr., Aug. 1948. (Rough draft)

Experimental determination of the sediment characteristics for different settling velocities by means of Spillner cylinder. Also an example of the design of a settling tank with the aid of the formulas developed.

Lefranc, Edouard — "Mesure de la permeabilitie des sols en place et ses applications." (Determinative method of the permeability of the soils in place and its application.) La Génie Civil, Paris, Vol. CXXV, No. 3235: 304-308, Aug. 15, 1948. Translated by A. D. McCullough, Oct. 1948. (Rough draft)

Meleshenko, N.T. — "Raschet Gruntovogo Potoka Dlia Sluchaia Ploskogo Fliutbeta, Imeiuschego Naklonnii Podstilaiuschchii Vodonepronichaemii Sloi."

(Calculation of ground-water flow under flat-bottomed structure, resting on porous soil, underlain by inclined watertight strata.) Trans. Scientific Research Inst. of Hydrotechnics, Leningrad, U.S.S.R., Vol. XVIII: 44-49, 1936. Translated by H. Marek, Jr., Sept. 1948. (Rough draft)

The solution to this problem has been obtained using the method proposed by N. N. Pavlovsky.

Nowotny, Hans — "Werkstoffzerstorung durch Kavitation - Untersuchungen am Schwinggerat." (Materials destruction through cavitation.) V.D.I., Berlin, 1921. Translated by Ferd Stenger, March 1948.

Tests carried out with high-frequency oscillator.

Ogilvi, A.A. — "Primenenie Metoda Estestvennogo Toka Dliia Opredeleniia Mest Filtratsii Vody Iz Vodokhranilishch." (Application of the method of natural flow for the determination of places of leakage from reservoirs.) Gidrotekhnicheskoe Stroitelstvo (Hydrotechnical Construction), Moscow, Indust. Tech. and Economic Journal of the Ministry of Hydroelectric Power Systems of the U.S.S.R., Vol. 15, No. 12: 21-22, 1946. Translated by I. Mittin and H. Marek, Jr., Sept. 1948.

General outline of the field test method and principles of its theory based on the induction of an electric field in the medium which encloses the moving fluid.

Ogilvi, A.A. — "Metod Opredeleniia In Situ Kaverznosti Porod." (Determinative method of porosity conditions of rock formations in place.) Gidrotekhnicheskoe Stroitelstvo (Hydrotech. Construction), Moscow, Indust. Tech. and Economic Journal of the Ministry of Hydroelectric Power Systems of the U.S.S.R., Vol. 15, No. 10: 25-26, 1946. Translated by I. Mittin and H. Marek, Jr., Sept. 1948.

Field procedures and theory for the determination of porosity coefficient of rocks under pressure by means of an indicator and pumping-in and pumping-out tests.

Pavlovsky, N.N. — "Osnovy Metoda Gidromekhanicheskogo Resheniia Zadachi O Svobodnoi Filtratsii Iz Otkrytykh Rusel." (Principles of the hydromechanical solution method of the problem of free percolation from open channels.) Trans. Inst. of Hydrotech. Research, Leningrad, U.S.S.R., Vol. XIX: 5-24, 1936. Translated by H. Marek, Jr., Sept. 1948. (Rough draft)

An exposition of the method's principles as an introduction to further articles on the subject.

Ron, Josef — "Rozdilovy Vyparomer." (Differential evaporometer.) Bulletin of the T.G. Masaryk Nat. Hydrological Institute, Prague, Czechoslovakia, pp 19-21, 1947. (Rough draft)

Description of the author's "differential evaporometer" and its measuring procedure. The amount of evaporation from the pan is determined from the difference between the total added volume and the excess volume of water above the base level automatically maintained by means of a suction tube.

Ron, Josef — "Mereni Ovzdusnych Srazek Srazkomernym Totalizatorem." (Measurements of atmospheric precipitations with a totalizer.) Bulletin "Work and Studies" (Práce a Studie), Nat. Hydrol. and Hydrotech. Institutes of T.G. Masaryk, Prague-Podlaba, Czechoslovakia, No. 60, 1946. Translated by H. Marek, Jr., Oct. 1948. (rough draft)

Description of the evolution of hood totalizers and the use of salts for the preservation of precipitations in liquid form. Experiments with conical totalizer hood; penetration

of oil film by drops of water and the use of oil film-covered metal surfaces for the formation and measurement of dew.

Thevenin, Jean — "Les Masques Etanches des Barrages en Enrochements." (Watertight facing of rip-rap dams. The bituminous-concrete facing of the Ghrib Dam.) Terres et Eaux (Soil and Water), Colonization and Hydraulic Service of the Government of Algiers, Africa, No. 2, Mar.-April, pp 27-42, 1948. Translated by A. D. Mc-Cullough, Oct. 1948. (Rough draft)

Vasilev, A.F. — "O Koeffitsiente Sherokhovatosti Betonnoi Oblitsovki Kanala." (Coefficient of roughness for concrete canal lining.) Gidrotekhnicheskoe Stroitelstvo (Hydrotech. Construction), Moscow, Indust. Tech. and Economic Journal of the Ministry of Hydroelectric Power Systems of the U.S.S.R., Vol. 15, No. 9: 21, 1946. Translated by I. Mittin and H. Marek, Jr., Sept. 1948.

Comparison of the design coefficient of canal concrete lining and hydraulic losses under winter conditions with the results of field observations.

Vibert, A. — "La Methode de Porchet Pour la Reconnaissance des Nappes Aquiferes." (Porchet's method for exploration of aquifereous strata.) La Génie Civil, Vol. CXXIII, No. 20, No. 3191, Oct. 15, 1946. Translated by H. Marek, Jr., Jan. 1947.

Clarification of the merits and limitations of the method in systematic applications.

Vorel, Cenek — "Pouziti Metod Matematicke Statistiky Pri Zpracovani Hydrologickeho Materialu." (Application of the method of mathematical statistics for the compilation and use of hydrologic material.) Bulletin "Work and Studies" (Práce a Studie), National Hydrol. and Hydrotech. Institutes of T.G. Masaryk, Prague-Podlaba, Czechoslovakia, No. 12, 1934. Translated by H. Marek, Jr., Oct. 1948. (Rough draft)

Discussion of the use of frequency distribution curves of the characteristics of rains, water stages, discharges, etc., and the adaption of internationally standardized compilation methods for the study of hydrologic material, definitions, and use of pertinent methods.

TENNESSEE VALLEY AUTHORITY, Knoxville, Tenn.

Direct inquiries to Albert S. Fry, Chief, Hydraulic Data Branch, Tennessee Valley Authority, Knoxville, Tenn. Translations made by Adrien Duncan.

Craya, A. — "Graphical calculations of variable regimes in canals." La Houille Blanche, Nov. 1945: 24-28, 36-38; March 1946: 124-129.

Re, R. — "A study of instantaneous release of a body of water in a canal by the graphical method." La Houille Blanche, May 1946: 181-187.

NATIONAL RESEARCH COUNCIL, Ottawa, Canada.

Direct inquiries to J. H. Parkin, Director, Division of Mechanical Engineering, National Research Council, Ottawa, Canada.

Kempf, Gunther

"Modelltank-Conferenz, Berlin 1937. Bericht 5 (XV), Bericht 6 (XVI), Bericht 10 (XIX)." (Towing tank conference, Berlin 1937). Hamburgische Schiffbau-Versuchsanstalt, Hamburg, Germany. Bericht 369. April 1937.

Report 5 - "Effect of artificial roughening on a sharply inclined stem."

Report 6 - "Allowances used in converting from model to ship scale."

Report 10 - "Comparison of the towing test and high seas performance of the M.S. 'San Francisco'."

COMMITTEES

ADVISORY COMMITTEE ON BASIC RESEARCH IN UNDERWATER BALLISTICS, Office of Naval Research, U. S. Navy Department.

Chairman, Dr. J. H. Wayland, Ordnance Test Station, Pasadena, Calif.

Purpose and aims: (a) to plan an effective hydrodynamics research program; (b) to aid the coordination of research and development; (c) to arrange meetings of larger groups in order to discuss recent developments; (d) to edit and arrange for publication of reports; (e) to encourage publication of papers; (f) to encourage visits to laboratories and research facilities; and (g) to keep the program alive and thereby attract qualified experts to the field.

During the past year the Committee has organized the Sixth and Seventh Underwater Ballistics Conferences held in Pasadena in November 1947 and in Hoboken in October 1948. The "Proceedings" of the Sixth Conference have been published, and the "Proceedings" of the Seventh Conference are being prepared.

The major task before the Committee at the present time is the preparation of a program of fundamental research in hydrodynamics.

RESEARCH COMMITTEES OF THE SECTION OF HYDROLOGY, American Geophysical Union, 1530 P Street, N.W., Washington, D. C.

President, Section of Hydrology, Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

Secretary, Section of Hydrology, Ray K. Linsley, Jr., 5517 Glenwood Road, Bethesda 14, Md.

Reports of the research committees are published in the Transactions of the American Geophysical Union.

CHEMISTRY OF NATURAL WATERS.

Chairman, L. V. Wilcox, U. S. Geological Survey, 136 Custom House, Denver 2, Colo.

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, 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, H. G. Wilm, Southern Forest Experiment Station, 1008 Federal Building, New Orleans 12, La.

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, W. O. Field, Jr., American Geographical Society, Broadway at 156th St.,

New York 32, N. Y.

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, 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, G. W. Musgrave, Research Specialist, Soil Conservation Service, U. S. Department 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, J. L. Hough, Department of Geology, University of Illinois, Urbana, Ill.

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, W. C. Lowdermilk, 1620 LeRoy Ave., 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.

PHYSICS OF SOIL MOISTURE.

Chairman, 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.

PRECIPITATION.

Chairman, Merrill Bernard, U. S. Weather Bureau, Washington 25, D. C.

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.

RUNOFF.

Chairman, Charles C. McDonald, 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, 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 (Special Committee).

Chairman, C. E. Jacob, Department 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.

Chairman, Executive Committee, Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

Purpose: The advancement and dissemination of knowledge relating to the occurrence of water in nature and its behavior in structures, water courses, and underground. In particular, the field of the Hydraulics Division shall embrace meteorology and hydrology as they affect the engineer, fluid mechanics in engineering usage, and applied hydraulics as a branch of engineering science which furnishes the basis for hydraulic design and for the practical use of water in the different specialized branches of hydraulic engineering. The Division was authorized April 19, 1938.

COMMITTEE ON FLUID MECHANICS.

Chairman, Vito A Vanoni, Research Project Supervisor, California Institute of Technology, Pasadena 4, Calif.

Purpose: To further the advancement of hydraulics through coordination of endeavor with related fields of fluid mechanics.

Accomplishments: A symposium on high velocity flow in open channels was presented at the annual meeting in New York in January 1948. A list of available motion pictures dealing with fluid flow phenomena has been assembled and distributed. The committee is collecting information on hydraulic demonstration apparatus, to assist colleges in building such equipment for use in teaching. Published "Civil engineers share knowledge of fluid mechanics with many related professions", by Hunter Rouse, Civil Engineering, Dec. 1947.

JOINT COMMITTEE ON GROUND WATER HYDRAULICS.

In process of organization. Proposed joint committee to replace Committee on Ground Water Hydraulics, Hydraulics Division, C. E. Jacob, Chairman; and Committee on Economic Importance of Ground Water, Engineering Economics Division, E. W. Bennison, Chairman.

Purpose: To study the physical laws governing the occurrence and movements of ground water and the engineering, economic, and legal aspects of its development, uses, and conservation.

COMMITTEE ON HYDRAULIC DATA AND FACTS.

Chairman, Paul Baumann, Los Angeles County Flood Control District, 751 South Figueroa St., Los Angeles 14, Calif.

Purpose: To stimulate, sponsor, and coordinate the gathering, compilation, and presentation of empirical data and facts, obtained from observations on existing structures and water courses.

Sub-committee on Gate and Dam Crest Coefficients, Paul Baumann, Chairman.

COMMITTEE ON HYDRAULIC RESEARCH.

Chairman, George H. Hickox, Associate Director, Engineering Experiment Station, University of Tennessee, Knoxville, Tenn.

Purpose: To initiate, organize, sponsor, and coordinate research in the hydraulic field.

Accomplishments: The following reorganization has taken place: The Sub-committee on High Velocity Flow and the Sub-committee on Translations were dissolved; the Sub-committee on Cavitation was reconstituted; and the Sub-committee on Density Currents was organized. A "List of suggested problems for hydraulic research" was submitted for publication in Civil Engineering.

Sub-committee on Cavitation in Hydraulic Structures, Robert T. Knapp, Chairman.

Sub-committee on Density Currents, A. S. Fry, Chairman.

COMMITTEE ON HYDROLOGY.

Chairman, Finley B. Laverty, 502 Lakeview Road, Pasadena, Calif.

Merrill Bernard, ex-officio.

Purpose: (a) To stimulate in civil engineering practice the adoption of precepts, theories, and design methods progressively developed in the field of applied hydrology; (b) to sponsor activities designed to increase knowledge of the phase of the hydrologic cycle beginning with the causes of rainfall and ending with the accumulation of runoff into channel flow; (c) to maintain cooperation with the Section of Hydrology of the American Geophysical Union, and other groups representing hydrology and related fields of science; and (d) to encourage cooperation between federal, state, and private interests in establishing and maintaining facilities for obtaining hydrometeorological data.

Accomplishments: The committee has been engaged wholly in the completion of the Manual on Hydrology.

Sub-committee on Evaporation for Hydrologic Manual, Adolph F. Meyer, Chairman.

Sub-committee on Runoff for Hydrologic Manual, Walter B. Langbein, Chairman.

Sub-committee on Ground Water for Hydrologic Manual, Donald Baker, Chairman.

Sub-committee on Precipitation for Hydrologic Manual, Merrill Bernard, Chairman.

Sub-committee on Infiltration for Hydrologic Manual, S. W. Jens, Chairman.

JOINT COMMITTEE ON DESIGN AND OPERATION OF MULTIPLE PURPOSE RESERVOIRS.

Chairman, Raymond A. Hill, Suite 1000, Edison Building, Los Angeles 13, Calif.

Purpose: To study and report on the problems involved in the planning, design, and operation of multiple-purpose reservoir systems with a view of obtaining an optimum watershed development and utilization.

Accomplishments: The Symposium on the Design and Purpose of Multiple-Purpose Reservoirs presented at the Society meetings in January and July 1947 is scheduled for publication in the Proceedings, A.S.C.E., in April 1949.

JOINT COMMITTEE ON FLOODS.

Chairman, Gerard H. Matthes, Broadway Central Hotel, Suite 518, New York 12, N. Y.

Purpose: To promote the collection and compilation of data pertaining to floods

in the United States, 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.

Sub-committee on Check Dams, Debris Dams, and Debris Basins, E. B. Debler, Chairman.

Sub-committee on Flood Control Structures other than Reservoirs, G. R. Williams, Chairman.

Sub-committee on Underscour at Bridge-piers and Abutments, C. F. Izzard, Chairman.

Sub-committee on Review of Flood Frequency Methods, W. P. Creager, Chairman.

JOINT COMMITTEE ON SEDIMENTATION IN RESERVOIRS.

Chairman, Carl P. Vetter, Bureau of Reclamation, Boulder City, Nevada.

Purpose: To study and report on problems connected with the depositing of sediment in reservoirs, its prevention and reduction.

Sub-committee on Physical Aspects, H. F. Blaney, Chairman.

Sub-committee on Remedies, Nathan C. Grover, Chairman.

Sub-committee on Sources of Sediments, Carl B. Brown, Chairman.

Sub-committee on Economic Effects of Sedimentation, A. P. Learned, Chairman.

JOINT COMMITTEE ON SNOW, ICE, AND PERMAFROST.

In process of organization.

COMMITTEE ON APPLIED HYDRAULICS, Civil Engineering Division, American Society for Engineering Education.

Chairman, Prof. Cecil S. Camp, Director, School of Hydraulic Engineering, Louisiana State University, Baton Rouge 3, La.

The purpose is to further the advancement of the teaching of hydraulic engineering and fluid mechanics courses.

The committee has sponsored the preparation of a list of "Motion pictures for use in teaching hydraulics and fluid mechanics". This list was prepared by Prof. Walter L. Moore of the University of Texas, and is a summary of information obtained from a number of laboratories throughout the country. It contains a short description of each motion picture, together with data on film size, type, availability and source. The list may be obtained from Prof. Camp or Prof. Moore.

A similar list, "Motion pictures of flow phenomena", was compiled by the Fluid Mechanics Committee of the Hydraulics Division, A.S.C.E., in January 1948. It may be obtained from Dr. Vito A. Vanoni, Hydrodynamics Laboratory, California Institute of Technology, Pasadena 4, Calif.

WATER RESOURCES DIVISION, American Water Works Association.

Chairman, executive board, R. M. Legette.

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COMMITTEE ON CONSERVATION OF GROUND WATER IN INDIANA.

Chairman, Prof. F. W. Greve, Purdue University, Lafayette, Ind.

The agenda of the committee include (a) preparation of a synopsis of available data relating to the artificial recharge of underground waters; (b) biological and other pollution of ground water by infiltration from rivers; and (c) ground water phases of the heat pump cycle.

The committee has obtained information concerning the geological conditions and water levels of most wells within a radius of ten miles of the Purdue University campus.

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 is organized to conduct, promote, and foster research in hydrodynamics affecting the design of ships.

This committee has undertaken to issue annually a bulletin listing research projects in progress in the United States related to naval architecture and marine engineering. Bulletin 1-3, published in November 1948, is the second of such publications. These bulletins follow closely the form of this bulletin, "Hydraulic Research in the United States", and contain reports on some of the projects reported herein which relate to the field of naval architecture and marine engineering. Copies may be obtained by addressing the Secretary, Herbert S. Howard, Hydromechanics Sub-committee, The Society of Naval Architects and Marine Engineers, 29 West 39 St., New York 18, N. Y.

INTERNATIONAL ASSOCIATION FOR HYDRAULIC STRUCTURES RESEARCH.

President, Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

The Association will meet at Grenoble, France, in August 1949, preceding the conference of the International Congress of Navigation to be held in Lisbon. The next triennium conference will be held in Delhi, India, February 1951.

The Association issued Volume 3 of its bulletin, "Hydraulic Research", covering the years 1938-1947 early in 1948. The bulletin contains reports from 35 laboratories in 17 countries, mostly European.

Information concerning membership in the Association may be obtained by addressing its President, Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn., or its Secretary, Prof. J. Th. Thijsse, Raam 61, Delft, Holland.

LABORATORY NOTES

UNIVERSITY OF ARKANSAS, Fayetteville, Ark.

Dean G. P. Stocker has been placed on the emeritus status, and Prof. George F. Branigan has succeeded him as Dean of the College of Engineering and Director of the Experiment Station.

BYRON JACKSON COMPANY, P. O. Box 2017, Terminal Annex, Los Angeles 54, Calif.

W. N. Beadle, Vice-President.

New buildings of the Byron Jackson Company include a pump test laboratory for research on new and improved horizontal and vertical centrifugal pumps and submersible electric motor designs. This laboratory permits of running tests up to 3000 hp with water volumes up to 70,000 gpm.

UNIVERSITY OF CALIFORNIA, College of Engineering, Berkeley, Calif.

Prof. R. G. Folsom, Department of Engineering.

Much of the space of the outdoor Fluid Mechanics Laboratory is being devoted to a project on the flow of air at very low pressures, in cooperation with the Office of Naval Research. The work is theoretical and experimental in nature, and studies the characteristics of air flow at subsonic and supersonic speeds for a continuous medium, for fully developed molecular flow, and for the transition region between these two limiting cases. The equipment involves special wind tunnels for operating at very low pressure conditions (to about 20 microns), special flow visualization apparatus, special calibration standards, a molecular beam apparatus, and high-speed rotating cylinder equipment. The results of the work under the project are released in reports to the Office of Naval Research and in technical articles submitted to appropriate periodicals.

CARNEGIE INSTITUTE OF TECHNOLOGY, Pittsburgh, Pa.

Prof. F. T. Mavis, Head, Department of Civil Engineering.

A $200,000 program for the improvement of civil engineering instructional and laboratory facilities in Industries Hall is in progress. The department is scheduled to move to its new quarters during 1949.

COLORADO SCHOOL OF MINES, Golden, Colo.

Prof. Henry A. Babcock, Asst. Professor, Department of Civil Engineering.

The hydraulic laboratory is shut down pending completion of new quarters. Limited operation will be resumed about July 1949.

THE UNIVERSITY OF CONNECTICUT, Storrs, Conn.

Victor Scottron, Associate Professor in Civil Engineering.

Professor Storrs has moved from Columbia University to the University of Connecticut, where he is assisting in the development of the hydraulic laboratories. It is expected that the research laboratory on Cedar Brook will be in operation by September 1949.

ILLINOIS STATE WATER SURVEY DIVISION, Box 232, Urbana, Ill.

Max Suter, Chief Engineer.

A new hydraulic, chemical, and bacteriological laboratory at Peoria, Ill., is now under construction. It will have a pumping capacity up to 3 cfs with 40-foot head, and will be used principally for ground water investigations. Construction

will soon start on a new laboratory at Champaign, Ill., with a pumping capacity up to 10 cfs and a head up to 40 feet.

THE JAMES LEFFEL & COMPANY, Springfield, Ohio.

J. Robert Groff, President and General Manager; G. A. Biggs, Chief Engineer.

The present program of testing and experimenting is a continuance of logical building and development on hundreds of different tests made in the past, having to do with propeller, Francis, and other types of turbines. Draft tubes and various hydraulic environmental conditions concerned with turbine installations are also tested. The program will continue to be a composite of experiment and development testing, and also will be concerned with testing of models of various commercial installations.

LOUISIANA STATE UNIVERSITY AND A & M COLLEGE, Baton Rouge, La.

Prof. Cecil S. Camp, Director, School of Hydraulic Engineering.

Professor Cecil S. Camp has replaced Dr. Glen N. Cox as Director of the School of Hydraulic Engineering. James F. Halsey has been added to the staff as Assistant Professor.

The Lester F. Alexander Waterways Fund Fellowship has been added to the six Louisiana State University fellowships, to make a total of seven fellowships available.

UNIVERSITY OF NOTRE DAME, College of Engineering, Notre Dame, Indiana.

Professor Steponas Kolupaila, formerly Dean of the faculty of Civil Engineering and leader of the Hydrologic Institute at the University in Kaunas, Lithuania, has joined the staff of the University of Notre Dame, and will assist in setting up a hydraulic laboratory there.

STATE OF NEW JERSEY, Department of Conservation, Division of Water Policy and Supply, 28 West State Street, Trenton, N. J.

H. T. Critchlow, Chief Engineer.

The Division of Water Policy and Supply exercises state jurisdiction over the diversion of water for public and potable purposes, and over the construction of dams and structures within the natural high water mark of streams.

The Division is completing a hydrological study of Elizabeth River to determine the size of flood for which protection should be provided when the drainage basin has been fully developed and the channel regimen has been radically changed by channel improvements and flood control works. This study has developed interesting data on the effect of large storm sewers on flood runoff.

NEW YORK UNIVERSITY, College of Engineering, University Heights, New York 53, N. Y.

Dr. Glen N. Cox, formerly Director of the School of Hydraulics at Louisiana State University, has been appointed Professor of Hydraulics and Mechanics at New York University. He will be in direct charge of all fluid mechanics and hydraulics work.

OKLAHOMA A & M COLLEGE, Division of Engineering, Stillwater, Okla.

Professor John H. Dawson, formerly with the University of Colorado, is now in charge of the hydraulic laboratory at Oklahoma A & M College. A research program will be started as soon as necessary equipment for a student laboratory has been constructed.

PURDUE UNIVERSITY, School of Civil Engineering and Engineering Mechanics, Lafayette, Ind.

Mr. W. W. Schenler has replaced Mr. J. T. Horner on the staff.

STEVENS INSTITUTE OF TECHNOLOGY, Graduate School, Hoboken, N. J.

Prof. B. K. Erdoss, Director, New York University-Stevens Cooperative Curriculum in Fluid Dynamics.

In the fall of 1947 a joint program was entered into by the Graduate Division, College of Engineering, New York University, and the Graduate School of Stevens Institute of Technology. The corriculum in Fluid Dynamics is now in its second year, and contains courses in mathematics, theoretical and applied fluid mechanics, thermodynamics, experimental methods, etc., offering a full academic program of one year, leading to the Master's degree. Further details may be obtained by writing to the graduate school of either institution.

SYRACUSE UNIVERSITY, Department of Civil Engineering, Syracuse 10, N. Y.

The new fluid mechanics laboratory is nearing completion and will be in operation early in 1949. In addition to facilities for academic instruction, the laboratory will be equipped to perform commercial testing and calibration of fluid meters, devices, and hydraulic apparatus. Professor A. M. Feiler will be in charge.

WAYNE UNIVERSITY, Department of Civil Engineering, Detroit 1, Mich.

A small hydraulic laboratory, to be used primarily for student instruction and demonstration, is nearing completion.

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

In January 1949 there will be set up within the Forest Management Division a section of influences, under which regular work will be done in influences and various phases of flood control.

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

Dr. L. Dudley Love, Silviculturist, transferred from the Soil Conservation Service to the Rocky Mountain Forest and Range Experiment Station as field division chief in charge of forest influences research. He replaced Dr. H. G. Wilm, who transferred to the Southern Forest Experiment Station at New Orleans, La.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station, Vicksburg, Miss.

A development of the Hydraulics Division is the use of metal airplane hangars for the housing of outdoor models. These structures are ideal for the purpose, each covering an area roughly 150 feet wide by 500 feet long, with no interior posts or columns and a center vertical clearance of about 40 feet. Each hangar has a floor space of 72,000 square feet. The gross area of the model shelters is about 270,000 square feet. The main water supply consists of a 60-inch steel pipe capable of carrying 200 cfs under a pressure head of 55 feet. Two 60-inch concrete pipe lines return the water to the supplementary reservoir.

TENNESSEE VALLEY AUTHORITY, Norris, Tenn.

Rex A. Elder, in charge, Hydraulic Laboratory.

The work in this laboratory is still very active, with the emphasis being shifted

from design to operation. Considerable work is being undertaken to develop equipment, the lack of which has hampered the carrying out of research work in the past.

A major change in personnel occurred on January 16, 1948, when Dr. G. H. Hickox resigned as head of the laboratory to become Associate Director, Engineering Experiment Station, University of Tennessee.

THE UNIVERSITY OF BRITISH COLUMBIA, Department of Civil Engineering, Vancouver, B. C., Canada.

A hydraulics laboratory, forming part of the new Engineering Building, is in the final stages of completion.

UNIVERSITY OF TORONTO, Department of Mechanical Engineering, Toronto, Canada.

The Department of Mechanical Engineering moved into its new building in December 1948. The River Flow Laboratory is designed for testing large and small models of river beds, harbors, flood control works, power plant intakes, and other similar projects. It contains three axial flow pumps with a combined capacity of 9000 gpm. A large glass-sided channel (36 inches square) and a ship channel 200 feet long, complete with model towing machine, will also be available. A heat pump will be installed for experimental work. Other facilities in the new Engineering Building include a workshop, mechanical and fuel testing laboratories, air conditioning and refrigeration laboratory, drafting room, engineering museum, heat engine and heat transfer laboratories, auditorium, and lecture rooms. Professor G. Ross Lord is in charge of all hydraulic work.

FOREIGN LABORATORIES

LABORATOIRES D'HYDRAULIQUE, Ecole Nationale Superieure d'Ingenieurs, Toulouse, France.

L. Escande, Professor, Faculty of Sciences, Director.

These hydraulic laboratories attached to the University of Toulouse comprise two groups, situated, one at the university itself, the others at Banleve, where a waterfall makes it possible to fill the various channels with flows exceeding 20 cubic meters per second.

Founded in 1915 by Professor Camichel, these laboratories have conducted extensive research in the various domains of hydraulics, resulting in more than 275 publications. In addition, they make all the studies on reduced-scale models concerning fluvial hydraulics and hydroelectric plant equipment.

In the last few years, the research has dealt more particularly with pressures in forced flows in conduits, the oscillations of water in surge tanks, the phenomena of discharge and overflow, and flow through bottom sluice gates.

A list giving a summary of research projects conducted between 1938 and 1947, and a bibliography covering work done since the establishment of the laboratories are available on loan from the National Hydraulic Laboratory, National Bureau of Standards, Washington, D. C.

The following list of foreign laboratories engaged in hydraulic research is obtained through the courtesy of Prof. J. Th. Thijsse, Director of the Hydraulic Laboratory at the Technical University of Delft, Netherlands, and Secretary of the International Association for Hydraulic Structures Research. A summary of such research is contained in the bulletin of the Association, "Hydraulic Research 1938-1947", which is distributed to members of the Association (see page 198 of this publication).

BELGIUM

Laboratoire de Recherches Hydrauliques des Ponts et Chaussées de Belgique,
(J. Lamoen, Director)
115, Berchemlei, Anvers (Borgerhout), Belgium

Institut d'Hydraulique de l'Université de Gand,
(L. J. Tison, Director)
59, Rue Neuve St. Pierre, Gand, Belgium

Laboratoire d'Essais d'Hydraulique Fluviale de l'Université de Liége,
(F. Campus, Director)
139, Quai de Rome, Liége, Belgium

Université de Liége, Cours et Laboratoires d'Hydraulique Générale et de Calcul et Installation des Conduites,
(Albert Schlag, Director)
75, Rue du Val-Benoit, Liége, Belgium

CEYLON

The Irrigation Research Laboratories,
(R. V. Burns, Director)
Colombo, Ceylon

CZECHOSLOVAKIA

Laboratoř vodnich staveb, Vysoká škola technická Dr. E. Beneše,
(Jan Bažant, Director)
95, Rue Veveří, Brno, Czechoslovakia

Státni ústav hydrologický T. G. Masaryka,
(F. Kovárík, Director)
Praha XIX, Podbaba, Czechoslovakia

DENMARK

Laboratoriet for Havnebygning og Fundering, Danmarks Tekniske Højskole,
(A. F. Mogensen, Director)
10, Øster Voldgade, Copenhagen K, Denmark.

Laboratoriet for Hydraulik, Danmarks Tekniske Højskole,
(A. E. Bretting, Director)
10 F, Øster Voldgade, Copenhagen K, Denmark.

FRANCE

Laboratoire d'Hydraulique des Ateliers Neyrpic,
(P. Danel, Director)
La Côte Rouge, Alger, Algeria

Laboratoire d'Hydraulique des Ateliers Neyrpic,
(P. Danel, Director)
Avenue de Beauvert, Grenoble (Isère), France

Université de Grenoble, Institut Polytechnique, Laboratoire d'Essais et de Recherches Hydrauliques,
(R. Silber, Director)
46, Avenue Félix-Viallet, Grenoble (Isère), France

Laboratoire Central d'Hydraulique,
(J. Laurent, Director)
10, Rue Eugène-Renault, Maisons-Alfort (Seine), France.

Electricité de France, Service des Etudes et Recherches Hydrauliques
(Laboratoire National d'Hydraulique),
(A. Nizery, Director)
20, Rue Hamelin, Paris (16e), France.

l'Institut de Mécanique des Fluides de Toulouse,
(L. Escande, Director)
Toulouse, France

GREAT BRITAIN

Department of Engineering, University of Aberdeen, Marischal College,
(J. Allen, Director)
Aberdeen, Scotland

Department of Scientific and Industrial Research, Hydraulics Research Organisation,
(Sir Claude Inglis, Director)
123, Victoria Street, London, S.W. 1, England

Hawksley Hydraulic Laboratory, City and Guilds College,
(C. M. White, Director)
Exhibition Road, London, S.W. 7, England

The Whitworth Engineering Laboratories, Victoria University of Manchester,
(A. H. Gibson, Director)
Manchester, England

HUNGARY

Földmüvelésügyi Minisztérium, Vizrajzi Intezet,
(J. Bogárdi, Director)
Lágymanyosi utca 14/a, Budapest XI, Hungary

INDIA

The River Research Institute, West Bengal,
(N. K. Bose, Director)
Anderson House, Alipore, Calcutta, India

The Irrigation Research Institute, East Punjab,
(Shri S. L. Malhotra, Director)
Amritsar, India

The United Provinces Public Works Department, Irrigation Research Station,
(Shri R. S. Chaturvedi, in charge)
Hardwar (U. P.), India

The Engineering Research Laboratories,
(S. P. Raju, Director)
Hyderabad, Deccan, India

The Hydraulic Research Station,
(Shri V. Ganesh Iyer, Director)
Krishnarajasagar, Mysore, India

The Central Waterways, Irrigation and Navigation Research Station,
(K. K. Framji, Director)
Poona, India

The Poona Irrigation Research Division, Public Works Department Bombay,
(J. P. Naegamvala, Director)
Poona, India

The Irrigation Research Station,
(Jenab T. P. Kuttiammu Sahib Bahadur, Director)
Poondi, Madras, India

INDONESIA

Waterloopkundig Laboratorium, Technische Hogeschool,
(H. Vlugter, Director)
Bandoeng (Java), Indonesia

ITALY

Laboratorio di Idraulica e Costruzioni Idrauliche del Politecnico di Milano,
(G. de Marchi, Director)
32, Piazza Leonardo da Vinci, Milan, Italy

Istituto d'Idraulica della Universita di Padova,
(E. Scimemi, Director)
16, Via Loredan, Padova, Italy

Istituto d'Idraulica della Universita di Pisa,
(A. Rastrelli, Director)
Via Diotisalvi, Pisa, Italy

NETHERLANDS

Mineraal Technologisch Instituut,
(C. van der Gaag, Director)
Oostsingel 209, Delft, Netherlands

Waterloopkundig Laboratorium,
(J. Th. Thijsse, Director)
Raam 61, Delft, Netherlands

NORWAY

Vassbygningslaboratoriet, Horges Tekniske Høgskole,
(H. M. Bakken, Director ad interim)
Trondheim, Norway

PAKISTAN

The Irrigation Research Institute, West Punjab,
(C. King, Director)
Lahore, Pakistan

The Irrigation Research Division,
(M. S. Quraishy, Officer-in-charge)
Sind, Karachi, Pakistan

PALESTINE

The Hebrew Technical College, Institute of Technology,
P.O.B. 910, Haifa, Palestine

PORTUGAL

Laboratorio de Hidraulica da Amadora de la Sociedade Portuguesa Neyrpic,
(P. Danel, Director)
95, Avenida Duque de Loulé, Lisbon, Portugal

Ministério das Obras Públicas, Laboratório de Engenharía Civil,
(Eduardo de Arantes e Oliveira, Director)
Avenida Rovisco Pais, Lisbon, Portugal

SYRIA

Laboratoire d'Hydraulique de l'Ecole Française d'Ingénieurs de Beyrouth,
(E. Crausse, Director)
Beyrouth, Syria

SWEDEN

Vattenbyggnadslaboratoriet, Chalmers Tekniska Högskola,
(T. Hultin, Director ad interim)
Göteborg, Sweden

A. B. Vattenbyggnadsbyran,
(G. Richert, Director)
29, Humlegårdsgatan, Stockholm, Sweden

Kungl. Väg- och Vattenbyggnadsstyrelsen,
(S. Stenberg, Director)
Stockholm, Sweden

Kungl. Vattenfallsstyrelsen,
(G. Westerberg, Director)
8, Karduansmakaregatan, Stockholm, Sweden

Stockholms Vattenledningsverk,
(E. Garberg, Director)
Stockholm, Sweden

Vattenbyggnadsinstitutionen, Kungl. Tekniska Högskolan,
(B. Hellström, Director)
Stockholm, Sweden

SWITZERLAND

Laboratoire d'Hydraulique de l'Ecole Polytechnique de l'Université de Lausanne,
(A. Stucky, Director)
67, Rue de Genève, Lausanne, Switzerland

Laboratoires de Recherches Hydrauliques et de Mécanique des Terres,
annexés à l'Ecole Polytechnique Fédérale,
(E. Meyer-Peter, Director)
37, Gloriastrasse, Zürich, Switzerland

TUNISIA

Laboratoire d'Hydraulique de Tunis des Ateliers Neyrpic,
(P. Danel, Director)
Tunis, Tunisia

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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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