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CIVIL ENGINEERING SECTION
COLORADO AGRICULTURAL EXPERIMENT STATION

ANNUAL REPORT
1 May 1962
by
M. E. Bender
Section Chief

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CIVIL ENGINEERING SECTION
COLORADO AGRICULTURAL EXPERIMENT STATION

ANNUAL REPORT

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I. STAFF PROJECTION FOR 1963-64

On this form please indicate the additional positions, over 1962-63 staff levels, which you feel will be necessary and desirable for your department. Justification for indicating additional positions can include enrollment increases, more graduate students, more OSURF projects, etc. Indicate the distribution of time for the various functions by man-months according to the same ground rules used for the 1962-63 staffing pattern.

Rank or title of position (Include non-faculty and Graduate Assistants)	Total Man Mos.	1963-64 Summer					1963-64 Academic Year				
		R. I.	Sta.	OSURF	Ext.	Other	R. I.	Sta.	OSURF	Ext.	Other
1. Hydraulic Engineer(Prof)	11			2			3	3	3		
2. Associate Prof	11		2				5	4			
3. Assistant Prof	11						11				
4. Grad. Assts: 6 Ph D	54							18	36		
5. 6 M S	54							18	36		
6. Clerk-Steno	11					2	9				
7. Needed for 100% implementation of proposed new and expanded research											
Prof. Staff (4.5 Pos.)	49							49			
M S Grad.(3)	27							27			
Ph D Grad.(5)	27							27			
Total Faculty Man Months	82		2	2			19	56	3		
Total Non-Faculty Man Mos.	11					2	9				
Total Grad. Asst. Man Mos.	162							90	72		

Note: Use an asterisk to indicate temporary summer appointments for OSURF research, summer session teaching, or other special programs.

ITEMS I, II, and III HAVE BEEN CONSOLIDATED FOR BETTER PRESENTATION

It is hoped that by July 1, 1963 a top man in hydraulics can be hired to assume technical responsibility for the research efforts in this area. This is absolutely essential if we are to develop the new hydraulics lab to its fullest capacity. This man would fill position 1 shown on the listing of new positions.

Professor E. F. Schulz will start his sabbatical leave March 15, 1963 and will be gone for two years. We must replace him to carry on the research in small watershed hydrology and to teach the hydrology courses. His replacement is shown as position 2. One-half of the cost of this replacement will come from savings on Professor Schulz's salary during the first year while he is on sabbatical and all of it will come from his salary savings the second year when he is on leave - without pay.

Two (2) new Ph D graduate assistantships and 2 new M S graduate assistantships are shown in positions 5 and 6. Each would be on a 9-months basis. These assistantships were needed in 1962-63, but because of the limitations on total salaries we have not been able to budget them. If our experiment station research is to fulfill its full responsibilities we must use as many research assistants on each project as is practical.

The positions listed in the first part of the tabulation are needed for our existing programs. The staff requirements for new and expanded research are shown as Item 7 of the tabulation. A break down of this staff is shown in the following section on new and expanded research.

New and Expanded Research:

Following are brief summaries of proposed new research programs. Detailed proposals for each of these programs will be furnished at a later date.

	<u>Prof. Sal.</u>	<u>Expense</u>	<u>Capital Outlay</u>
<p>1. <u>Mechanics of Open Channel Flow.</u> Field observations will be correlated with laboratory studies to determine flow conditions in both rigid boundary and alluvial boundary channels. This ties closely to much of the research that has been done here in the past. This will provide valuable design criteria for the design of open channels.</p>	<p>\$ 15,000 1.5 FTE</p> <p>\$ 7,200 2 Ph D Grad.</p>	<p>\$ 10,000</p>	<p>\$ 5,000 Experimental and field equipment.</p>
<p>2. <u>Ground Water Tables.</u> There is a need to expand existing well networks in certain areas and to get all data ready for machine analysis on a continuing basis. This would be coordinated with UGCS and other ground water interests.</p>	<p>\$ 9,000 1.0 FTE</p> <p>\$ 2,700 1 M S Grad.</p>	<p>\$ 4,000</p>	<p>\$ 5,000 Instrumentation for expanded network.</p>
<p>3. <u>Supercritical Flow.</u> Water control in many instances requires knowledge of the behavior of structures under conditions of supercritical flow. Applications include drainage design in urban areas, highway design, and many other water structures.</p>	<p>\$ 12,000 1 FTE</p> <p>\$ 3,600 1 Ph D Grad.</p>	<p>\$ 4,000</p>	<p>\$ 25,000 Super-critical flume.</p>
<p>4. <u>Water Balance at High Elevations.</u> Studies of the deposition of moisture at high elevations will provide basic information for optimum use and management of moisture that originates at high elevations.</p>	<p>\$ 5,000 0.5 FTE</p> <p>\$ 2,700 1 M S Grad.</p>	<p>\$ 1,000</p>	<p>\$ 0</p>

	<u>Prof. Sal.</u>	<u>Expense</u>	<u>Capital Outlay</u>
5. <u>Localized Scour.</u> A basic study of the phenomena of localized scour is needed to better design hydraulic structures in such a way as to prevent failure because of scour.	\$ 5,000 0.5 FTE	\$ 4,000	\$ 0
	\$ 2,700 1 M S Grad.		
TOTALS	\$ 64,900	\$ 23,000	\$ 35,000

IV. CAPITAL CONSTRUCTION

The following capital construction is needed.

(1) The office section of the new hydraulics laboratory will be almost filled the day the new facilities are occupied. Any growth in present activities or any expansion into new areas of research will be seriously hampered by lack of office and small laboratory space. It is essential that the office section be expanded within the next four years which means that the request to the legislature for this expansion should be made in 1964.

The expansion should be three stories following the same general plan and design as the present office section. It should connect to the east end of the present office section and extend east to the east side of the aeromechanics laboratory. This would provide approximately 25,000 square feet of additional space. The cost of building and furnishings, estimated at \$16 per square ft, would be approximately \$400,000. Part of this money could probably be obtained from a Federal Agency on a matching fund basis.

(2) An outdoor hydraulics laboratory is being developed near College Lake as a part of the overall research facilities. This outdoor laboratory has great potential and will provide an unusual and unique facility that will allow research that could not possibly be done in an indoors laboratory.

An essential part of this outdoor laboratory is a pumping plant located in College Lake to provide an adequate flow of water to the various research facilities in the outdoor laboratory. The pump in this installation must be a high-head, large capacity pump and there must be a means of controlling accurately the rate of flow. It is estimated that this pumping plant will cost approximately \$75,000. It is possible that a part of this money could be obtained on a matching fund basis but since this pumping plant is absolutely necessary for the development of this outdoor laboratory, plans should be made to obtain full state financing. This should be requested in the budget for 1965-64.

(3) Expansion of Main Campus Weather Station (Estimate \$10,000).

The new weather station now being built on the main campus will essentially serve the functions of the old stations: to act as an airways observation station for the U.S. Weather Bureau.

In the last year a facsimile receiving and processing facility has been acquired which serves both instruction and research on the

campus with the complete set of weather charts and forecasts issued by the Weather Bureau and disseminated by this method. Housing for this facility is needed. Further, a central location is necessary for the storing and maintenance of various pieces of equipment. These functions cannot be adequately accommodated on the Foothills Research campus.

The new weather station has been built with the thought of extension of the building in the background. There is a blank wall for such an addition, and the building is oriented so that space for the addition is laid out. Power outlets, etc., are already provided for in this wall, and it is merely necessary to cut a door.

Hence, it is proposed to double, approximately, the space of the weather station by building onto the wall which has been constructed with this addition in mind. The cost of this will be \$10,000.

V. OUTSTANDING ACHIEVEMENTS

Members of the Civil Engineering Section have been active in a wide variety of activities, both on and off campus. To list the activities of only a few individuals would do injustice to the others; hence no tabulation of reports, papers, conferences and other activities is listed.

The outstanding event of the fiscal year for the Civil Engineering Section is the forthcoming move to the new Hydraulics Laboratory on the Foothills Campus, scheduled for the summer of 1962.

Reports of Progress by Projects (Excluding CSURF Non-Agricultural Projects.)

Project 104 - Fund 305, 307: Meteorological Observations

Complete meteorological observations continue to be taken daily at 7:00 AM and 7:00 PM. In addition airways meteorological observations are taken regularly every odd hour. In April 1961 the Weather Station was moved to a new location approximately 400 ft to the NW of the previous location. Complete observations have been taken at the old and the new site from April 1961 until April 1962. 1961 was the wettest year of record at the Weather Station at Colorado State University.

Project 104 - Fund 310: Effect of Cloud Seeding on Rocky Mountain Snowfall

Cloud seeding with silver iodide nuclei on these selected at random for the purpose of determining the effect on the daily accumulation of snowfall, atmospheric ice nuclei, and other cloud and snow characteristics. Significant increases of ice nuclei have occurred in the area of the observation network in the vicinity of Climax, Colorado (downwind from the seeding generators) on the number of the "seeded" days.

Project 105 - Fund 303, 307: Ground Water Fluctuations and Their Relation to Pumping

Records of water levels continue to be taken each spring and fall at approximately 250 observation wells in the South Platte and Arkansas Basins. A few continuous records are available of ground water levels.

Because of the high amount of precipitation in 1961, water tables in eastern Colorado were generally 2 to 3 ft higher than the corresponding measurements in 1960.

Project 106 - Fund 307: Development and Improvement of Water Measuring Devices

Development and testing has continued on determining of flow rates from submerged Parshall flumes. Trapezoidal measuring flumes have shown merit over those of the Parshall type.

Tests on the vane-type flow meters indicate a probable accuracy under field operation of ± 5 percent.

Project 108 - Fund 303, 307: Sealing of Canals and Reservoirs with Colorado Clays

Laboratory testing of more than 200 clay samples from more than 90 deposits in Colorado has been accomplished, and field evaluations of approximately more than 90 installations of Colorado clays in canals and reservoirs have been completed.

Project 109 - Fund 310: Genesis Areas for Hailstorms in the High Plains

The position and movement of precipitation cells have been tracked by a radar set located at New Raymer, Colorado from 15 May to 15 August 1961. The cells that produced hail were identified from

concurrent data from a special surface network. The location of genesis of these precipitation cells was related to terrain features and low-level wind flow. It appears that regions of hail genesis can be identified from a "Lift Factor" computed from terrain elevation differences and low-level wind flow.

Project 110 - Fund 307 - 310: Groundwater Management

Field studies are being conducted in the Arkansas and South Platte Valleys to determine groundwater characteristics, and management programs will later be applied to determine optimum operating techniques.

Project 113 - Fund 307: Hydrometeorology

Equipment for obtaining observations of wind and temperature has been placed in the field near Berthoud Pass, Colorado to determine turbulent structure of the atmosphere as a function of wind speed and perhaps also direction. Commercial wind equipment purchased for the study has proved to be inadequate for the severe conditions encountered. The equipment is being modified and field tested in order to obtain these data during the winter of 1962-63.

Project 114 - Fund 307: Watershed Hydrology

This study has been concerned with making an inventory of available hydrologic data, based mainly on records from gaging stations maintained by the U.S. Geological Survey. Features of the peak rate of flow and water yields are being determined and these data are being punched on cards. Work is being conducted to determine the number and extent of the homogeneous hydrologic regions in the state. This division is being made on the basis of physical characteristics of watersheds.

Project 1412, Investigations to Develop Wind Tunnel Techniques for Measuring Atmospheric Gaseous Diffusion in Model Vegetative Surfaces

A study of diffusion from a line source into a boundary layer over a smooth, flat plate has been completed. Results show that the diffusion pattern can be separated into different zones, according to distances from the source, in which different similarity laws are valid for the diffusion process.

VI. PUBLICATIONS (For the period 15 April 61 to 15 April 62)

Let's "Muddy" the Ditch Water, by R. D. Dirmeyer, Jr. Published in Colorado Farm and Home Research, Vol. 11, No. 4.
CER61RDD18

Dual Channel Stream Monitor, by S. S. Karaki, Earl E. Gray and Jack Collins. Submitted for publication to ASCE.
CER61SSK19

Bentonite Sealing Investigations, by R. D. Dirmeyer. Final Report, Period of February 1, 1959 to January 31, 1961. Prepared for the Southeastern Colorado Water Conservancy District and the Colorado Water Conservation Board. Colorado State University Experiment Station, Engineering Research.
CER61RDE20

Graduate Education and Research, by A. R. Chamberlain, presented at the joint meeting of the joint budget committee and the legislative committee on education beyond high school of the Colorado General Assembly at CSC, Greeley, Colorado.
CER61ARC21

Flow in a Sloping Aquifer as Affected by Hydraulic Properties of Porous Media, by R. H. Brooks. U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Northern Plains Branch, Progress Report No. 1, Non-Funded Contributing Project of the Western Regional Research Committee, Project W-51, Drainage Design for Irrigation Agriculture.
CER61REB22

Progress Report on Hydrologic Studies of the Upper Colorado River, by Richard A. Schlausener. Prepared for presentation at Sixteenth Annual Meeting Colorado River Water Forecast Committee, Senate Chambers, State Capitol Building, Salt Lake City, Utah, 10 April 1961. To be published in Colorado River Water Forecast Committee Proceedings.
CER61RAS23

Snowfall and Snowfall Accumulation near Climax, Colorado by Lewis O. Grant and Richard A. Schlausener. Presented at the joint meeting of Western Snow Conference and Columbia River Water Forecast Committee. April 11 to 13, 1961 at Spokane, Washington. To be published in Western Snow Conference Proceedings.
CER61LOG24

Cloud Seeding in Central Colorado - Progress Report, by Lewis O. Grant. Prepared for presentation at Sixteenth Annual Meeting, Colorado River Forecast Committee, Senate Chambers, State Capitol Building, Salt Lake City, Utah, 10 April 1961. To be published in Colorado River Forecast Committee Proceedings.
CER61LOG25

PUBLICATIONS - Continued

Uniform Water Conveyance Channels in Alluvial Material, by D. B. Simons and M. L. Albertson. Presented at the 1958 ASCE Hydraulics Division Conference in Atlanta, Ga. Published in Proceedings of ASCE, Hydraulics Division, Vol. 86, No. EY5, May 1960.
CER61DBS26

Civil Engineering Section Colorado Experiment Station Annual Report, by A. R. Chamberlain.
CER61LARC27

Progress Report of Work Accomplished at Colorado State University on the Cooperative Project on Climatology of the Upper Colorado River Basin, by R. A. Schlessener. Prepared for State of Colorado. Acct. No. 1720-74-0.
CER61RAS28

Desilting Structure at the Gualanday Canal Headworks Coello Project. Colombia, S. A. - Model Study - Prepared for Tipton and Kalmbach, Inc., Denver, Colorado by S. S. Karaki
CER61SSK29

Civil Engineering Final Report on Measurement of Atmospheric Ozone with the Dobson Spectrophotometer, by Lewis O. Grant, Contract No. AF19(604)-7305, April 1960, prepared for Geophysics Research Directorate, Air Force Cambridge Research Center, Air Research and Development Command, U.S. Air Force, Bedford, Massachusetts.
CER61LGC30

Studies of Flow in Alluvial Channels, Basic Data from Flume Experiments, by D. B. Simons and E. V. Richardson, U.S. Geological Survey.
CER61LEVR31

Ground-Water Recharge Research in Colorado, by Marton W. Bittinger. Prepared for presentation at the Biennial Conference on Ground-Water Recharge. University of California at Berkeley, June 28-29, 1961.
CER61MWB32

Closing Discussion by S. Y. Hwang of "A Discharge Formula for Flow in Straight Alluvial Channels," by H. K. Liu and S. Y. Hwang.
CER61SKH33

Depressed Curb Opening Inlets - Supercritical Flow - Experimental Data, prepared for U.S. Department of Commerce Bureau of Public Roads, Hydraulic Research Division, by S. S. Karaki. (Not for distribution).
CER61SSK34

PUBLICATIONS - Continued

Radiation Safety in Sediment Studies, by D. W. Hubbell. To be published in Water Resources Division Bulletin, Water Resources Division of U.S. Geological Survey.

CER61LW135

Specifications for the Temperature and Humidification Control Units of the Micrometeorological Wind Tunnel at Colorado State University, by E. J. Plate and J. E. Cernak. Prepared for White Sands Missile Range, New Mexico under Contract No. DA-36-039-SC 8057.

CER61LJP36

Managing Our Ground Water Resources, by Merton W. Bittinger. Published in Colorado Farm and Home Research. Vol. 11, No. 5, March-April 1961.

CER61LWB37

Unsteady Free Surface Flow in a Storm Drain, by Vujica M. Yevdjevich. Prepared for U.S. Bureau of Public Roads under Contract CFR 11-7952.

CER61LW138

Closure for ASCE Paper No. 2551 "Unsteady Flow of Ground Water Into a Surface Reservoir, by William Haushild and Gordon Kruse," by William Haushild and Gordon Kruse, to be published in ASCE.

CER61WLE39.

Development of a Graduate and Research Program in Fluid Mechanics, by A. R. Chamberlain and M. L. Albertson. Prepared for a joint meeting of the Civil Engineering and Sanitary Engineering Divisions of the American Society for Engineering Education, meeting at the University of Kentucky, 28 June 1961.

CER61ARC40

Water Application by Sprinkler and Furrow Irrigation, by Gordon Kruse, Paul Schlausener, Walter Selby and Bert Sowerhalder. Submitted for publication in Agricultural Engineering. Journal of American Society of Agricultural Engineers.

CER61LGG41.

Preliminary Report - Hydraulic Model Studies Stream Gaging Control Structure for the Rio Grande Conveyance Channel near Bernardo, New Mexico, by D. D. Harris and E. V. Richardson.

CER61LW142.

The Role of Ground-Water Reservoir Management in the Comprehensive Development of the River Resources of the South Platte River Basin, by Merton W. Bittinger. Prepared for presentation at the 120th meeting of the Missouri Basin Inter-Agency Committee, August 3, 1961, Fort Collins, Colorado.

CER61LWB43

PUBLICATIONS - Continued

The Mechanics of a Mathematical Ground-Water Model, by F. J. Trelease and H. W. Bittinger. Paper presented to the Irrigation and Drainage Division of ASCE. Submitted to ASCE for publication.
CER61MFB44

Analysis of Meteorological Data for the Upper Colorado River Basin, by Richard A. Schlausener. A summary of the verbal report presented to the Engineering Committee of the Upper Colorado River Basin on 20 July 1961.
CER61RAS45

On the Relation of the Latitude and Strength of the 500 Millibar West Wind Along 100 Degrees West Longitude to the Occurrence of Hail in the Lee of the Rocky Mountains, by Richard A. Schlausener. Prepared for publication in the bulletin of the American Meteorological Society. ASTP No. 26.
CER61RAS46

Fluid Mechanics of Porous Media I. Hydraulic Characteristics of Porous-Media, by R. H. Brooks and A. T. Corey. Progress Report No. 1 Agricultural Research Service, Soil and Water Conservation Research Division, Northern Plains Branch.
CER61MFB47

Report of the 1961 National Science Foundation Summer Fluid Mechanics Institute for College Teachers, by James R. Barton. Submitted to National Science Foundation under Contract NSF G-15399.
CER61MFB48

A Unified Consolidation Theory, by I. S. Dunn and J. P. Nielsen (ASCE Publication)
CER61LSD49

Flume Studies Using Medium Sand and Bentonite, by D. B. Simons, E. V. Richardson and W. L. Hauschild. Water Supply Paper 1948 on Studies of Flow in Alluvial Channels.
CER61DEB50

Evaluation Study of the Pendvane Flowmeter, by A. R. Robinson. Prepared through the cooperation of the Applied Research Company, The Colorado Experiment Station and Agricultural Research Service.
CER61ARR51

Analysis of Precipitation Data in the Upper Colorado River Basin, by Richard A. Schlausener and Loren W. Crow. Prepared for the State of Colorado for Project 2485. AST Paper No. 18.
CER61RAS52

PUBLICATIONS - Continued

Some General Aspects of Fluctuations of Annual Runoff in the Upper Colorado River Basin, by Vujica M. Yevdjevich, Prepared for the State of Colorado for Project 2482.

CER61VMY54

Flume Studies of the Transport of Pebbles and Cobbles on a Sand Bed, by R. K. Fahnestock and W. L. Haushild. Submitted for publication. Presented at the conference of the Geological Society of America in Cincinnati, Ohio, November 4, 1961.

CER61WLB55

The General Atmospheric Circulation of the Tropics, by Herbert Riehl. Submitted for publication.

CER61HR56

Index Method of Rating Gaging Stations and Computing Records. Discussion by E. V. Richardson and D. B. Simons. Published in U.S. Geological Survey Water Resources Bulletin. Internal.

CER61EVR57

Hail Genesis Areas In and Near Northeastern Colorado, by Richard A. Schleusener and Thomas J. Henderson, prepared for the Crop Hail Insurance Actuarial Association. Report of Research supported by National Science Foundation, Grant NSF-G-17964 and Crop Hail Insurance Actuarial Association.

CER61RAS58

Characteristics of Hailstorms in the Colorado State University Network, 1960-61, by R. A. Schleusener and L. O. Grant.

CER61RAS59

Investigations to Develop Wind Tunnel Techniques for Measuring Atmospheric Gaseous Diffusion in Model Vegetative Surfaces, by E. J. Plate. First Annual Report July 1, 1960 to July 1, 1961. Contract No. 12-14-100-4546(41).

CER61EJP60

Die Feinstruktur der Strahlstromme, by Elmar R. Reiter. Progress report prepared for U.S. Navy Weather Research Facility under contract No. N189(188)538 29A. Submitted for publication in "Die Umschau," Frankfurt.

CER61ERR61

The Effects of Some Properties of Water-Clay Dispersions on Flow in Alluvial Channels, by W. L. Haushild, D. B. Simons, and E. V. Richardson, to ASCE for publication.

CER61WLB62

PUBLICATIONS - Continued

Colorado Hailstorm Studies 1960-61, A Progress Report on Research conducted under support from National Science Foundation Grants NSF-G-1254 and NSF-G-17964. Prepared by the Hail Research Staff for 1961: R. A. Schlausener, L. O. Grant, L. Blandin, C. Thomas, E. Ellis, J. Lohe, E. Mason, L. Eaton, G. Jones.

CER61RAS63

Colorado Cooperative Project in Climatology by Richard A. Schlausener, prepared for the Colorado Agricultural Experiment Station in cooperation with the United States Weather Bureau, Status Report.

CER61RAS64.

Model Study of the Sediment Ejector for the Trimmu-Sidnai Link Canal, by S. S. Kazaki. Interim Report prepared for Tipton and Kalmbach, Inc., Denver, Colorado

CER61SSK65

A Preliminary Laboratory Study of Lateral Turbulent Diffusion at the Surface of an Alluvial Channel (Draft of Geological Circular) by Adrian R. Chamberlain and W. W. Sayre.

CER61ARC66

The Interactions of Microclimate, Plant Cover, and Soil Moisture Content Affecting Evapotranspiration Ratio, by W. E. Marlatt. Paper prepared for 4th Conference of Agricultural Meteorology, St. Louis, Mo. ASTP No. 25

CER61WEM67

Flume Studies of the Effect of Temperature on the Mechanics of Flow in Alluvial Channels, Studies of Flow in Alluvial Channels, Water Supply Paper, 1948, Chapter F. by D. W. Fabbell and Khalid Al-Shaikh Ali.

CER61DWH68

Mechanization in Agriculture, by N. A. Evans, Paper prepared for Western Business Review Magazine.

CER61WAB69

Influence of Inorganic Watershed Covers on Moisture Exchange in a Vertical Direction Across the Soil-Air Interface, Progress Report No. 1 - Colorado Contributing Project to Western Regional Project W-75 - Hydrologic Processes of Moisture Exchange in Moisture Conservation, by A. T. Corey and L. G. King, Colorado Agricultural Experiment Station.

CER61ATC70

PUBLICATIONS - Continued

Design Criteria for Drain Tile Filters and Envelopes by W. A. Evans and others, Progress Report, 1961, Colorado Participating Project to Regional Research Project W-51, Colorado Agr. Exp. Sta. in cooperation with USDA-ARS and Colorado Soil Conservation Service.
CER61MAE71

Forces and Moments on a Restrained Model in Regular Waves, by E. F. Schulz. Prepared for David Taylor Model Basin under Contract NOHR 1610-04.
CER61MPS72

Hydraulic Research at Colorado State University, by R. A. Schloesener. Prepared for the National Bureau of Standards. "Hydraulic Research in the United States."
CER61PAS73

The Oceanic Heat Budget as Affected by Hurricane Audrey (1957) by Arthur C. Pike. A Report on Research conducted under Contract No. ONB-9918 between the U.S. Weather Bureau and Colorado State University.
CER61ACP74

Operating Characteristics of Ground-Water Reservoirs Occupying a Trench, by Morris M. Skinner and Robert E. Glover. Paper for presentation at the Annual Meeting of the American Association for the Advancement of Science, Denver, Colorado, December 30, 1961.
CER61MAS75

Wind Tunnel Modeling of Atmospheric Diffusion, by J. E. Cermak and L. V. Baldwin. Summary Progress Report, 1 March 1959 to 1 December 1961. Prepared for U.S. Department of Health, Education and Welfare, Public Health Service, NIH.
CER61JEC76

A Control Structure for Measurement of Water and Sediment, by E. V. Richardson and D. D. Harris. U.S. Geological Survey Prof. Paper, 1962 Annual Review.
CER61EVR77

Diffusion of an Instantaneous Plane Source in a Steady Uniform Channel Flow, by A. R. Chamberlain. U.S. Geological Survey Paper to be presented.
CER61ARC78

Resistance to Flow in Alluvial Channels, by D. B. Simons and E. V. Richardson. Closure to ASCE.
CER61DES79

Flume Studies of the Transport of Pebbles and Cobbles on a Sand Bed, by R. K. Fahnestock and W. L. Hauschild, U.S. Geological Survey. Submitted to the Bulletin of GSA for publication.

CER61RIF80

Sediment Ejector for the Trimm-Sidhmal Link Canal, by S. S. Karaki. Model Investigation prepared for Tipton and Kalmbach, Inc., Denver, Colorado.

CER61SSK81

Research Reports, Papers, Bulletins and Theses, 1948 through 1961.

CER61RAS82

Observational Data on the Position of Hailfall with Respect to Precipitation Cells, by Richard A. Schlessener and Thomas J. Henderson. Atmospheric Science Technical Paper No. 25. Prepared for presentation at AMS Conference on Severe Storms, Norman Oklahoma, 13-15 February 1962.

CER62RAS1

Climatic Fluctuations Studied by Using Annual Flows and Effective Annual Precipitations, by Vujica M. Yevdjevich. Paper presented at the International Symposium on Climatic Changes, October 1 to 8, 1961, Rome, Italy. Symposium sponsored by UNESCO (co-sponsored by World Meteorological Organization, International Association for Meteorology, and International Association for Scientific Hydrology).

CER62VMY2.

On Identification of Hail-Bearing Clouds From Satellite Photographs, by H. Riehl and R. A. Schlessener. Submitted for publication to Journal of Applied Meteorology. Atmospheric Science Technical Paper No. 27.

CER62HR3

Flow Measurement in Open Channels, by A. R. Robinson and A. R. Chamberlain. A paper to be presented at National Meeting, ASCE, Houston, Texas, February 19-23, 1962. Joint contribution from Colorado State University and SWC Research Division, ARS, USDA, Fort Collins, Colorado.

CER62ARR-ARC4.

Uniform Water Conveyance Channels in Alluvial Material, Closure by D. B. Simons and M. L. Albertson.

CER62DBS-MIA5

Proceedings...Second Annual Bridge Engineering Conference, by J. W. H. Fead, M. E. Bender, and James R. Goodman. Compilation of Papers presented at the Second Annual Bridge Engineering Conference, Fort Collins, Colorado, March 18, 1961.

CER62JWHP6

PUBLICATIONS - Continued

Hydraulic Properties of Soils as Factors in Drainage Design, by R. H. Brooks. U.S. Dept. of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Northern Plains Branch. Paper presented at ARS-SCS Drainage Workshop, February 14-16, 1962, Riverside, California
CER62NHB7

Progress Report of Clay Sealing Investigations During 1961, by R. D. Ditzmeyer, Jr. Prepared for the Colorado Water Conservation Board, Colorado State University Experiment Station.
CER62IDD8

Discussion of R. H. Douglas' RECEIPT HAILSTORM RESEARCH - A Review, by Richard A. Schlausenar. Prepared for American Meteorological Society Conference on Severe Storms, Norman, Oklahoma, February 15, 1962.
CER62RAS9

Operation and Maintenance of the Low Speed Precision Wind Instrument Test Facility, by H. J. Plate. Final Report on White Sands Wind Tunnel, for U.S. Army Ordinance, White Sands Missile Range, New Mexico, under Contract No. DA-29-040-ORD-2346.
CER62LJF10

On the Nature of Clear-Air Turbulence (CAT), by Elmar R. Reiter and Robert W. Hayman. Scientific Interim Report prepared for the Naval Research Facility under Contract No. N189(188) 538-28A. Atmospheric Science Technical Paper No. 28.
CER62HRR11

Some Observations of Low-Level Wind Variation in the Vertical in Tropical Cyclones, by Arthur C. Pike. A report on research conducted under Contract No. CWB-9918 between the U.S. Weather Bureau and Colorado State University. Atmospheric Science Technical Paper No. 29.
CER62ACF12

Radiation Measurements over the Caribbean during the Autumn of 1960, by Herbert Riehl. A report on research conducted under Contract No. CWB-9918 between the U.S. Weather Bureau and Colorado State University. March 1962. ASFR 2.
CER62HR15

Meteorological Data 1887-1957, by Maxwell Parshall. Colorado State University and Colorado Agricultural Experiment Station. Bulletin 509-S.
CER62MP14

PUBLICATIONS - Continued

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CER62ARR15

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