BIBLIOGRAPHY

with annotations

ON WATER DIVERSION, CONVEYANCE AND APPLICATION FOR IRRIGATION AND DRAINAGE

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Water Management Research

in Arid and Sub-Humid Lands of the Less Developed Countries

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INTRODUCTION

This bibliography was prepared by members of the Civil Engineering team of the Water Management Research Project of Colorado State University (CSU). The Water Management Research Project is an interdepartmental undertaking of CSU acting as a member of the Council of United States Universities for Soil and Water Development in Arid and Sub-Humid Areas (CUSUSWASH). Other member universities are the University of California at Davis, Utah State University and the University of Arizona. The General Chairman of CUSUSWASH is A. R. Chamberlain, President of CSU.

The Director of the Water Management Research Project at CSU is Maurice L. Albertson, Professor-in-charge of the Water Resources Program in Civil Engineering. The project is sponsored by the United States Agency for International Development (USAID) under Omer Kelley, Deputy Director, Research and Institutional Grants Staff of the Agriculture and Rural Development Service, Office of the War on Hunger, USAID under Contract No. AID/csd-2162.

The Water Management Research Project has as its field of study the management of water for the optimum development of agriculture in arid areas with special reference to the Indus Basin of Pakistan. The intent is to apply an interdisciplinary approach with experts from water resources management, civil engineering, agricultural engineering, agronomy, economics, history, political science, sociology, and anthropology participating. The main purposes of the Project are to aid Pakistan and other arid and sub-humid areas in solving their water management problems and to cooperate with Pakistani centers of study to help them develop their research capabilities in the areas of water management.

The bibliography was prepared to compile a list of current publications of special interest to civil engineers on the subject of water management for agriculture. Topics covered by the bibliography include the following:

1. River Diversions
2. Fluvial Morphology and River Training
3. Diversion Structures
4. Canals and Related Structures
5. Sedimentation and Erosion
6. Farm Turnouts
7. Flow Measurement
8. Land Forming
9. Methods of Irrigation
10. Farm Drainage

In preparing this bibliography, publications from the following societies and organizations were surveyed:

1. American Society of Civil Engineers
2. American Society of Agricultural Engineers
3. International Association for Hydraulic Research
4. United States Bureau of Reclamation
5. United States Army Corps of Engineers
6. United States Geological Survey
7. Colorado State University
8. West Pakistan Engineering Congress
9. United States Department of Interior Water Resources Research Center
10. American Geophysical Union
11. Soviet Hydrology (published by American Geophysical Union)

In addition, the following sources were used:

1. "Bibliography of Irrigation, Drainage, River Training and Flood Control" published by the International Commission on Irrigation and Drainage.
2. "Engineering Index" published by Engineering Index, Inc. of New York.
3. "Dissertations Abstract" published by University Microfilms Inc. of Ann Arbor, Michigan.
4. "Geomorphological Abstracts" published by London School of Economics.
5. "Geophysical Abstracts" published by U. S. Geological Survey.
6. "Geoscience Abstracts" published by American Geological Institute of Washington, D. C.

Annotations and brief summaries in some cases were obtained from these sources and have been included.

The subject matter in this report has been split into three parts. The first part contains the main bibliographical entries numerically listed and alphabetically arranged according to the last name of the first author. Listings have been prepared in accordance with the recommendations laid down in "Bibliographic References" by Dorothy L. Anderson of Pennsylvania State University. The second part is an index containing a list of about two hundred key words selected from "Water Resources Thesaurus" published by the office of Water Resources Research of the U. S. Department of the Interior. The last part of the report is a source list containing addresses of periodicals, publications, societies and other sources which published the cited references.

After each key word are listed the assigned numerals of all entries dealing with it. Selection can be made for specific subjects by locating numerals common to the relevant key words. The numerals have been specially arranged in columns to facilitate this matching.

The bibliography is specifically prepared for the needs of the Civil Engineering team of the Water Management Research Project, but should also be helpful to those involved in planning, design and research in the general field of irrigation and drainage. It is hoped that readers will call to the attention of the writers any deficiencies. They would also appreciate comments on the utility of the indexing scheme.

The writers are deeply indebted to a number of persons who helped in the preparation of this report and take this opportunity to acknowledge their contribution. Our special thanks are due to Maurice L. Albertson without whose encouragement and guidance the completion of this report would not have been possible; and to Charles W. Thomas, Professor of Civil Engineering at C.S.U. who drew from his long association with the USBR, ASCE, and his work throughout the world in irrigation to advise on the search for pertinent literature. Thanks also are extended to Jose Mejia, Mustafa Kilinc and Allah Rakha, Graduate Students at C.S.U. who have researched, arranged and indexed the individual references. We are also indebted to Patricia Johanson who has typed all of the bibliographical entries in final form. We would also like to acknowledge Mary Grace Smith, Lorraine Stephens, and Betty Hutcheson for typing the remaining portions of the report and Mary Fox, Supervisor of the typing pool at the Engineering Research Center at C.S.U.

BIBLIOGRAPHY

1. Abalyants, S.H., "Study of Sediment Transport in Streams," Annual Bulletin of the International Commission on Irrigation and Drainage, 1962, pp. 71-75.

   Sediment transport research in the USSR is reviewed, mainly in connection with irrigation development. Poslovsky's, Girshkan's, and Cherkasov's work is noted. Later work based on more reliable data, connected with the mean value of coarseness of suspended sediment, is presented.

2. Abdel-Rahman, N.M., "Effect of Flowing Water on Cohesive Beds," Zurich Eidgenoessische Technische Hochschule. Versuchsanstalt fur Wasserbau und Erdbau, Mitteilungen No. 56, 1963, p. 114.

   Study of erosion phenomenon in pure cohesive soils, based on vane shear-strength of bed material and tractive stress of water; method of estimating resulting mean erosion depth at steady state is developed; with help of this method tractive resistance of such beds can be obtained; discussion of stability of channels in cohesive soils is also included together with estimation of their coefficient of bed roughness. 20 refs.

3. Abdel-Samie, A.G., "The Efficiency of Sprinkler Irrigation in Desert Soil Reclamation at Inchass Farm," Transactions of the Fourth Congress on Irrigation and Drainage, ICID, Vol. 4, 1960, pp. 12.521-12.554.

4. Abdullah, M.S. and Simons, D.B., "Pipe Insert Flow Meter," Colorado State University Agricultural Experiment Station, CER64MSA-DBS32, Nov. 1964.

5. Abdul, I. and Saeed, A., "Consistency and Comparison of Depth Integrating and Vertical Bottle Sampler," Irrigation Research Institute, Lahore, 1959.

6. Abdul, M., "Rehabilitation of Old Irrigation System - Bagramie Project, Afganistan," Proceedings Near East and South Asia Region, 5th Irrigation Practices Seminar, New Delhi. U.S. Agency for International Development Mission to India (USAID), New Delhi, March 2-14, 1964, pp. 219-222.

7. Abdulrabimov, T.I., "Irrigation in Azerbaijan USSR," International Commission on Irrigation and Drainage - Annual Bulletin, 1958, pp. 52-57.

8. Abid, A., "Effect of Bhakra Dam on the Gudu Inundation Canals," Irrigation Research Institute, Lahore, 1959.

9. Abid, A. and Abdul, L., "Design of Scouring Canals," Irrigation Research Institute, Lahore, 1959, p. 10.

10. Abul-Fetouh, Abdel-Hadi, "Flow over Escape Weirs," Transactions Fourth Congress on Irrigation and Drainage. International Commission on Irrigation and Drainage, Vol. 6, 1960, pp. C449-C465.

11. Ackers, P., "Charts for the Hydraulic Design of Channels and Pipes," Hydraulic Research Paper, Department of Scientific and Industrial Research, Hydraulic Research Station, Wallingford, England, 1963, Paper No. 2, 2nd ed., pp. 50.

12. Ackers, P., "Comprehensive Formula for Critical Depth Flumes," Water and Water Engineering, Vol. 65, No. 785, July 1961, pp. 296-306.

    Makes modifications to the usual solution for the head to discharge relationship in free flowing venturi flumes to allow for the head/loss, due to boundary friction in the throat.

13. Ackers, P., "Experiments on Small Streams in Alluvium," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 90, No. HY4, part 1, Paper 3959, July 1964, pp. 1-37.

    Experimental study indicates correlations between stream geometry and discharge; these are compared with established regime equations, with some areas of disagreement; results are analyzed on basis of sediment transport, channel roughness, and width-depth ratio; relationships can be used to predict geometrical functions.

14. Ackers, P., "Resistance of Fluids Flowing in Channels and Pipes," Hydraulics Research Paper, Hydraulics Research Station, Wallingford, England, 1958.

15. Ackers, P. and Harrison, A.J.M., "Critical-Depth Flumes for Flow Measurement in Open Channels," Department of Science and Indus. Research, Hydraulics Research Paper 5, 1963, p. 49.

Theory and design of critical-depth flumes of trapezoidal throat section are considered including limiting cases of common rectangular-throated and triangular-throated flumes; general design method is derived which leads to semi-graphical technique for obtaining theoretical calibration that includes allowance for frictional losses in throat. Analysis of some published data shows agreement between theoretical and measured discharges.

16. Adachi, S., "A Theory of Stability of Streams," International Association for Hydraulic Research, 12th Congress (Ft. Collins, Colo.), 1967, 1(A42), pp. 338-342.

In this paper stability of the stream is treated theoretically by using the small amplitude oscillation theorem to find the flow factor contributing to the origin of meandering. In order to express the lateral variations of a stream the mean quantities with respect to the flow depth are introduced into the basic equations.

17. Addison, H., "Land, Water and Food," Chapman and Hall - Second edition, 1961, 284 p.

18. Advani, R.M., "A New Method for the Solution of Hydraulic Jump Problems in Open Channels with Special Reference to Channels of Parabolic Sections," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 18, No. 7, July 1961, pp. 661-668.

19. Advani, R.M., "Critical Depth in Circular Channels - A New Method," Irrigation and Power, New Delhi, 1962, Vol. 19, No. 7, pp. 514-517.

A general method for formulating the basic equations in terms of suitable non-dimensional parameters is presented, with a view to universal types of solutions.

20. Advani, R.M., "Critical Depth in Trapezoidal Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 88, No. HY3, Paper 3122, May 1962, pp. 69-77.

Several methods of computing critical depth in trapezoidal channels are described; various equations are expressed in terms of suitable nondimensional parameters in order to make them universal in application.

21. Advani, R.M., "Design Calculations for Rough Turbulent Flow in Channels," Water and Water Engineering, Vol. 68, No. 821, July 1964, pp. 280-286.

Method of obtaining direct solution for rough turbulent flow in open channels; simplification of previous approach, with use of Manning's formula is expressed in terms of suitable nondimensional parameters; example calculations.

22. Advani, R.M., "Determination of Elements of Hydraulic Jump in Trapezoidal Channels," Institution of Engineers (India), Vol. 42, No. 9, Part CI5, May 1962, pp. 335-354.

Various methods of determining elements of hydraulic jump discussed; simple method of universal application devised by author, based on use of relative numbers coupled with sound dimensional reasoning, is presented and its importance outlined.

23. Advani, R.M., "Generalized Method for Solution of Hydraulic Jump Problems in Rectangular Channels," Indian Journal of Power and River Valley Development, Vol. 10, No. 7, July 1960, pp. 11-15.

In India methods of Blench, Montague, Crump and Brown, and known empirical formulas are used for determination of factors of hydraulic jump; in case of high dams, these methods have to be modified; author presents numerical table and diagram and extended version of Crump's table for determining elements of hydraulic jump in rectangular channel for case of high spillway dams.

24. Advani, R.M., "Hydraulic Jump in Trapezoidal Channels," Water Power, Vol. 18, No. 4, Apr. 1966, pp. 161-162.

Various methods of computing elements of hydraulic jump in trapezoidal channels are described; Belanger equation is expressed in terms of suitable nondimensional parameters to make it universal in application.

25. Advani, R.M., "New Method for Hydraulic Jump in Circular Channels," Water Power, Vol. 14, No. 9, Sept. 1962, pp. 349-350.

New method is presented which is particularly useful when given elements of flow are rate of flow and loss of energy.

26. Afzal, M., "Planning Irrigation Requirements," Symposium on Water Resources Development, West Pakistan Engineering Congress, Lahore, 1969, Vol. XI, Paper No. 89, pp. 13-40.

27. Agarwal, K.M., "A Short Note on Suitable Linings for Earthen Canals," Civil Engineering and Public Works Review, Vol. 50, No. 591, Sept. 1955, pp. 990-991.

Outlines methods for checking seepage losses from irrigation canals and the type of lining used for Sarda Power House Channel in Uttar Pradesk.

28. Agarwal, K.M., "Design of the Floor of a Regulator on a Medium Soil," Civil Engineering and Public Works Review, Vol. 51, No. 601, July 1956, p. 768.

29. Agarwal, S.C., "Result of Canal Seepage," Indian Farming, Vol. 82, 1956, pp. 206-207.

30. Agarwal, G.K. and Mital, J.P., "Development of Irrigation in U.P. (India)," 38th Annual General Session Lucknow, Institution of Engineers (India), 1958, pp. 85-89.

31. Agey, W.W. and Andrew, B.F., "Reduction of Seepage Losses from Canals by Chemical Sealants," United States Bureau of Mines, Report Investigations 6584, 1965, p. 73.

Study comprised alternative laboratory treatments of 3 in. deep test beds of canal earths with 74 water-soluble chemicals in search of one or more that would effectively improve water barrier characteristics of component clays; sodium carbonate, one of least expensive, was among most effective; addition of 0.4 lb of reagent per square yard greatly reduced seepage; effect of changes in hydraulic gradient, compaction, drying and wetting, freezing and thawing, and variation in dissolved salts in water.

32. Ahmad, H., "Silt Trouble in Jamrao Canal: ex-Nara Canal of Sukhur Barrage," Engineering News, West Pakistan Engineering Congress, Lahore West Pakistan, Dec. 1964, Vol. 9, No. 4, pp. 32-37.

Traces the trouble due to improper regulation; states that the silting trouble has been removed by a simple change in regulation.

33. Ahmad, K.S., "Reclamation of Waterlogged and Saline Lands in West Pakistan," Pakistan Geographical Review, Vol. 16, No. 1, 1961, pp. 1-18.

34. Ahmad, K.S. and Abbasi, A.A., "Evolution of Drainage in the Indus Plain," Pakistan Geographical Review, Vol. 15, No. 2, 1961, pp. 1-18.

35. Ahmad, M. and Ali, A., "Effect of Barrages on the Regime of Rivers of Indus Basin," Proceedings of the 9th Annual Meeting of the International Association for Hydraulics Research, Paper IV/22, 1961, pp. 1177-1194.

36. Ahmad, M., "Automatic Regulator for Outlets," Irrigation Research Institute, Lahore, Technical Note, 1959.

37. Ahmad, M., "Design of Silt Excluders and Silt Ejectors," Golden Jubilee Publication, West Pakistan Engineering Congress, October 1963, Part II, pp. 85-120.

38. Ahmad, M., "Effect of Scale Distortion of Model Bed Material and Time Scale on the Geometrical Similarity of Local Bed Scour," Proceedings of the 6th General Meeting of the International Association for Hydraulic Research, D-4, 1955, pp. 1-16.

Results of a number of model investigations made from time to time have been analyzed to study the geometrical similarity of localized scour in relation to the following factors. 1. Scale distortion. 2. Change in the size of bed material of the model. 3. Time scale. Scale distortion from friction, regime flow and tractive force formulae have been tested and limits to scale distortion have been suggested.

39. Ahmad, M., "Model of Hydiara Siphon," Irrigation Research Institute, Lahore, 1959, p. 9.

40. Ahmad, M., "Model Studies for the Ejectors of the Right Bank of Gudu Barrage," Irrigation Research Institute, 1959, p. 7.

41. Ahmad, M., "Model Studies for the Feasibility and Design of an Excluder at the Intake of Warsak Power Tunnel, Irrigation Research Institute, 1959, p. 15.

42. Ahmad, M., "Model Studies of Kurram Garhi Weir for Prevention of Shingle Entry into the Head Regulator," Irrigation Research Institute, Lahore, 1959, p.3.

43. Ahmad, M., "Model Studies of Silt Ejector for Shadiwal Hydel," Irrigation Research Institute, Lahore, 1959, p.9.

44. Ahmad, M., "Model Tests for Silt Exclusion from the Off-Taking Canals of Gudu Barrage," Irrigation Research Institute, Lahore, 1959, p. 10.

45. Ahmad, M., "Observation, Record and Analysis of Pressure Pipe, Data of Weirs on Permeable Foundations," Proceedings of West Pakistan Engineering Congress, Lahore, 1952, Vol. XXXVII, Paper No. 294.

46. Ahmad, M., "Role of Research in the Control and Use of Water," Symposium on Role of Engineering Research in Developing Economy of Pakistan, West Pakistan Engineering Congress, Lahore, Oct. 1966, Vol. IX, No. 77.

47. Ahmad, M., "Silt Ejector for M.R. Link Canal," Irrigation Research Institute, Lahore, 1959, p. 5.

48. Ahmad, M., "Some Aspects of Design of Headworks to Exclude Sediment from Canals," Proceedings of the 4th General Meeting of the AIAH, Bombay, 1951, pp. 175-203.

49. Ahmad, M., "Some Aspects of the Design of Weirs or Canal Falls in Relation to Scour," Proceedings of West Pakistan Engineering Congress, Lahore 1951, Vol. XXXVI, Paper No. 289.

50. Ahmad, M., "Studies in Some Hydraulic Features of the Design of Taunsa Barrage," Proceedings of West Pakistan Engineering Congress, Lahore, 1956, Vol. XL, Paper No. 315, Part A.

51. Ahmad, M., Latif, A., and Ali, M., Ch., "Studies in Hydraulic Features of the Design of Taunsa Barrage," Proceedings of West Pakistan Engineering Congress, Lahore, 1956, Vol. XL, Paper No. 315, Part B.

52. Ahmad, M., Ahmad, Mian, M.,and Awan, S.A., "Automatic Regulator to Obtain Constant Discharge in a Channel for a Widely Varying Incoming Flow," Third Congress on Irrigation and Drainage, R5 Q9, 1957.

53. Ahmad, M. and Rehman, Ch. A., "Design of Alluvial Channels as Influenced by Sediment Charge," Proceedings, West Pakistan Engineering Congress, Lahore, 1962, Vol. XLVI, Paper No. 351.

54. Ahmad, M. and Rehman, A., "Silt Carrying Capacity of a Channel and Criteria for Canal Closure Against Excessive Silt Entry," Proceedings of the West Pakistan Engineering Congress, Vol. 45, Part 1, Paper No. 350, 1961, pp. 101-124.

Investigate the problem of silt carrying capacity of a channel and permissible limit of sediment entry into a canal through a rational approach from the mechanics of sediment transport on bed and in suspension and using bed material composition curves.

55. Ahmad, M. and Ali, M., "Some Salient Features of Silt Ejector in an Alluvial Channel Based on Hydraulic Model Studies," Symposium on Sedimentation Problems as a Result of Indus Basin Works, West Pakistan Engineering Congress, Lahore, Apr. 1962, Vol. VI No. 44.

56. Ahmad, M. and Ali, M., "Studies in Some Hydraulic Features of the Designs of Taunsa Barrage, Part III," Proceedings of West Pakistan Engineering Congress, Lahore, 1957, Vol. XLI, Paper No. 327.

57. Ahmad, M., Ali, M., and Khaliq, A., "Sediment Exclusion Methods and Devices at the Intake of Canals," West Pakistan Engineering Congress, Paper No. 341, 1960, pp. 1-31.

58. Ahmad, M. and Ibrahim, M., "On Silting Distribution and Factors Affecting Sediment Exclusion from Canals," Proceedings of West Pakistan Engineering Congress, Lahore, 1954, Vol. XXXVIII, Paper No. 301.

59. Ahmad, M. and Rehman, A., "Appraisal and Analysis of New Data from Alluvial Canals of West Pakistan in Relation to Regime Concepts and Formulae," Proceedings of West Pakistan Engineering Congress, Lahore 1963, Vol. XLVII, Paper No. 356.

60. Ahmad, N, "A Comparative Study of Various Types of Energy Dissipators," Proceedings of the 3rd General Meeting of the IAHR, Paper No. 4, 1949, pp. 1-7.

61. Ahmad, N. and Razzaq, A., "A Stable and Impervious Lining for Canals of West Pakistan," Proceedings of West Pakistan Engineering Congress, Lahore, 1960, Vol. XLIV, Paper No. 344.

62. Ahmad, N., "A Study of the Rise of Ground Water and Its Salinity in the Irrigated Areas of Indus Plains," Symposium on Waterlogging and Salinity in West Pakistan Golden Jubilee Session, West Pakistan Engineering Congress, Lahore, Oct. 1963, Vol. VII, No. 60.

63. Ahmad, N., "Canal Lining Investigations," Indus, Vol. 2, No. 9, Oct. 1961.

64. Ahmad, N., "Drainage of Irrigated Soils in Arid Regions, a Review on the Drainage Measures Adopted by Various Countries and a Discussion of the Information Available in the Punjab," Proceedings of the Engineering Congress, Pakistan, Paper No. 312, Vol. 39, 1955.

65. Ahmad, N., "Field and Laboratory Experiments on Seepage Measurements from Conventional Type of Double and Single Type Lining in Use in West Pakistan," Irrigation Research Institute, Lahore, Report No. 138, Ph/L.C. 20, 1957.

66. Ahmad, N., "Irrigation Practice in Pakistan with Special Reference to the Design of Energy Dissipators," Pakistan Journal of Science, Vol. 5, No. 1, Jan. 1953.

67. Ahmad, N., "Lining of Abbasia Canal," Irrigation Research Institute, Lahore, Report No. 148, Ph/L.C.24, 1957.

68. Ahmad, N., "Lining of Channels: a Short Review of the Laboratory Tests Carried out on the Various Types of Lining Materials," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research,, Bombay, 1951, pp. 81-125.

69. Ahmad, N., "Mechanism of Erosion Below Hydraulic Works," Proceedings of the 5th General Meeting of the International Association for Hydraulic Research, 1953, pp. 133-143.

70. Ahmad, N., "Optimum Dimensions of Energy Dissipators Below Flat Weirs and Falls," Proceedings of the 3rd General Meeting of the International Association for Hydraulic Research, Grenoble, Paper No. 5, 1949, pp. 1-10.

71. Ahmad, N., "Problems of Canal Lining in West Pakistan," 3rd International Congress on Irrigation and Drainage, 1957.

72. Ahmad, N., "Problems of Irrigated Soils of West Pakistan," UNESCO Tashkent Seminar, Aug. 1962.

73. Ahmad, N., "Research on Water and Land for Survival," Symposium on Role of Engineering Research in Developing Economy of Pakistan, West Pakistan Engineering Congress, Lahore, Oct. 1966, Vol. IX, No. 80.

74. Ahmad, N., "Sediment in Rivers of Indus Basin," Pakistan Journal of Sciences, Vol. 8, No. 5, Sept. 1956.

75. Ahmad, N., "Soil Erosion by the Indus and its Tributaries," Pakistan Geographical Review, Vol. 15, No. 2, 1960, pp. 5-17.

This paper attempts to estimate the severity of soil erosion in the Indus catchment by recording measurements at specific points on the rivers concerned, of runoff, sediment load (in terms of sand silt and clay in suspension), and bedload (assumed to be 20% of the total suspended load, and to be composed of sand).

76. Ahmad, N., "Water Conservation Studies for West Pakistan," Symposium on Role of Engineering Research in Developing Economy of Pakistan, West Pakistan Engineering Congress, Lahore, Oct. 1966, Vol. IX, No. 81.

77. Ahmad, N., Salah-Ud-Din, F.K., and Ali, D., "Sediment in Rivers of the Indus Basin. III.-Actual Measurement of Sediment Content," Pakistan Journal of Science, Vol. 9, No. 6, Nov. 1957, pp. 250-260.

78. Ahmad, N., and Ali, D., "Sediment of the Indus," Journal of the West Pakistan Water and Power Development Authority, 1, Queens Road, Lahore, (West Pakistan), Aug. 1962, Vol. 3, No. 7, pp. 10-17.

Detail scientific analysis of the sediment load with special reference to the erosion of the catchments of the Indus and its tributaries.

79. Ai, Y.H. and Huang, H.C., "A Study on Several Economic Questions Concerning Land Leveling," U. S. Joint P. Res. Serv. Transl., Chingchi Yen-Chiu (Econ. Res.), June 4, 1964, Vol. 3, pp. 91-102.

80. Aksoy, S., "An Analytical Study of the Riverbed Degradation Downstream of Large Dams," Proceedings of the 11th General Meeting of the International Association for Hydraulic Research, Vol. 3, No. 5, 1961, pp. 1-9.

81. Alam, A.M.Z., Cheyer, T.F. and Kennedy, J.F., "Friction Factors for Flow in Sandbed Channels," Massachusetts Institute of Technology, Department of Civil Engineering, Hydrodynamics Laboratory, Report No. 78, June 1966, pp. 98.

New method for determining friction factors of flow in erodible-bed channels is developed from stability analysis of fluid-bed interface, with yield expression for length-height ratio of bed forms that is then used in dimensional analysis of friction factor problem.

82. Albertson, M.L., "Turbulence Flume to Measured Bed Load," Transactions of the American Geophysical Union, CER47-52MLA52, Colorado State University, Ft. Hills, 1951, Vol. 32, pp. 7.

In planning water-control works involving canals, it is of utmost importance that consideration be given to the sediment load which is to be carried by the canal. This load should be considered in relation to the capacity of the canal for carrying sediment and the load which is being carried by the stream or other body of water from which the canal derives its supply.

83. Albertson, M.L., Barton, J.R., and Simons, D.B., "Fluid Mechanics for Engineers," Prentice-Hall Publishing Company, 1960, 500 pp.

An elementary and intermediate treatment of fluid mechanics intended primarily to serve the student of fluid mechanics; also intended to serve the practicing engineer and researcher who need to have a convenient reference to the basic principles and applications of fluid mechanics.

84. Alexander, G.N., Karoly, A., and Susts, A.B., "Divertible Flow of Streams," Institution of Engineers (Australia), Civil Engineering Transactions, Vol. CE 8, No. 1, Apr. 1966, pp. 29-43.

If flow in stream can be specified by parameters required to define one of log-normal, gamma and Weibull distributions, then from analysis given estimates can be obtained of proportion of mean flow that can be diverted by channel of given capacity; consideration is also given to selection of distribution type and to requirements regarding storage at point of diversion; graphs are provided to obtain results directly for log-normal and γ distributions.

85. Alger, G.R., and Simons, D.B., "Fall Velocity of Irregular Shaped Particles," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 94, No. HY3, Paper No. 5949, May 1968, pp. 721.

86. Algert, J.H., "A Statistical Study of Bed Forms in Alluvial Channels," U.S. Geological Survey, Colorado State University, CER 65 JHA 26, June 1965.

87. Algert, J.H., "Statistics of Sand Channel Bed Forms," M.S. Thesis at Colorado State University, June 1965.

88. Alghita, B.K., "The Problem of Freeboard in Irrigation Channels, Drainage Channels, Embankments, Levees, and Reservoirs," Transactions of the 2nd Congress on Irrigation and Drainage, R4Q3, 1954.

Factors affecting freeboard in irrigation channels.

89. Ali, M., "Earthwork on Irrigation Works in the Land of the Indus," Proceedings of West Pakistan Engineering Congress, Lahore, 1966, Vol. XLVIII, Paper No. 378.

90. Ali, M., "Lining of Link Canals," Engineering News (Pakistan), Lahore, West Pakistan, Sept. 1962, Vol. 7, No. 3, pp. 17-25.

Examines the suitability or otherwise of lining link canals of the Indus Basin Replacement plan, and the economies of pumping out the seepage losses by tubewells; selects Trimmu-Sidhai Link as a typical example for his examination.

91. Ali, M., "Design of Outlets," Golden Jubilee Publication West Pakistan Engineering Congress, Oct. 1963, Part II, pp. 161-218.

92. Ali, M., "Hydraulic Features of Distributary Head Regulator," Golden Jubilee Publication, West Pakistan Engineering Congress, Oct. 1963, Part II, pp. 121-160.

93. Allen, J.W., "The Discharge of Water Over Side Weirs in Circular Pipes," Proceedings of the Institution of Civil Engineers, Vol. 6, Feb. 1957, pp. 270-287.

Reviews formulas of various workers; gives details of experimental work done by the author on side weirs formed in the wall of a circular pipe.

94. Allen, J., and Albinson, B., "An Investigation of the Manifold Problem for Incompressible Fluids with Special Reference to the Use of Manifolds for Canal Locks," Proceedings of the Institution of Civil Engineers, Vol. 4, No. 1, Apr. 1955.

95. Allen, J., and Chee, S.P., "Resistance to Flow of Water Round Smooth Circular Bend in Open Channel," Institution of Civil Engineer, Proceedings, Vol. 23, Nov. 1962, pp. 423-434.

Attempt to clarify certain aspects of scale effect exhibited by models of open channels containing bends; apparently simple case of smooth channel including one semicircular bend was studied; from tests on 3 such channels it is shown how total loss of head is affected by depth, Reynolds number and Froude number, and how scale effect can be reduced by exaggerating vertical scale; desirable exaggeration depends not only on horizontal scale but also upon width/depth ratio in larger channel which model is designed to simulate.

96. Allen, R.G., "Water Supplies and Conservation," Journal of the Royal Society of Arts, London, England, Apr. 1963, Vol. VIII, No. 5081, pp. 384-402.

Includes discussion.

97. Allred, E.R., and Machmeier, R.E., "Effect of Wind Resistance on Rotational Speed of Boom Sprinkler, (a theoretical analysis)," Transactions of the American Society of Agricultural Engineers, Saint Joseph, Michigan (USA), 1962, Vol. 5, No. 2, pp. 218-219 and 225.

98. Allred, E.R., and Machmeier, R.E.,"Use of Boom Sprinklers for Irrigation," Minnesota Farm and Home Science, St. Paul (USA), Spring 1962, Vol. 19, No. 3, pp. 10, 17, 19.

99. Al-Shaikh Ali, K.S., "A Field Study of Energy Loss in Bends in Rigid Boundary Trapezoidal Channels," Ph.D. Dissertation at Colorado State University, June 1964.

100. Al-Shaikh, A., "Flow Dynamics in Trapezoidal Open Channel Bends," Colorado State University, Ph.D. Dissertation, Reference No. Tc 175-S536, 1964.

101. Amer, A.M., "Eliminating Waterlogging Caused by Canal Seepage," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 92, No. IR2, Proceedings Paper 4840, June, 1966, pp. 33-46.

The phenomenon of waterlogging caused by canal seepage flow is described, using a covered interceptor, for the hydrogeological conditions of the Nile Valley (Egypt, U.A.R.) The problem is considered as a two-dimensional steady-seepage flow from a canal into an interceptor drain, placed in a semipervious aquifer, with a deep impervious stratum. The resulting mathematical theory is checked with an experimental study. The method of calculating the interceptor drain is given, and a practical example is solved. It is concluded that the maximum efficiency of interceptor drains, adopted for such hydrogeological conditions, can be attained by keeping a certain ratio between the hydraulic permeability of the aquifer and the clay layer.

102. Amer, F., and El Gabaly, M.M., "Tile Spacing in the Nile Delta," Alexandra Journal of Agricultural Research, Alexandria (UAR), Jan. 1962, Vol. 10, No. 1, pp. 97-109.

103. American Society of Agricultural Engineers, "Minimum Requirements for the Design, Installation and Performance of Sprinkler Irrigation Equipment," Agricultural Engineering, The Journal of the American Society of Agricultural Engineers, Vol. 32, No. 3, Mar. 1951, pp. 166 and 168.

These proposed American Society of Agricultural Engineers sponsored recommendations were initiated in 1948 by the American Society of Agricultural Engineers Subcommittee on Sprinkler Irrigation. Part I. Design and Performance: 1. Application Rate; 2. System Capacity; 3. Depth of Water Application; 4. Uniformity of Water Application; 5. Crop Damage. Part II. Dealer-Purchaser Responsibilities: A. Dealer Responsibility; 1. Proper Design; and 2. Proper Installation.

104. American Society of Agricultural Engineers, "Minimum Requirements for the Design, Installation, and Performance of Sprinkler Irrigation Equipment," British Columbia Department of Agriculture, Engineering Division, B.A.E. 20, 1962, p. 4.

105. American Society of Agricultural Engineers Committee on Pump Drainage, "Selected Bibliography on Pump Drainage," Transactions of the American Society of Agricultural Engineers, 1960, pp. 62-64.

106. American Society of Civil Engineers, "Irrigation and Drainage Research Conference," report by the Research Committee of the Irrigation and Drainage Division, Paul H. Berg, Chairman, Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 90, No. IR4, Proceedure Paper 4180, Dec. 1964, pp. 1-106.

The purpose of the Conference was to bring together scientists, engineers, and others who are authorities in the field of irrigation and drainage science to freely exchange ideas and knowledge in their specialties. The objectives of the Conference were to delineate and stimulate research needs in the selected subject fields. The advancement of knowledge and employment of the quality of engineering in planning, design, operation, and maintenance of irrigation and drainage systems was the ultimate objective of the Conference deliberations.

107. American Society of Civil Engineers, "Irrigation Research in the United States and Canada," American Society of Civil Engineers, 1957, pp. 102.

108. American Society of Civil Engineers, "Sediment Transportation Mechanics - Introduction and Properties of Sediment," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 88, No. HY4, Pt. 1, Paper 3194, July 1962, pp. 77-107.

Progress Report by Task Committee on Preparation of Sedimentation Manual; size, shape and specific weight of sediment particles; fall velocity of spheres; effect of shape of particle on fall velocity, and of sediment concentration on settling velocity; fall velocity of sand grains; effect of size of settling column on fall velocity; size frequency distributions; specific weight of sediment deposits.

109. American Society of Civil Engineers, "Sediment Transportation Mechanics -Wind Erosion and Transportation," American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, Mar. 1965.

110. American Society of Civil Engineers, "Sediment Transportation Mechanics - Nature of Sedimentation Problems," Proceedings of the American Society of Civil Engineers, Vol. 91, No. HY2, Pt. 1, Paper 4260, Mar. 1965, pp. 251-266.

Progress Report of Task Committee on preparation of sedimentation manual; hydrospheric forces are considered; information is presented in manual on processes of erosion, transport, and deposition influencing damages created by sediment.

111. American Society of Civil Engineers, "Sediment Transportation Mechanics, Suspension of Sediment," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY5, Pt. 1, Paper 3636, Sep. 1963, pp. 45-76.

Turbulence, as factor in suspension of sediment, is defined and diffusion mechanism is examined; differential equation for suspension of sediment and equations for distribution of suspended sediment in turbulent flow are derived; agreement between suspended load distribution equation and measurement of suspended load and effect of suspended sediment on flow characteristics is examined.

112. American Society of Civil Engineers, "Sediment Transportation Mechanics - Erosion of Sediment," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 88, No. HY4, Pt. 1, Paper 3195, July 1962, pp. 109-127.

Progress Report by Task Committee on Preparation of Sedimentation Manual; land erosion; local scour; scour by jets; scour due to hydraulic structures; degradation and aggradation.

113. American Society of Civil Engineers, "Erosion of Cohesive Sediments," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 94, No. HY4, Paper 6044, July 1968, pp. 1017.

114. Amrik, S., "Uppal Instantaneous Suspended Sediment Sampler," Indian Journal of Power River Valley Development, 612 Madan Street, Calcutta-13 (India), Aug. 1962, Vol. 12, No. 8, pp. 7-10.

115. Ansley, R.W., "Sediment Transport in Supercritical Flow," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY6, Pt. 1, Paper 4533, Nov. 1965, pp. 57-65.

Study is made of transition between flow of solids-fluid mixture in fully suspended regime and flow with sediment bed; it is shown that critical deposit condition is function of solids concentration, Reynolds number, Froude number, and geometry of flow; dimensional analysis is tested by experimental data; sand-water mixtures were studied in supercritical open-channel flow in small laboratory flume.

116. Ananda Rao, V., "Irrigation in Madras State," Indian Journal of Power and River Valley Development, Vol. 9, No. 5, May 1959, pp. 11-18.

117. Ananthanarayanan, N.S., "Energy Dissipation Below Hydraulic Structures," Irrigation Research Division (Poosidi, India), Report No. Misc. 3/55, July 1955.

118. Anderson, H.W., "Suspended Sediment Discharge as Related to Stream Flow, Topography, Soil, and Land Use," Tranactions of the American Geophysical Union, Vol. 35, No. 2, Apr. 1954, pp. 268-281.

119. Andre, H., "Chemical Flow Gaging - The Integration Method," La Houville Blanche, No. B, 1960, pp. 833-843, French.

Reviews principles and basic assumptions of the method; gives operational procedures; examines the results, brings out the possibilities, advantages and drawbacks of the methods; suggests improvements.

120. Argyriadis, C., and Luthin, J.N., "Criteria for Tile Drain Springs in Artesian Areas," Tranactions of the American Society of Agricultural Engineers, 1960, pp. 87-89.

121. Argyropoulos, P.A., "Cross-Sectional Shape and Irregularities in River Channels," Proceedings of the 12th Congress of the International Association for Hydraulic Research, 1 (A33), 1967, pp. 262-271.

This is a comprehensive report of studies on channel cross-sectional shapes and irregularities in the light of hydrology and hydromorphology. Before discussing the specific problems, these two subjects are briefly surveyed, followed by a study of elements affecting the shape of channels and their irregularities.

122. Argyropoulos, P.A., "General Solution of Hydraulic Jump in Sloping Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 88, No. HY4, Pt. 1, Paper 3190, July 1962, pp. 61-75.

Generalized analysis of hydraulic jump in sloping or horizontal prismatic channels of any cross-sectional shape is presented, which leads to simple and practical method of computing essential dimensions of phenomenon.

123. Argyropoulos, P.A., "Modern Conceptions of Hydraulic Resistances of Unsteady Flows in Natural Stream Channels," Proceedings of the 11th General Meeting of the International Association for Hydraulics Research, Vol. 3, No. 19, 1965, pp. 1-6.

124. Argyropoulos, P.A., "New Direct Method for Computing Resistance to Flow in Open Channels," Kentucky University -Engineering Experiment Station, Bulletin 80, Mar. 1966, pp. 44.

New direct method for computing flow resistance in open-channels is proposed; method is based on formation of rapidly varied flow local phenomenon of hydraulic jump; proposed method is generally applied in exponential conduits and particularly in rectangular, triangular, and parabolic open-channels; verification of method by using experimental data is realized; other different analytical and practical elements are given; during laboratory investigation of hydraulic jump in parabolic and triangular channel, experiments were carried out with jump produced by water flowing from adjustable sharp-edged vertical sluice gate.

125. Argyropoulos, P.A., "The Hydraulic Jump and the Effect of Turbulence on Hydraulic Structures,Contribution to the Research of the Phenomenon," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1/6, pp. 173-183.

The excessive turbulence and eddies produced by the hydraulic jump are of special interest in the stability and general correspondence of overflow-dams, sluice-gates, weirs and other hydraulic structures. Generally, the theory of the-jump is associated intimately with erosion and its control.

126. Argyropoulos, P.A., "Theoretical and Experimental Analysis of the Hydraulic Jump in a Parabolic Flume," Proceedings of the VII Congress of the International Association of Hydraulic Research, Section D, 1957, pp. 1-19.

127. Arhen, T.P., "Ground Water: Its Use for Irrigation, Safe Yield from Alunite Area or Basin, Artificial Recharge of Supply, and Planned Utilization of Underground Reservoirs," Transactions of the 2nd Congress on Irrigation and Drainage, Question 6, R. 1, 1954.

128. Arnborg, L., "Suspended Load Transportation and Deposition in Connection with Dredging of River Bed," International Association for Hydraulic Research, 11th Congress, Leningrad, 1965, 3.49.

Deals with the increase in suspended load caused by dredging operation and its subsequent deposition downstream. Method proposed can also be used for forecasting changes in water quality by artificial measures in river channels, as by pulp mills and for estimating deposition rates within river basins and power plant reservoirs.

129. ARS-SCS Workshop on Hydraulics of Surface Irrigation, Proceedings of the Workshop, Denver, Colorado, Feb. 9-10, 1960, pp. 110.

130. Arumugam, S., "Development of Village Irrigation Works," The Engineering Association of Ceylon, Colombo, 1957, pp. 115.

131. Asar, H.J., "Alternative Proposals for Remodelling Marala Headworks," Proceedings of West Pakistan Engineering Congress, Lahore, 1963, Vol. XLVII, Paper No. 360.

132. Asar, H.J., "Irrigation Practices of Pakistan," Engineering News, West Pakistan Engineering Congress, Lahore, West Pakistan, Mar, 1963, Vol. 8, No. 1, pp. 35-39.

Gives a brief history of irrigation development in Pakistan; describes present practices peculiar to Pakistan.

133. Asar, H.J.,,"Marala Headworks - Site Investigation," Proceedings of West Pakistan Engineering Congress, Lahore, 1965, Vol. XLVIII, Paper No. 364.

134. Asar, H.J., "Remodelling of Irrigation Works," Engineering News (Pakistan), Vol. 6, No. 2, June 1961, pp. 39-42.

135. Asbeck, W.F., "Asphalt Irrigation Canal Linings," Third Congress on Irrigation and Power, R1, Q7, 1957.

136. Asghar, A.G., "Distribution System of Irrigation Projects in Pakistan," Third Regional Irrigation Practices Leadership Seminar NESA Region, Lahore, Feb. 15-26, 1960, pp. 141-151.

136. Continued
Describes a typical canal distribution system; discusses problems of irrigation practices such as water requirements of different crops, methods of irrigation.

137. Asghar, A.G., "Particular Problems in Water Short Areas (West Pakistan)," Pakistan Journal of Science, Lahore, West Pakistan, July 1963, Vol. 4, No. 15, pp. 171-189.

138. Asghar, A.G., "Use of Limited Water Supply," Second Regional Irrigation Practice Leadership Seminar, Teheran, 1959, pp. 49-65.

139. Asghar, A.G., and Ahmad, N., "Drainage of Irrigated Soil in Arid Regions," Proceedings of West Pakistan Engineering Congress, Lahore, 1955, Vol. XXXIX, Paper No. 312.

140. Ashburn, C., "How to Cut Irrigation Water Losses," Reclamation Era, No. 2, May 1957, pp. 33-34.

141. Askochensky, A.N., "Basic Trends and Methods of Water Control in the Arid Zones of the Soviet Union," UNESCO, UNESCO House, Place de Fontenoy, Paris-7 (France), Arid Zone Res. No. 18, 1962, pp. 401-410.

142. Asthana, K.C. and Rao, G.K., "New Approach to Design of Most Economical Trapezoidal Section of Open Channels," Institution of Engineers (India), Vol. 46, No. 7, Pt. CI 4, Mar. 1966, pp. 251-265.

Paper reviews two equations used for design of most economical trapezoidal section of open channel and brings out that when bottom width and depth of channel have to be limited due to physical considerations, these equations, which consider side slope as constant, cannot be satisfied when either bottom width or depth of channel, instead of its side slope, has to be kept constant.

143. Aswathnarayan, T.R., "Distribution System in Chambol Main Canal," Indian Construction News, Vol. 9, No. 10, 1960, pp. 59-67.

144. Austin, W., "How to Stretch Water Supplies," Western Crops and Farm Management, California (USA), Mar. 1962, Vol. 11, No. 3, pp. 44-48.

145. Ayers, H.D., "Economics of Portable Sprinkler Irrigation System Design for Annual Crops in Subhumid Areas," Transactions of the 4th Congress on Irrigation and Drainage, ICID, Vol. 4, R. 3, 1960, pp. 12.21 to 12.32.

146. Azaria, A., "Relations between Farm Irrigation Practices and Project Design and Management," Second Regional Irrigation Practices and Leadership Seminar, Teheran, 1959, pp. 66-75.

147. Azarnia, A., "The Development of Water Resources in Iran-Its Problems and Implications," F.A.O. World Food Congress, United Nations, Rome, Italy, May 3, 1963, Document No. WFC/63/CP/1A/2B, pp. 7.

148. Babington, S., "Design of Canal Structures: Some Features of the Major Aqueducts," Indian Journal of Power and River Valley Development, Vol. VI, No. 10, Oct. 1956, pp. 109-116.

Outline of the main canal structures such as regulators, outlets, falls, aqueducts, super-passages, level crossings and road crossings of the Hirokud Canal System.

149. Bagley, M.J., "Co-Operative Sprinkler Irrigation Projects," Australian Irrigator-Pasture Improver, Sydney, Australia, Apr. 1962, Vol. 7, No. 5, pp. 20-24.

150. Bagnold, R.A., "Some Aspects of the Shape of River Meanders," United States Geological Survey, Professional Paper 282-E, 1960.

151. Bagnold, R.A., Wolman, M.G., and Brush, L.M., "Flow Resistance in Sinuous or Irregular Channels," United States Geological Survey, Professional Paper 282-D, 1960

152. Bail, J.N., "Overcoming Weed Trouble in Head Ditches," Mallee Hort Digest, Vol. 7, No. 2, Oct. 1960, pp. 23-25.

153. Bakhsh, S.A., and Muzafar, A., "Construction Aspects of Balloki - Sulemanki Link," Proceedings of West Pakistan Engineering Congress, Lahore, 1954, Vol. XXXVIII, Paper No. 307.

154. Baleshwar, N., "Economic Utilization of Irrigation Supplies," Bhagirath, Vol. 4, No. 5, Oct. 1957, pp. 181-185.

155. Baleshwar, N., "Efficiency of Irrigation Works," Indian Journal of Power and River Valley Development, Calcutta, India, June 1963, Vol. 13, No. 6, pp. 33-36.

156. Baleshwar, N., "Irrigation in India - Its Varied Aspects," Bhagirath, Apr. 1957, Vol. 3, No. 11, pp. 496-501.

157. Ball, J.W., "Limitations of Metergates,"" Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 88, No. IR4, Pt. 1, Paper 3359, Dec. 1962, pp. 23-38.

Hydraulic and physical characteristics of device for measuring irrigation water; metergates of different sizes were tested and evaluated for flow measuring; research on 10 in. diam plastic pipe with square edge flush entrance to add general information for analyzing metergate tests.

158. Bandini, A., "Economic Problem of Irrigation Canals-Seepage Losses," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 92, No. IR4, Paper No. 5034, Dec. 1966, pp. 35-57.

Method for simplifying calculation, aiming at economic solution of canal lining problem without lessening precision of results is presented; problem is defined in terms of functions having as independent variable canal water depth, by means of which all factors are coordinated and connected.

159. Banerji, E.A.R., "Problems and Possibilities of Irrigation Agriculture in West Bengal," Indian Journal of Power and River Valley Development, Vol. 7, No. 9, Sep. 1957, pp. 75-78.

160. Banks, H.O., "Irrigation in the Future," American Society of Civil Engineers Journal of Urban Planning and Development Division, Jan. 1967, Vol. 93, No. UP1, pp. 41-55.

Projections of need for irrigated agriculture in the next 50 years were calculated for three areas.

161. Baring, R., and Goodland, N.L., "Irrigation in a Temperate Climate," World Crops, London, England, Mar. 1964, Vol. 16, pp. 58-62.

162. Barishnikov, N.B., "Sediment Transportation in River Channels With Flood Plains," Publications of the Association Internationale d'Hydrologie Scientifique, No. 75, 1967, pp. 404-412.

It is difficult to determine the effect of turbulent interaction upon sediment transportation in river channels within flood-plains. At the laboratory of the Leningrad Hydrometeorological Institute, more than 200 tests were carried out in two flumes, one 40, the other 110 cm. wide.

163. Bartels, L.F., "Efficient Pasture Irrigation on a Claypan Soil," Journal of the Department of Agriculture of Victoria (Australia), Vol. 59, No. 4, Apr. 1961, pp. 179-183, 201.

164. Bartels, L.F., "Flood Irrigation of Pastures," Journal of the Department of Agriculture of Victoria (Australia), Aug. 1963, Vol. 61, No. 8, pp. 369-373.

165. Bartels, L.F., "Hydraulic Roughness of a Flooded-Irrigated Pasture," Transactions of the American Society of Agricultural Engineers, Vol. 3, No. 1, 1960, pp. 71-72.

166. Bartels, L.F., "Timetable for Spray Irrigation," Journal of the Department of Agriculture of Victoria (Australia), Vol. 57, No. 2, 1959, pp. 77-80.

167. Bashiruddin, S., "Irrigation in U.S.S.R." New Irrigation Era, Vol. V, No. 5, Vol. V, No. 6, Oct. 1957, pp. 17-29, and pp. 2-8.

168. Basset, D.L., and Tinney, E.R., "Water Surface Configuration and Velocity of Advance in Hydraulic Laboratory Test," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 11-18.

169. Basu, S.K., "Fundamental Problems of Meander Formation (With Special Reference to the Bhagirathi River)," Indian Journal of Power and River Valley Development, Vol. 17, No. 2, 1967, pp. 15-23.

The Bhagirathi River, a typical deltaic stream, has been chosen for this study, as its history presents extremely important aspects for the general knowledge of river dynamics and morphology. Since all aspects of river dynamics cannot be discussed within the framework of a single report, only one aspect of river dynamics - meandering - is treated.

170. Baxter, R.I., "A Simple Flow-Metering Device for Use in Flood Irrigation Experiments," Australian Journal of Experimental Agriculture and Animal Husbandry, Melbourne, Australia, Feb. 1964, Vol. 4, No. 12, pp. 49-51.

Describes a flow-metering device developed for the measurement of rate of flow of water for flows up to one cusec from surface irrigation channels on to flood-irrigated land with a head difference less than six inches.

171. Baykal, I., "Weed Control Problems of Irrigation Systems in Turkey," Proceeding Near East and South Asia Region 5th Irrigation Practices Seminar, New Delhi, 1964, pp. 376-388.

172. Beale, J.G., and Howell, D.T., "Relationships Among Sprinkler Uniformity Measures," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 92, No. IR1, Proc. Paper 4720, Mar. 1966, pp. 41-48.

From among the many different measures of uniformity (or nonuniformity) of application of water by sprinkler irrigation, five are defined. They have been termed the Christiansen coefficient of uniformity, the coefficient of variation, the Wilcox-Swales uniformity coefficient, the United States Department of Agriculture pattern efficiency, and the "higher" pattern efficiency. These are all effectively measures of dispersion of precipitation about a mean. The coefficient of variation and the Wilcox-Swales uniformity coefficient are complementary. No simple relationships between the other measures can be derived, but it is shown that some limited experiments support the notion that the relationships are approximately those that would exist if the precipitation were normally distributed even though it seldom is.

173. Beattie, R.H., "Supplementary Irrigation for Pastures," Dairy Digest, Department of Agriculture, Victoria, Australia, Vol. 6, No. 6, 1959, pp. 9.

174. Beattie, D.W., Kotex, M., and Best, C.J., "Fluming and Siphons - Marecka, Dimbulah Irrigation Project (Symposium)," Journal of the Institution of Engineers (Australia), Vol. 33, No. 10-11, Oct.-Nov. 1961, pp. 353-364.

175. Bedeus, K., and Ivicsics, L., "Observation of Noise of Bed Load," International Geodetic and Geophysical Union, Publication No. 65, 1964, pp. 384-390.

Device for continuous observation of bed load noises consists of submergible recorder and amplifier equipped with transistor as well as of measuring gage, both located in boat; since weight and dimensions of device are small, it is easy to handle, observation of noises can be performed in any point of water course and variation of bed load movement characteristics can be observed; on basis of distribution of noise intensities, zones of violent, temperate, and quiet bed load movement have been determined.

176. Beesten, C.V., "Hydraulic Model Research for I.B.P.," Symposium on Role of Engineering Research in Developing Economy of Pakistan, West Pakistan Engineering Congress, Lahore, Oct. 1966, Vol. IX, No. 79.

177. Behera, B., "Mathematical Formulae for Nonscouring and Non-silting Velocity in Erodible Channels With Any Silt Charge," Irrigation and Power Journal of the Central Board of Irrigation and Power, Vol. 13, No. 2, Apr. 1956, pp. 254-262.

Presents two formulae derived mathematically, one for non-scouring and the other for non-silting critical velocity in erodible channels.

178. Behera, S.S., "Canal System," Indian Journal of Power and River Valley Development, Vol. 6, No. 10, 1956, pp. 53-58.

179. Benami, A., "New Head-Loss Tables for Sprinkler Laterals," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 94, No. IR2, Proc. Paper 5969, June 1968, pp. 185-197.

The current approximate procedure of computing head losses in sprinkler laterals, for the purpose of selecting proper diameters, is reviewed. Head-loss expressions that account for both pipe flow as well as quick and branching-flow couplers are developed. These expressions facilitate the computation of pressure heads at end sprinklers on a lateral. The required parameters are diameter of the lateral, number of sprinklers, operating conditions for the selected sprinkler, sprinkler spacings and tubing lengths. The expressions developed can be used in order to prepare tables that may be easily and conveniently employed in the selection of proper lateral diameters. The preparation and use of tables for 3-in. horizontal aluminum laterals are demonstrated.

180. Benami, A., and Hore, F.R., "New Irrigation-Sprinkler Distribution Coefficient," Transactions of the American Society of Agricultural Engineers, Vol. 7, No. 2, 1964, pp. 157-158.

Paper results from extensive analysis of two coefficients using data from over 100 sprinkler patterns, and based on these analyses, presents new coefficient which is believed to be better index of degree of pattern uniformity.

181. Bennett, H.H., "Engineering in Soil Conservation," Agricultural Engineering, The Journal of the American Society of Agricultural Engineers, Vol. 28, No. 12, Dec. 1947, pp. 559-562.

Engineering is a fundamental part of modern soil conservation. In one way or another it enters into conservation work at almost every step and stage from planning, through application of the plan to the land, right on to the stage of maintenance.

182. Berg, P.H., "Methods of Applying Irrigation Water," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 86, No. IR3, Pt. 1, Paper 2595, Sep. 1960, pp. 71-82.

Factor influencing selection of method of applying irrigation water on farm and various methods of irrigation are described in general; discussion of conveyance and distribution systems used for providing irrigation water on individual farms.

183. Berge, O.I., and Groskopp, M.D., "Irrigation Equipment in Wisconsin," Wisconsin Agriculture College, Extension Service Circular, Vol. 90, 1964, pp. 15.

184. Bergstrom, W., "Weed Seed Screens for Irrigation Systems," Pacific North West Bulletin, Bulletin 43, Mar. 1961, pp. 8.

185. Bettess, F., "A Note on the Hydraulic Jump," Civil Engineering and Public Works Review, Vol. 55, No. 647, June 1960, pp. 798.

186. Bhamidipaty, S., "Mechanics of Degradation and Aggradation in a Laboratory Flume," Ph.D. Dissertation, Colorado State University, Ft. Collins, Colorado, CED68-69SB26, 1968.

187. Bharat, S., "Bed Load Transport in Channels," Irrigation and Power, Journal of the Control Board of Irrigation and Power, Vol. 18, No. 2, Feb. 1961, pp. 110-126.

Describes an experimental research concerning movement of bed load in open channels.

188. Bharat, S., "Hydraulic Roughness of Alluvial Channels," Research Journal, Water Resources Development Training Center, Univerisity of Roorkee, Vol. 3, No. 1, Nov. 1960, pp. 161-176.

Examines the position with respect to roughness of alluvial channels in the light of existing theories and regime equations. Shows that the existing theories of Einstein and Liu are not comparable with the observed data. Proposes a new empirical equation for rippled beds.

189. Bhattacharjee, B.K., and Davis, E.H., "Sprinkler Irrigation - Types and Possibilities," International Rice Commission Newsletter, Vol, 10, No. 2, June 1961, pp. 5-8.

190. Bhattacharjee, B.K., and Davis, E.H., "Sprinkler Irrigation: Types and Possibilities," Indian Journal of Power and River Valley Development, Vol. 11, No. 2, Feb. 1961, pp. 13-15.

191. Bhatti, F.K., "Silt Movement in Channels," Engineering News (Pakistan), Vol. 1, No. 4, pp. 31-33.

192. Bhowmik, N.G., "The Hydraulic Design of Large Concrete - Lined Canals," M.S. Thesis at Colorado State University, Aug. 1965.

193. Bhowmik, N.G., "The Mechanics of Flow and Stability of Alluvial Channels Formed in Coarse Materials," Ph.D. Dissertation, Colorado State University, CED68-69NGB11, Aug. 1968.

194. Bhowmik, N.G., and Simons, D.B., "Stabilization of Alluvial Channels," Paper presented at American Society of Civil Engineers, New Orleans, Louisiana, Feb. 1969, CEP68-69NGB-DBS14, 1969.

195. Bijker, E.W., Stapel, D.R.A., and Vries, M.de, "Some Scale Effects in Models with Bed-Load Transportation," Proceedings of the 7th General Meeting of the International Association for Hydraulic Research, No. A1, 1957, pp. 1-16.

With movable bed models it is usually impossible to meet all requirements at a time. The consequence is, that scale-effects occur in the model. In this paper two aspects will be studied. A. The influence on the flow-picture of any given velocity-scale, in connection with the scales for the roughness. B. The scale-effect for the time-scale in case of changes in the bottom as a result of non-permanent sand-transportation.

196. Bill, S.M., "Aqualin: The Answer to Submerged Weeds," Acqua, Official Journal of the State Rivers and Water Supply Commission, Victoria, Melbourne, C.I. Australia, Dec. 1964, Vol. 16, No. 4, pp. 81-85.

197. Bill, S.M., "Recent Developments in Weed Control in Irrigation Supply Channels and Drains," International Commission on Irrigation and Drainage, Annual Bulletin 1963, 1963, pp. 30-32.

The Victoria State River and Water Supply Commission (Australia) utilizes organic weed killers for cleaning irrigation channels in preference to mechanical means. The preferred chemical, acrolein, is not sprayed but slowly pumped into the moving stream of water and is effective against cattail, ribbonweed,etc.

198. Bill, S.M.,,"Weed Control in Channels and Drains," Armadale, Australia, State Rivers and Water Supply Commission, 1962, pp. 12.

199. Bilonski, W.K., and Kidder, E.H., "Factors That Affect Distribution of Water From Medium Pressure Rotary Irrigation Sprinklers," Transactions of the American Society of Agricultural Engineers, Vol. 1, No. 1, 1958, pp. 19-23, 28.

Laboratory study, using 20 to 60 psi sprinklers; report on effects of oscillating arm, operating pressure, orifice diameter, length of cylindrical part of nozzle and roughness in it, angle of taper in sprinkler nozzle and noncircular orifices, rate of rotation of sprinkler, length of tube between body of sprinkler and nozzle, and cylindrical discharge tubes.

200. Binnie, A.M., "The Flood Protection of a Standing Wave Flume by Means of a Sluice-Gate Placed Upstream," Journal of the Institution of Water Engineers, Vol. 15, No. 3, May 1961, pp. 229-232.

201. Birkhead, G., "Water in West Pakistan," Water Resources Research, 1967, Vol. 3, No. 2, Richmond, Virginia, pp. 307-318.

This article describes several of the salient problems about water and the administration of water programs in West Pakistan. The separation of India and Pakistan in 1947 divided the Indus Basin, leaving three major tributaries in India and most of the irrigated lands in Pakistan. The 1960 Indus Waters Treaty provides for a series of waterworks.

202. Birmingham, T.H., "Stilling Basin of Impact Type," American Society of Civil Engineers, May 1962, Vol. 32, No. 5, pp. 67-68.

Discusses the design with the help of model experiments carried out to achieve an economic solution for culvert outlets discharging with high velocities. (up to 50 fps).

203. Bishop, A.A., "Relation of Intake Rate to Length of Run in Surface Irrigation," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 87, No. IR1, Pt. 1, Paper 2769, Mar. 1961, pp. 23-29.

Relationship between intake rate of soil and length of run in surface irrigation within regard to amount of water lost below root zone through deep percolation; nomograph is included from which percentage of loss by deep percolation can be estimated for soils having different intake characteristics.

204. Bishop, A.A., Simons, D.B., and Richardson, E.V., "Total Bed-Material Transport," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY2, Pt. 1, Paper 4266, Mar. 1965, pp. 175-191.

Method of estimating bed-material discharge of sand-bed flumes, canals, and rivers is presented; method uses group of curves developed from flume data that relate intensity of transport, intensity of shear, and median fall diameter of bed material; these curves illustrate that intensity of transport varies with regime of flow and form of bed roughness; application of method yields good results for sand-bed channels when depth of flow is less than 4 ft.

205. Bishop, W.W., "Gully Erosion in the Queen Elizabeth National Park," Uganda Journal (Kampala), 1962, 26C2, pp. 161-165.

Two types of erosion are recognized: sheet erosion, which is relatively unimportant and gully erosion, which is very serious near Kazinga Channel.

206. Biswas, T.D., Nielsen, D.R., and Biggar, J.W., "Redistribution of Soil Water After Infiltration," Water Resources Research, 1966, Vol. 2, No. 3, pp. 513-524.

The redistribution of soil water after the cessation of infiltration in three agricultural soils was analyzed experimentally in the laboratory. It was found that the rate of redistribution within the soil profiles depended upon the initial depth of wetting and the soil water content - soil water pressure - capillary conductivity relations.

207. Bittenger, M.W., and Logenbaugh, R.A., "Theoretical Distribution of Water from Moving Irrigation Sprinkler," Transactions of the American Society of Agricultural Engineers, Vol. 5, No. 1, 1962, pp. 26-30.

Analysis of pattern shapes to determine distortion obtained when moved in straight line and circular paths; advantages and limitations in distribution rate of various types of stationary sprinklers.

208. Black, R.D., Huggins, L.F., and Replogle J.A., "Investigating Flow Into Tile at Joints," Agricultural Engineering, Vol. 46, No. 9, Sep. 1965, pp. 494-498.

Tile crack spacing and "blinding" within topsoil were evaluated in respect to restriction of flow in drainage systems; three field experiments were conducted between 1949 and 1964 in Iowa on various soil types; tests were carried out to investigate effect of tile spacings on passage of water into tile lines and effects of various blinding materials on flow into tile lines; tile spacings investigated in study did not have significant effects on tile discharges.

209. Blainey, J.M., "Irrigation and Drainage Problems at Red Cliffs and Merbein," Aqua - The State River and Water Supply Commission, Melbourne, Australia, Vol. 10, No. 8, Apr. 1959, pp. 147-150.

210. Blainey, J.M., "Excessive Water Use and Drainage in Permeable Tiled Drained Soils," Transactions of the 4th Congress on Irrigation and Drainage I.C.I.D., Vol. 6, 1960, pp. 301-C312.

211. Blainey, J.M., "The Problem of Excessive Irrigation and Drainage at Red Cliffs and Merbein," Aqua, Vol. 11, No. 5, Jan. 1960, pp. 93-111.

How much water to apply; current irrigation practice; inducing the grower to irrigate efficiently.

212. Blair, G.Y., "Land Subsidence Complicates Irrigation," Journal of Soil and Water Conservation, Soil Conservation Society of America, Vol. 16 5A, No. 5, Sep. Oct. 1961, pp. 234-235.

213. Blake, D.N., "Design of Metal Pipe for Use in Irrigation Structures," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol, 89, No. IR3, Pt. 1, Paper 3634, Sep. 1963, pp. 45-51.

Two new developments in fabricating corrugated metal pipe, and study of changes in corrugation configuration, result in better finished product than that which has been produced by riveting method; lockseam method is shown to reduce leakage factor to greater extent than lapseam riveting method; spotweld method, as now used, has shown greater seam strengths; use of pipe in irrigation field.

214. Blanchet, C.H., and Drautzoff, W., "Protection Against the Silting-Up of the Junction of a Canal and a River," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research, Bombay, 1951, pp. 481-493.

215. Blanco, C., "Canal Lining," Third Congress on Irrigation and Drainage, R18Q7, 1957.

216. Blaney, H.F., and Criddle, W.D., "Determining Consumptive Use and Irrigation," Australasian Irrigator and Pasture Improver, Sydney, Australia, Feb. 1964, Vol. 10, No. 3, pp. 7-9.

217. Blaney, H.F. and Criddle, W.D., "Determining Consumptive Use for Planning Water Developments," Irrigation Drainage Speciality Conference, American Society of Civil Engineers, Las Vegas, Nevada, Nov. 2-4, 1966, pp. 1-34.

218. Blaney, H.F., and Buberty, M.R., "Irrigation in the Far West," Agricultural Engineering, Vol. 38, No. 6, June 1957, pp. 414-417.

219. Blench, T., "Hydraulics of Canals and Rivers of Mobile Boundary," Civil Engineering Reference Book, Butterworth Scientific Publications, London, 1961, pp. 434-470.

The phenomenon of complex mobile boundary hydraulics, the formulae discovered, and their application to river and canal engineering.

220. Blench, T., "Inductible Approach to Phases of Mobile Bed Roughness," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A-3, Vol. No. 1, 1967, pp. 18.

The status of "evolution of the river bed" and "sediment transport" in the IHD Program is discussed. A major weakness in the combined topics is seen to be the gross discordance among competitive bed-load transport formulas, which are flow formulas expressed with the bed-load transport explicit in the roughness factor. Discordances are believed to arise from reliance on deduction from speculative premises to the exclusion of physical consideration. An inductive attack on the formula problem is outlined, with explanations. An orientation of research is proposed to suit.

221. Blench, T., "Mobile Bed Fluviology - A Regime Theory Treatment of Rivers for Engineers and Hydrologists," T. Blench Associates Ltd., 1966.

222. Blench, T., "Regime Behavior of Canals and Rivers," Butterworth Scientific Publications, London, 1957, pp. 138.

223. Blench, T., "Regime Formulas for Bed Load Transportation," Proceedings of the 6th General Meeting of the International Association of Hydraulic Research, D-1, 1955, pp. 1-18.

Regime theory derived from the interrelation of self-adjusting variables of canals carrying small quantities of sand bed-load in dune formation, shows that: a. V^2/d, called the bed-factor, is a parameter determined by only the nature and intensity of the bed-load and the nature of the fluid. b. A slope relation, for final self-adjusted channel dimensions, may be written in terms of a slightly generalized friction factor and Reynolds number, and a non-dimensional constant (viz. King's constant 3.63), without explicit reference to the bed-load. In this paper are reported the results of analyzing the classic Gilbert data in the light of regime theory ideas. These data involve bed-loads extending far beyond the ordinary practical range, and particle sizes from medium sand to fine gravel; bed conditions, starting with dunes, extend through sheet flow into the antidune zone, but the Reynolds number remains at and below the lowest canal data figures. The major practical results of the analysis are: a. To establish the existence of very simple forms for the two independent sediment-transportation formulas necessary and sufficient for practical design; the forms suffer discontinuity at critical conditions. b. To establish the enormous gaps that must be filled in experimental knowledge before the coefficients of any practical formulas can be stated with assurance.

224. Blench, T., "Regime Theory for Self-Formed Sediment-bearing Channels," Proceedings of the American Society of Civil Engineers, Vol. 77, Separate No. 70, 1951.

225. Blench, T., "Regime Theory for Self-Formed Sediment Bearing Channels," Transactions of the American Society of Civil Engineers, Vol. 117, 1952, pp. 383-408.

226. Blench, T., "Utility of the Inductive Method of Regime Theory," Proceedings of the 8th General Meeting of the International Association for Hydraulic Research, Seminar II, 1959, pp. 11-SII-1/2.

227. Blench, T., Ahmad, M., and Ahmad, N., "Scour in Alluvium Below Falls," Proceedings of the IAHR, Stockholm, 1948, pp. 341-350.

228. Blench, T., and Bryan, R., "Regime Analysis of Laboratory Data on Bed-Load Transport," La Houille Blanche, No. 2, Mar.-Apr. 1957, pp. 132-157, English and French.

229. Blewitt, R.I., "Diversion Ditches on Sugar Cane Lands in Hawaii," World Farming, Kansas City, Missouri (USA), Sep. 1962, Vol. 4, No. 9, pp. 34,36, 38-40.

230. Blewitt, R.I., "Present-day Irrigation in Hawaii," Irrigation Engineering and Maintenance, 264 Gravier St., New Orleans 12, Louisiana (USA), May 1962, pp. 9-12.

Describes the development of methods of irrigation in Hawaii, viz., surface and sprinkler for sugarcane, pineapple, and track, orchard and pasture crops.

231. Bloodgood, G., "Success Story - Search for Cheap Canal Linings," Engineering News Record, Vol. 167, No. 13, Sep. 28, 1961, pp. 34-35.

Bureau of Reclamation 15 year old lower cost canal lining program uses four major types of linings; unreinforced portland cement concrete, buried asphalt membrane, thick compacted earth and pneumatically applied cement mortar; techniques and economy achieved by each method are discussed.

232. Bloomer, N.T., Markland, E., and Power, G., "Design of Two-dimensional Entrances to Hydraulic Channels," Engineering (London), Vol. 199, No. 5184, June 1955, pp. 765-767.

233. Blosser, R.O., and Owens, E.L., "Irrigation and Land Disposal of Pulp Mill Effluents," Water and Sewage Works, Chicago, Illinois (USA), Sep. 1964, Vol. 111, No. 9, pp. 424-432.

234. Blyskowski, A.H., "Modification of Natural Streams by Engineering Structures," Proceedings of the 9th General Meeting of the International Association for Hydraulic Research, Paper IV/3, 1961, pp. 1051-1054.

235. Bobrovitskaya, N.N., "Discharge of Suspended Sediments as a Function of Hydrologic Characteristics," Soviet Hydrology, Selected Paper, Translation from Trudy GGI, No. 141, pp. 107-120, 1967, No. 2, pp. 173-183, (11 pages, 5 figures, 5 tabulations, 9 references).

235. Continued

Mean annual suspended sediment discharge of the Polowet and other USSR rivers was investigated as a function of hydrologic characteristics, particularly of rise of spring flood water. No unique relation between water discharge and sediment discharge was found. The rate of rise of flood waters correlated stongly with sediment discharge, however.

236. Bogardi, J., "Characteristic Correlations of Bed Load and the Hydraulic Factors of Natural Stream Channels," The Port Engineer, Vol. 4, No. 3, July 1955, pp. 16-20.

237. Bogardi, J.L., "European Concepts of Sediment Transportation," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY1, Pt. 1, Paper 4195, Jan. 1965, pp. 29-54.

Various criteria defining regime of sediment transportation used in Europe are examined, including sediment-transporting capacity and stage of incipient motion; brief review of recent American results is given in comparison to European studies; main conclusion is that almost every problem connected with regime of sediment movement may be approached through use of same set of interrelated variables.

238. Bogardi, J., "Some Aspects of Application of Theory of Sediment Transportation to Engineering Problems," Journal of Geophysical Research, Vol. 66, No. 10, Oct. 1961, pp. 3337-3346.

Sediment transportation in natural streams is to appreciable extent influenced by hydrological conditions of watercourse; widely different hydrological conditions on sediment transporting capacity, on relationship between discharge and sediment concentration, and on correlation between particle diameter and mean velocity.

239. Bohanan, L.B., "Irrigation Use of Water," American Waterworks Association Journal, Vol. 50, No. 3, Mar. 1958, pp. 310-314.

Examines some critical aspects of water requirements of crops and stresses that planning of water supply should be on watershed basis rather than for individual farm.

240. Bond, A.W., "Behavior of Suspensions," Journal of the Institution of Water Engineers, Vol. 15, No. 7, Nov. 1961, pp. 495-516.

241. Bond, A.W., "The Behavior of Suspensions," Civil Engineering Transactions, The Institution of Engineers, Australia, Vol. CE1, No. 1, Mar. 1959, pp. 1-17.

242. Bondurant, J.A., "Hydraulics of Surface Irrigation," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 18-20.

243. Bondurant, J.A., "Mechanization of Surface Irrigation," Crops and Soils, Vol. 14, No. 1, Oct. 1961, pp. 23.

244. Bondurant, J.A., and Humpherys, A.S., "Surface Irrigation Through Automatic Control," Agricultural Engineering, Vol. 43, No. 1, Jan. 1962, pp. 20-21, 35.

Systems for conserving and utilizing water and labor; survey of components necessary for automatic surface irrigation systems; tests and design developments of mechanical self operating gates controlled by sensing or timing devices for irrigation of bordered fields.

245. Borden, J.W., "Land Forming for Irrigation, Drainage, Erosion Control and Efficient Farm Management," 5th Congrés International de Génie Rural, No. 1, 1960, pp. 436-446.

Studies have revealed that unsatisfactory crop yields are often caused by improper or insufficient land preparation. Land forming which embodies two distinct techniques, dirt moving and land smoothing, improves the field surface so that the land can produce to the limits of its capabilities.

246. Borden, J.W., "Land Smoothing for Improved Drainage," Agricultural Engineering, The Journal of the American Society of Agricultural Engineers, Vol. 37, No. 6, June 1956, pp. 401-406, and 410.

Land levelers or smoothers, rapidly gaining in popularity as aids in both drainage and irrigation practices, have proven especially useful in facilitating uniform distribution of surface water, with the result that erosion is minimized, more water enters the soil, and earlier planting, maturing, and harvesting of crops is made possible.

247. Boreli, M., and Jorasevic, D., "Clogging of the Porous Media," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 2, pp. 516-521.

Following general considerations of the problem of clogging, a differential equation is given for certain types of clogging, as well as the results of investigations.

248. Bose, N.K., "Utilization of Irrigation Water," Science and Culture, Vol. 21, No. 7, Jan. 1956.

249. Bose, N.K., and Pramanik, H.R., "Scour Below Weirs," Proceedings of the 2nd General Meeting of the International Association for Hydraulic Research, Stockholm, 1948, pp. 351-360.

250. Bourrieres, P., "The Mekong Valley Project," Impact of Science on Society (UNESCO), 1964, Vol. 14, No. 4, pp. 263-279.

Defines the Mekong development project launched by ECAFE, involving flood control, the extension of irrigation and hydro-power schemes for the benefit of the four riparian states.

251. Bouvard, M., "Initial Effect in the Suspended Load, Investigations of the Determination of the Saturation of a Flow with Suspended Load," Proceedings of the 8th General Meeting of the International Association for Hydraulic Research, 1959, pp. 3-SII/1-3.

252. Bouvrie, C.des, "Laboratory Investigation of Design Criteria for Drain Tile Filters, M.S. Thesis at Colorado State University, July 1962.

253. Bouwer, H., "Infiltration Patterns for Surface Irrigation," Agricultural Engineering, The Journal of the American Society of Agricultural Engineers, Vol. 38, No. 9, Sep. 1957, pp. 662-664, and 676.

A few easy-to-take field measurements provide the necessary data for a new method of determing water absorption patterns for border or furrow irrigation systems.

254. Bouwer, H., and Rice, R.C., "Salt Penetration Technique for Seepage Measurement," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 94, No. IR4, Proc. Paper 6304, Dec. 1968, pp. 481-492.

Seepage rates in open channels or reservoirs are determined from the rate of salt penetration into the bottom material. A portion of the bottom is covered with crystals of a non-deflocculating salt. After dissolving, part of the salt enters the bottom with the seepage flow. The rate of advance of the peak of the resulting salt concentration "wave" in the bottom material is measured with an electrical-conductivity probe. Laboratory studies showed that the seepage rate could be calculated by multiplying this salt penetration rate by the porosity of bottom material. A field study in a reservoir showed excellent agreement between the seepage obtained in this manner and the rate of fall of the water surface. The salt-penetration technique is simple and it can be carried out under a wide variety of canal conditions.

255. Bouwer, H., "Theoretical Aspects of Unsaturated Flow in Drainage and Subirrigation," Agricultural Engineering, Vol. 40, No. 7, July 1959, pp. 395-400.

256. Bouwer, H., "Theoretical Aspects of Seepage from Open Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY3, Pt. 1, Paper 4321, May 1965, pp. 37-59.

Seepage from open channels was evaluated by analog in relation to depth and shape of channel, position of water table, and saturated and unsaturated permeability of soil; subsoil conditions included impermeable layer and permeable layer at varying depth; case of clogged bottoms and banks was treated analytically; it is shown that seepage increases with increasing water depth, but at slower rate than discharge for uniform flow and that canals convey water more efficiently when deep than when shallow; other analyses refer to effect of bottom treatment for seepage reduction, and to effect of unsaturated flow on seepage.

257. Bouwer, H., "Variable Head Technique for Seepage Meters," Transactions of the American Society of Civil Engineers, 33 West 39th St., New York, 18, New York (USA), 1962, Vol. 127, pp. 434-451.

Proposes technique for measuring canal or reservoir seepage losses with seepage meter; the method also furnishes information regarding hydraulic conductivity of bottom material and seepage gradients; deals with the resistance network analog which was used for analysis of pertinent factors and flow components, and for obtaining examples to illustrate the method.

258. Bouwer, H., and Helms, J.O., "Flexible Tubing in Sprinkler Irrigation," Agricultural Engineering, The Journal of the American Society of Agricultural Engineers, Vol. 38, No. 11, Nov. 1957, pp. 794-799.

Sprinkler irrigation's role in present American agriculture is evident from the several millions of acres that are estimated to be irrigated. Irrigation is the complete control of the amount and the rate of water application, and the partial control of the uniformity of wetting. However, from a materials-handling standpoint, irrigation with portable sprinkler systems usually involves high energy requirements for pumping and high labor requirements for moving pipe.

259. Bouwer, H., Meyers, L.E., and Rice, R.C., "Effect of Velocity on Seepage and Its Measurement," Proceedings of the American Society of Civil Engineers, Journal of Irrigation and Drainage Division, Sep. 1962, Vol. 88, No. IR3, Pt. 1, pp. 1-14.

260. Bowman, C.C., "Dimensional Analysis Applied to More Efficient Application of Irrigation Water," Tranactions of the American Society of Civil Engineers, Vol. 7, No. 3, 1964, pp. 238-239, and242.

Method of deriving equation for calculating velocity, depth of flow and proper stream size for efficient border irrigation is described; application of equation is made to border strips covered with alfalfa and grass.

261. Bowman, C.C., "Manning's Equation for Shallow Flow," United Stated Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 21-28.

262. Boyd, M.B., and Escoffier, "Types of Flow in Open Channels," United States Army, Water Experiment Station Miscellaneous, Paper No. 2-498, June 1962, pp. 24.

263. Boyer, M.C., "Estimating the Manning Coefficient for an Average Bed Roughness in Open Channels," Transactions of the American Geophysical Union, Vol. 35, No. 6, Dec. 1954, pp. 957-961.

264. Boyer, M.C., "Water Supply Versus Irrigation in Humid Areas," Transactions of the American Society of Civil Engineers, 1959, pp. 280-290.

265. Bouyoucos, G.J., "Improved Soil Moisture Meter," Agricultural Engineering, The Journal of the American Society of Agricultural Engineers, Vol. 37, No. 4, Apr. 1956, pp. 261-262.

When, how much, and how deep to irrigate are basic questions to which the irrigator requires reliable answers each time he applies irrigation water to cropland. The author in this article reviews latest improvements in a soil moisture meter and related equipment widely used in recent years as a scientific guide to irrigation.

266. Bozoky-Szeszich, K., "Investigation of Hydraulics of Border-Flow Irrigation with Allowance to Change of Infiltration in Time," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 4, 1963, pp. 16.509-16.523.

Equation is derived to determine position of water cover moving forward on terrain in bordership irrigation which takes into account velocity of infiltration with time; mean infiltration rate and mean depth of water sheet covering strip are calculated from actual measurements; attempt is made to establish empirical relationships from measured values with help of nomogram.

267. Brand, W.E., "Solution of an Unusual Subsurface Drainage Problem," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 94, No. IR2, Proc. Paper 5973, June 1968, pp. 199-221.

267. Continued

Details are given of all stages in the design of the sophisticated subsurface drainage system in the city of Antwerp, including the execution of extensive field pumping tests, the analysis of the alternative solutions to the problem, and the study of the hydraulics of the horizontal intake pipes adopted to effect the groundwater lowering. The possible effect of precipitation of ferric oxide from the ground-water is considered. This most important factor complicated the design, and necessitated complete submergence of the intake system.

268. Brett, T.M., "Movable Bed Studies of Ski-Jump Structures for Erosion Control," Journal of the Institution of Engineers, Australia, Vol. 29, No. 1-2, Jan.-Feb. 1957, pp. 29-30.

269. Brice, J.C., "Erosion and Deposition in the Loess-Mantled Great Plains, Medicine Creek Drainage Basin, Nebraska," United States Geological Survey Professional Paper, 1966, No. 352-H, pp. 255-339, (58 figures, 9 tables, 62 references).

About 12,000 years ago, the Peorran loess was incised, and the drainage system ramified to approximately its present extent. Deposition about 1000-5000 years ago led to formation of the Stockville Terrace. There followed minor deposition, further valley incision, and finally, accumulation of Late Recent alluvium. Adjusted channel frequency is the most useful property of the drainage system in accounting for the areal distribution of gullies.

270. British Standards Institution, "Methods of Measurement of Liquid Flow in Open Channels - Weirs and Flumes," British Standards Institution, British Standard 3680, Pt. 4A, 1965, pp. 91.

Thin plate weirs and venturi flumes; Standard deals with measurement of flow in rivers and artificial channels under steady flow conditions using weirs, notches and flumes; only conditions of free flow are considered in which flow is independent of variation in tail water levels; measuring devices covered are rectangular thin plate (square-edged) weirs (full width, and fully or partially contracted), triangular thin-plate (squared-edged) weir (V-notch), and standing wave or free flowing venturi flumes.

271. Brooks, D.A., "Hand Laying Concrete Draintile in Open Ditches," Irrigation Engineering and Maintenance, Nov. 1960, pp. 8-9.

Describes hand laying method of tile drains practised by a farmer in San Joaquin Valley in California.

272. Brooks, N.H., "Calculation of Suspended Load Discharge from Velocity and Concentration Parameters," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 29, pp. 229-237.

A method is presented for the integration of suspended load discharge quickly and easily from measured or predicted distributions of velocity and sediment concentration. The assumptions are: (1) the velocity distribution is logarithmic, and (2) the concentration follows the suspended load equation.

273. Brooks, N.H., "Mechanics of Streams With Movable Bed of Fine Sands," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 83, Paper 668, 1956.

274. Brooks, N.H., "Sediment Transportation and Modern Fluid Mechanics," Proceedings of the 8th General Meeting of the International Association for Hydraulics Research, 1959, pp. 18-SII/13.

275. Brooks, R.H., "Unsteady Flow of Groundwater into Draintile," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 87, No. IR2, Pt. 1, Paper 2836, June 1961, pp. 27-37.

Solution to nonlinear differential equation describing unsteady flow toward equally spaced drains above horizontal impermeable boundary is presented; solution was compared with field data and published numerical results and suitable agreement was found when drain spacing was large relative to depth of drains.

276. Brown, D.R.M., "A Study of Factors Influencing the Efficiency of Vortex Tube Sand Traps," Proceedings of the Institution of Civil Engineers, London, England, June 1964, Vol. 28, Paper 6717, pp. 197-200.

277. Brown, F.R., "Fluctuation of Control Gates," International Association for Hydraulic Reasearch, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1, pp. 258-269.

Gates or closure devices are particularly vulnerable to flunctuation when the depth of flow over and under the closure device, as it is being lowered through flow, is about equal to or exceeds the height of the gate.

278. Brown, L.N., "Irrigation on Steep Land," Division of Agricultural Science, University of California, Feb. 1962, Circular 509, pp. 26.

Describes fundamentals of main irrigation method, viz.; furrows, strip checks or borders, return water systems, contour ditches, sprinkler and basin irrigation.

279. Brownscombe, R.H., "Field Evaluation of Tile Drains Laid with Organic Binding Materials," Transactions of the American Society of Agricultural Engineers, Saint Joseph (ASCE), 1962, Vol. 5, No. 1, pp. 61-63, and 67.

280. Bruk, S. "Properties of Flowing Sediment," Publication de l'Association International d'Hydrologie Scientifique, No. 59, 1962, pp. 283-292.

Shear flow of sediment in the form of bed load on the bottom of alluvial rivers is an important aspect of sediment transport. The flowing sediment grains show peculiar properties not present in ordinary fluids.

281. Brush, L.M., "Exploratory Study of Bed-Load Transportation in a Meandering Channel," Proceedings of the 8th General Meeting of the International Association for Hydraulic Research, Seminar V, 1959, pp. 9-SII-1/3.

282. Brush, L.M., "Sediment Sorting in Alluvial Channels," Primary Sedimentary Structures and their Hydrodynamic Interpretation, edited, G.V. Middleton, (Society of Economic Paleontologists and Mineralogists, Specific Publication 12), 1965, pp. 25-33 .

The formation of primary sedimentary structures in and along an alluvial channel occurs as a result of interactions between gravity, the physical characteristics of the sediment, and fluid as well as the hydraulic environment. The occurrence of many of these structures in channels results from the presence of ripples, dunes, bars, and antidunes on the bed.

283. Brush, L.M., Ho, H.W., and Singamsetti, S.R., "A Study of Sediment in Suspension," Publication de l'Association Internationale d'Hydrologie Scientifique, No. 59, 1962, pp. 293-310.

The theory of molecular diffusion is useful in formulating analogous hypotheses for turbulent diffusion; in certain circumstances, the model may even be extended to include diffusion of foreign material within a turbulent fluid.

284. Brutsaert, W., "The Adaptability of an Exact Solution to Horizontal Infiltration," Water Resources Research, Aug. 1968, Vol. 4, No. 4, pp. 785-789, (5 pages, 3 figures, 1 appendix, 12 references).

A mathematical solution is provided for the concentration-dependent diffusion equation. The equation is shown to be adaptable to the problem of horizontal infiltration, a phenomenon of one dimensional flow in a partly saturated porous medium.

285. Bruun, P., and Lackey, J.B., "Engineering Aspects of Sediment Transport," Florida University - Engineering and Industrial Experiment Station, Technical Progress Report II, July 1962, pp. 65.

Sediment transport in rivers, stable channels in alluvial material, sediment transport on sea shores and its importance in design of harbor and coastal-protection works and of coastal inlets, and tracing of sediment transport with special reference to recent development of radioactive tracers; principal plant and animal groups that affect sediment transport.

286. Bucko, S., Holy, I., and Stehlik, O., "Soil Erosion in Czechoslovakia," Journal of the Czechoslovak Geographical Society (Prague), Supplement for the 20th International Geographical Congress (London 1964), 1964, pp. 37-46, in English.

Large-scale soil-erosion research in Czechoslovakia dates only 15-20 years back. It was carried out along hydrological, pedological, land-improvement and geographical lines. Sheet-wash and gully erosion are primarily governed by diversity of the terrain, torrential rains, presence of loam and sandy-loam soil and discontinuity of the vegetation cover.

287. Buie, T.S., "Flat Fields Must Be Drained," Better Crops (with Plant Food), Vol. 44, No. 2, Mar,,Apr. 1960, pp. 12-15.

288. Bullard, W.E., "Estimating Sediment Production in a Large Watershed," Bulletin de l'Association International d'Hydrologie Scientifique (Louvain), 1962, 7(3), pp. 40-45, (In English).

Estimates of average annual sediment production in the 4,560 square-mile Umpqua River Basin in Southwest Oregon were developed to assess the impacts of land condition, use, and management in the watershed on the quality of the water produced.

289. Bunyan, J.E., Some Aspects of Design of Hydraulic Structures in Alluvium," The Institution of Civil Engineers, Vol. 10, Paper No. 6265, June 1958, pp. 145-162.

Article mentions theory of hydraulic jump forming in horizontal floor and way of determining position of jump when it forms on sloping glacis; method of determining position of jump; jump profiles given to show how shape of jump is influenced by its position on sloping glacis; parameters influencing scour development downstream of structure.

290. Buras, N., and Herman, T.,"Analytical - Experimental Approach to Determination of Spacing-Depth Relationships of Tube Drains," International Geodetic and Geophysical Union Section for Scientific Hydrology,Publ. No. 66, Vol. 2, 1965, pp. 409-418.

Design of tube drainage systems should be based on synthesis of experimental field results, analysis of hydrological and climatological data and mathematical model of flow regime within artificially drained soil; climate and hydrological uncertainties should be incorporated into design process.

291. Burgess, J.S., "Scour Downstream of a Compound Measuring Weir," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 4, pp. 1163-1171.

Two of the factors are of particular interest, and their importance was shown by the results of model tests in which scour occuring in the model was compared with that observed in the prototype. It was shown that similarity between scour in the model and in the prototype occurred only when the model was operated repeatedly at various discharges within the whole range of prototype discharges.

292. Burgi, P.H., "Seepage Effect on Channel Bank Stability," M.S. Thesis, Colorado State University, Fort Collins, Colorado, CET68-69PB51, June 1969.

293. Burnett, G.I.S., "Water and Farming III, Tile and Mole Drains Need Expert Planning," New Zealand Meat Producer, Wellington, New Zealand, Oct. 1, 1963, Vol. 8, No. 1.

294. Burnett, G.I.S., "Water and Farming V, Surface Irrigation Needs Big Volume of Water," New Zealand Meat Producer, Wellington, New Zealand, 1963, Vol. 3, No. 8, pp. 34-35.

295. Burns, F.L., "Sealing Cracks and Leaking Joints in Concrete Channels with Flexible Surface Membranes," Aqua, Vol. 12, No. 12, Oct. 1960, pp. 40-47.

Describes the results of field tests with some plastic material.

296. Bursali, T., "Bottom Shear Measurement in an Open Channel Flow," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A24, Vol. 1, 1967, pp. 194.

Resistance to flow, as well as the bed load movement in an alluvial channel can be defined starting from the notion of shear velocity. Formulas are not valid in an alluvial channel if the bottom is covered with sand waves, dunes or antidunes.

Theoretical computation of shear stress on a dune is nearly impossible because of the secondary currents and perturbations in the vicinity of the bottom. Whereas, a direct measurement apparatus would be able to inform us about the skin friction on any point of the dune as well as the total force exerted by the flow. In this purpose, a direct shear measurement apparatus has been realized. Preliminary experiments on smooth and rough bottoms have given satisfactory results. They are compared with the computed results and a surface pitot tube measurements.

To realize such as apparatus does not constitute the main purpose, but it constitutes a precious tool of investigation in the case of undulating alluvial beds.

297. Busch, C.D., and Kneebone, W.R., "Subsurface Irrigation with Perforated Plastic Pipe," Transactions of the American Society of Agricultural Engineers, Vol. 9, No. 1, 1966, pp. 100-101.

297. Continued

Study was set up to compare subsurface with sprinkler irrigation on common bermuda grass plots grown as turf; performance of two systems was evaluated in terms of amount of water used and quality of turf produced; turf data for 2 years showed that sprinkler and subsurface irrigation can be managed for comparable water use and turf quality on established crop; however, model studies emphasize that distribution pattern inherent in buried perforated-pipe system can give rise to problems of uniformity and excess water application under certain conditions.

298. Busch, C.D., and Turner, F., "Sprinkler Irrigation with High Salt Content Water," Transactions of the American Society of Civil Engineers, 1967, Vol. 10, No. 4, pp. 494-496, (3 pages, 2 figures, 5 tabulations).

A study was conducted in Safford, Arizona to determine the effects of saline water sprinkling on the yield of cotton.

299. Butler, E.D., "Land Leveling in Arkansas Delta," Agricultural Engineering, Vol. 42, No. 3, Mar. 1961, pp. 127-131.

Grades of 0.1-0.3 ft/100 ft. for optimal drainage and irrigation are attained by plane method of land-leveling; optimum plane is determined mathematically.

300. Cain, J.C., "Automatic Sub-Irrigation Equipment for Sand Cultures," Proceedings, American Society for Horticultural Science, College Park, Maryland, June 1963, No. 82, pp. 831-636.

301. Calheiros Braga, M., and Lousada Dos Santus, A., "Results of the Substitution of Surface Irrigation by Sprinkler Irrigation, Study of Specific Case of Silveiras Farm," International Commission on Irrigation and Drainage, Annual Bulletin, 1960, pp. 46-58.

302. Cambell, R.B., "Redistribution of Surface Flow from High-Application-Rate Sprinklers," Hawaiian Planters' Record, Honolulu, Hawaii (USA), June 1963, Vol. 56, No. 4, pp. 277-287.

303. Campbell, J.S., and Brebner, A., "The Prediction of Flow Rates in Aluminum Pipe, Irrigation Tubing, and Fittings, and its Hydraulic Efficiency After Years of Service,"Transactions of the Engineering Institute of Canada, t3, No. 1, Apr. 1959, pp. 43-50.

304. Campbell, F.B., "Hydraulic Design of Rock Riprap," United States Waterways Experiment Station, Miscellaneous Paper 2-777, Feb. 1966, pp. 47.

Paper summarizes study of open channel flow condition affecting riprap design and suggests design proceedure based on hydraulic principles rather than on rule-of-thumb formulas; riprap design is idealized by study of stability of cubical elements, field and laboratory investigations required for development of firm design criteria are recommended.

305. Campbell, R.B., "Salinity in Relation to Overhead Irrigation," Hawaii Sugar Technological Report, 1961, No. 20, pp. 255-261.

306. Canham, R.A., "Spray Irrigation for Disposal and Crop Growth," Industrial Wastes, Vol. 2, No. 3, May, June 1957, pp. 57-60.

307. Cant, R.R., "Irrigation Review and Assessment of Present Knowledge," Fruit World and "Market Grower", Sydney, Australia, 1964, Vol. 65, No. 9, pp. 42 and 44.

308. Cantor, L.M., "Water and Man: a Geography of Hydroelectric Power and Irrigation," London, Catto and Windus, 1963, pp. 64.

309. Carbonnel, J.P., "Analysis of Suspended Material for the Study of Sediment Discharge of Rivers," Bulletin de l'Association Internationale d'Hydrologie Scientifique, Vol. 9, No. 3, 1964, pp. 35-37, French.

A sampling method is described for the study of suspended matter. Samples taken at various points across a section of the river are grouped together to form a water of average composition, which is then flocculated with 25% alum solution

310. Carey, W.C., "Comprehensive River Stabilization," Journal of the Waterways and Harbors Division, American Society of Civil Engineers, Vol. 92, No. WW1, Proc. Paper 4672, Feb. 1966, pp. 59-86.

310. Continued

Comprehensive river stabilization is a multi-purpose water resources improvement measure. By virtue of the program of cut-off and corrective dredging of Gen. H. B. Ferguson, President, Mississippi River Commission (1932-1938), and the follow-up stabilization program of his successor, Gen. M.C. Tyler, the lower Mississippi River improvement became the world's first example of comprehensive river stabilization. This type of river improvement, which lends itself to stage construction, is of great significance to the inhabitants of the unimproved alluvial rivers in the undeveloped areas of the world. The first stage, the securing of a gently-sinuous single channel stream by means of cut-off and corrective dredging, will contribute a substantial measure of flood control, some drainage improvement, improved navigation, fish and wild-life benefits, and other water resources purposes for a few years, pending obtaining the capital needed for complete stabilization.

311. Carlson, E.J., "Gravel Blanket Required to Prevent Wave Erosion," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 85, No. HY5, Paper No. 2021, May 1959, pp. 109-145.

Surface wave erosion laboratory tests were performed in hydraulic wave flume on materials shipped from Yakima Project, Washington, to determine cover blanket needed to prevent leaching of fine base material; most stable cover blanket was formed by screening talus material on 3/4 in. screen; minus 3/4 in. material was placed over base material with plus 3/4 in. material on surface.

312. Carlson, E.J., and Enger, P.F., "Sediment Control at a Headworks Using Guide Vanes," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 33, pp. 287-304.

The Bureau of Reclamation has in progress a general study program concerning the control at canal headworks of coarse sediments diverted from alluvial streams. The study described in this paper was conducted as one phase of the general program. Its purpose was to develop satisfactory arrangements of bottom and surface vanes, to compare the performance of each type.

313. Carlson, M.E., "The Development of Irrigation in Nebraska, 1854-1910, A Descriptive Survey," Abstracts of Dissertations and Titles of Theses, Louisiana State University, Baton Rouge, Louisiana (USA), 1964, Vol. 24, No. 8, pp. 3309-3310.

314. Carolus, R.L., "A New Approach to Irrigation Practice," Proceedings of the Ohio Vegetable Potato Growers Association, Growers Handbook, Columbus, 1964, Vol. 49, pp. 99-103.

315. Carr, S.R., "The Use of Hydraulic Models in Developing Standard Irrigation Structures," 3rd Congress of Irrigation and Drainage, Vol. IV, Question 9, 1957, pp. 9.49-9.60.

Describes model tests used to develop new hydraulic shapes for check, drop, and off-take regulators in order to effect saving in both initial and maintenance costs, to increase their hydraulic efficiency and to eliminate scour downstream of them.

316. Carr, S.R., "Extension Walls for Limiting Erosion of Water Control Structures," Civil Engineering Transactions, The Institution of Engineers, Australia, Vol. CE2, No. 2, Aug. Sep. 1960.

317. Carstens, M.R., "Similarity Laws for Localized Scour," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY3, Paper 4818, May 1966, pp. 13-36.

Object of study is to develop similarity criteria for sediment-transport rate and for scour depth in localized-scour situations; principal assumption is that in area of localized scour, velocity and velocity distribution are results of disturbance element around which scour was occuring; criteria are presented; for flow situations that are free from gravity waves, sediment inflow from upstream, and extraneous influences on flow pattern such as dunes passing through scour hole; procedure is demonstrated for case of horizontal cylinder settling into scour hole in oscillatory flow.

318. Carton, J.E., Beasley, R.P., and Barefoot, A.D., "Automation of Cut Back Furrow Irrigation," Agricultural Engineering, Saint Joseph, Michigan; Ames, Louisiana (USA), June 1964, Vol. 45, No. 6, pp. 328-329.

318. Continued

Briefly describe the automatic cutback furrow irrigation system installed on the Irrigation Reasearch Station at Altus, Oklahoma; show that the uniformity of application is improved by this method.

319. Castanon, A.G., "Prefabricated Canals and Dykes," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 6, 1960, pp. C-365 to C-386.

Considers advisable the use of prefabricated canals and dykes, a solution which, though more costly at the outset, is more economical in the long run owing to its longer duration.

320. Caudwell, R., "Land Drainage," Farmer's Club Journal, London, No. 2, 1960, pp. 140-152.

321. Cecen, K., "Seepage onto the Slopes in Isotropic and Anisotropic Soils," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 2, pp. 468-484.

There are certain difficulties in studying analytically the hydromechanical problem of the seepage of water, which flows in a homogeneous-isotropic porous medium on a horizontal impermeable base, into the atmosphere on a slope as a thin layer or its evaporation. Generally we have to perform graphical integrations to evaluate the results we obtained.

322. Cella, P., "Graphical Comparison of Uniform Flow in Open Channels," Civil Engineering, July 1967, pp. 63.

323. Central Board of Irrigation and Power, "Fluming," Central Board of Irrigation and Power, Publication No. 6, July 1958, pp. 96.

324. Central Board of Irrigation and Power, "Manual on River Behavior, Control and Training," Central Board of Irrigation and Power, Publication No. 60, 1956 (1957), pp. 378.

325. Central Soil Conservation Board, Ministry of Agriculture, Government of India, "Irrigation Methods to Control Erosion," Central Soil Conservation Board, Ministry of Agriculture, Government of India, 1958, pp. 4.

326. Central Water and Power Research Station, Poona (India), "Energy Dissipation Below Head Regulator, East Kosi Canal, Hanumannagar Barrage," Central Water and Power Research Station, Annual Research Memoirs, 1960.

327. Chakravarty, R.B., "Problems and Possibilities of Irrigation in West Bengal," Indian Journal of Power and River Basin Development, Vol. 7, No. 9, Sep. 1957, pp. 71-72, 78.

328. Chandnani, J.J., Gandhi, R.T., and Singh, K., "Preliminary Studies on the Comparative Systems of Irrigation," Indian Journal of Agronomy, Vol. 4, June 1960, pp. 222-229.

329. Chandrashekhara Swamy, N.V., "On the Mean Velocity Distribution in a Turbulent Channel," Irrigation and Power, Journal of the Central Board on Irrigation and Power, Vol. 17, No. 2, Apr. 1960, pp. 190-196.

330. Chang, H.Y., Simons, D.B., and Brooks, R.H., "The Effect of Water-Detention Structures on River and Delta Morphology," Symposium on River Morphology, Bern, Association Internationale d'Hydrologie Scientifique, No. 75, Sep. 25-Oct. 7, 1967, pp. 438-448.

The effect of flood-water retarding and sediment detention structures upon river morphology, including aggradation of river channels and resevoir deltas, has been studied in a large laboratory model basin.

331. Chang, F., Simons, D.B., and Richardson, E.V., "Total Bed-Material Discharge in Alluvial Channels," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A-17, Vol. 1, 1967, pp. 132.

A study of total bed-material discharge in alluvial channels, partially based on existing theories, has been conducted.

The bedload discharge was obtained by utilizing the energy-work relation of the fluid and the bed material. An equation for velocity distribution was obtained by integrating the Reynolds equations using Prandtl's hypothesis of mixing length.

Applying the basic equation for the distribution of suspended load by O'Brien, the suspended bed-material discharge was investigated in terms of bedload discharge. Then, the total bed-material discharge was obtained simply by adding the bedload discharge and the suspended bed-material discharge.

The results through checking with available laboratory and field data appeared to be mutually consistent and satisfactory.

332. Charreau, C., and Sene, D., "Experiment in Irrigation by Sprinkling in Senegal," United Nations Conference of Applied Science and Technology, Nov. 21, 1962, Vol. 11, No. 504, pp. 14.

333. Chapman, L.S., "Dalopon Plus 2, 4-D for the Control of Weeds in Irrigation Channels," Cane Growers' Quarterly Bulletin, Australia, No. 24, Apr. 1, 1961, pp. 115-117.

334. Chatley, H., "The Distortion of Scales in Models With Loose Beds," Proceedings of the 2nd General Meeting of the International Association for Hydraulic Research, Stockholm, 1948, pp. 107-111.

335. Chaturvedi, R.S.,"Expansive Sub-Critical Flow in Open Channel Transitions," Institutions of Engineers (India), Vol. 43, No. 9, Pt. CI5, May 1963, pp. 447-487.

Formulas for design of rational transitions in expansive flow of water in open channels evolves logically and scientifically with systematic model experimentation; has justification of rigorous mathematical derivation under assumptions made, and support of extensive laboratory examination; proposed formula would yield more dependable and easier solution than available at moment with one-dimensional approach.

336. Chaudhry, M.Y., "Concrete Lining of Warsak Irrigation Tunnel," Quarterly Journal of the West Pakistan Engineering Congress, 6 Bank Square, The Mall, Lahore, (West Pakistan), Dec. 1962, Vol. 7, No. 4, pp. 5-15.

337. Chowdry, A.H., "Canal Lining as Practised in Pakistan," Third Congress on Irrigation and Drainage, R13Q7.

Gives in brief the specifications and the technique of brick and concrete type linings as developed in Pakistan.

338. Chen, T.F., and Davis, J.R., "Measuring Water Surface Disturbances," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 42, No. 4, Apr. 1961, pp. 192-195.

The motion of waves which occur on a water surface has been studied fairly extensively; however, in the case where a series of irregular small waves rise and disappear at a rapid rate, the observation of this system becomes difficult.

339. Chicherin, E.V., "The Soviet Irrigation Picture," Water and Water Engineering, London, England, Feb. 1963, Vol. 67, No. 804, pp. 45-46.

Brief details of the immense schemes completed or in progress in the USSR on the Amu-Darya, Syr-Darya, River Vakhsh.

340. Chikwendu, L.N., "Secondary Currents in Curved Stratified Rivers," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A54, Vol. 1, 1967, pp. 438.

Although numerous papers dealing with secondary currents have been published in the past, all of these have been for conditions where the field was homogeneous in density. The present paper describes a series of laboratory experiments pertaining to the patterns, magnitudes, and mixing effects of secondary currents in curved density-stratified rivers. The angle made by the stream on the bed, a good measure of the strength of the secondary current, has been correlated by means of empirical equations to fluid, flow, and channel geometric properties.

341. Chin, L.T., "The Practice of Rotational Irrigation in Taiwan, Republic of China," United Nations Conference of Applied Science and Technology, Geneva, Oct. 11, 1962, Vol. 6, No. 259.

342. Childs, E.C., and Poulovassilis, A., "The Moisture Profile Above A Moving Water Table," Journal of Soil Science, The Clarendon Press, Oxford (England), Sep. 1962, Vol. 13, No. 2, pp. 271-285.

343. Chitale, S.V., "Design of Alluvial Channels," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, Vol. 3, 1966, pp. 20.363-20.427.

The paper discusses the existing concepts of the "regime" theory of channels developed by Lacey, Inglis, Blench, etc., and the various formulas derived for the design of alluvial channels using the "regime" theory. The author reviewed old and new data obtained for gaging stations in the Punjab, Uttar Pradesh, Beryal, etc.

344. Chitale, S.V., "Energy Dissipation in Hydraulic Jump Below Weirs and Falls," Irrigation and Power (India), Vol. 16, No. 4, Oct. 1959, pp. 465-477.

Indian and American design practices of hydraulic jump type horizontal stilling basins; length of basin according to Indian practice is based on height of jump while American designs correlate it with downstream depth of flow.

345. Chitale, S.V., "Hydraulics of Stable Channels," Central Water and Power Research Station, Government of India, 1966.

346. Chithambaran, V.K., and Mirajgaoker, A.G., "Flume Studies on Natural Roughness in Rigid Open Channels," Institution of Engineers (India), Vol. 45, No. 7, Pt. CI4, Mar. 1965, pp. 571-585.

To introduce roughness in channels, gravel of 1 1/2 to 2 in. size was used; four different placements were tried on slope of 0.0054; it was observed that Chezy's resistance function is logarithmically related to relative roughness as suggested by previous research workers; exponential relationship between Chezy's resistance function and roughness intensity parameter is found to give good approximation; other parameters which are useful in study of very rough channels are also discussed.

347. Chiu,C., "The Role of Secondary Currents in Hydraulics," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A51, Vol. 1, 1967, pp. 415.

The role of secondary currents in several areas of hydraulics is described and discussed. The mechanics governing the existence of secondary currents in straight non-circular channels is also presented. The major part of the discussion is based on analytical equations of secondary flow velocities and results of applying a semi-empirical method for calculating the sediment concentration under the influence of secondary currents.

348. Chohan, R.M.A., "Remodelling Balloki Headworks," Proceedings of West Pakistan Engineering Congress, Lahore, 1966, Vol. XLIX, Paper No. 375.

349. Chohlis, J., "Spectacular Sprinkler," Western Crops and Farm Management, Vol. 10, No. 6, June 20, 1961, pp. 26-27.

350. Choudhury, M.A., "Operating Bambanwala Ravi-Bedian-Depalpur Link Canal in 1961," Proceedings of West Pakistan Engineering Congress, Lahore, 1965, Vol. XLVIII, Paper No. 369.

351. Chow, V.T., "Open-Channel Hydraulics," McGraw-Hill Book Company, Inc., New York, 1959, pp. 680.

352. Christensen, P.L., Doneen, L., Werenfels, and Houston, C., "Furrow Size, Placement, and Grass Culture Effects on Vineyard Irrigation," California Agriculture California University, Davis, Department of Water Science and Engineering; and California University, Davis, Agricultural Extension Service, June 1968, Vol. 22, No. 6.

Studies were conducted in Fresno County, California to evaluate irrigation water penetration rates as affected by size and placement of furrows and the use of grass culture.

353. Claypoole, E.H., "Take a Good Look at Sprinkler Irrigation," Reclamation Era, Vol. 46, No. 3, Aug. 1960, pp. 57-60, 82.

354. Cochran, R.A., "Figuring Total Sprinkler Irrigation Costs," Irrigation Engineering and Maintenance (USA), Vol. 11, No. 2, Feb. Mar. 1961, pp. 12-13.

355. Colby, B.R., "Effect of Depth of Flow on Discharge of Bed Material," United States Geological Survey, Water Supply Paper 1498-D, 1961 12 pages.

Computations with Einstein procedure and empirical analysis of data from flumes and natural streams agree qualitatively in showing complex effect of depth of flow on relationship of discharge of bed material to mean velocity; depth of flow has complex and varied effect on relationship between discharge of bed material and stream power and has, except at low shares, large but simpler effect on discharge of bed material.

356. Colby, B.R., "Monograph for Computing Shear on Streambed Sediment," United States Geological Survey, Professional Paper 475-C, 1963, pp. 202-205.

A monograph for computing effective shear on bed sediment particles from known mean velocities is given and explained. It is based on a slightly different velocity equation from the one that is commonly used, and it eliminates the need for trial-and-error computation of effective shear.

357. Colby, B.R., "Relationship of Unmeasured Sediment Discharge to Mean Velocity," Transactions of the American Geophysical Union, National Research Council, National Academy of Sciences, Vol. 38, No. 5, Oct. 1957, pp. 708-717.

358. Colby, B.R., "Practical Computations of Bed-Material Discharge," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 90, No. HY2, Pt. 1, Paper 3843, Mar. 1964, pp. 217-246.

358. Continued

Average relationships between discharge of bed material per foot of stream width and each of 4 usually dominant measures including mean velocity, stream power, and 2 forms of effective shear on bed sediment are shown graphically as possible bases for practical computations of bed-material discharge.

359. Colby, B.R., and Hubbell, D.W., "Simplified Methods for Computing Total Sediment Discharge with Modified Einstein Procedure," United States Geological Survey, Water-Supply Paper 1593, 1961, 17 pages.

Einstein method was modified by computing total sediment discharge of stream on basis of samples of bed sediment, depth-integrated samples of suspended sediment, stream flow measurements, and water temperature; each of 4 nomographs appreciably simplifies major step in computations and results are nearly as accurate mathematically.

360. Colby, B.R., and Hembree, C.H., "Computations of Total Sediment Discharge Niobrara River near Cooly, Nebraska," Geological Survey (USA), Water Supply Paper No. 1357, 1955, pp. 1-187.

361. Colby, B.R., and Scott, C.H., "Effects of Water Temperature on Discharge of Bed Material," United States Geological Survey, Professional Paper 462-6, 1965, pp. 25.

Viscosity changes that result from changes in water temperature have three effects on sediment discharge; they influence thickness of laminar layer, vertical distribution of suspended sediment in turbulent flow and bed configuration; overall temperature effects as reported for flume and field studies; approximate quantitative effect of water temperature on relation between bed-material discharge and mean velocity.

362. Cole, J.F., "Cost of Pumping Irrigation Water in the Estancia Valley of New Mexico," New Mexico Agricultural Experiment Station, State College, Bulletin No. 444, Feb. 1960, pp. 34.

363. Cole, K.S., "Siphon Tubes for Furrow Irrigation in the Kimberleys," Australasian Irrigator and Pasture Improver, Sydney, Australia, Aug. 1964, Vol. 9, No. 9, pp. 7-11, World Farming, Kansas City, Missouri, Sep. 1964, Vol. 6, No. 9, pp. 44-46.

364. Colebrook, C.F., "Flow of Water in Unlined, Lined and Partly Lined Rock Tunnels," Proceedings of the Institution of Civil Engineers (London), Vol. 10, Paper No. 6281, Sep. 1958, pp. 103-132.

Determines minimum, mean and maximum values of equivalent hydraulic gradient.

365. Collinge, V.K., "The Discharge Capacity of Side Weirs," Proceeding of the Institution of Civil Engineers, Vol. 6, Feb. 1957, pp. 288-304.

366. Colorado State University, "Sediment-Sealing with Bentonite in a Dune Sand: Field and Laboratory Studies of Lateral 1, Interstate Canal, Torrington, Wyoming, Pathfinder Irrigation District, North Platte Project," Colorado State University, CER58RTS25, 1958.

367. Committee on Hydromechanics of Hydraulics Division, American Society of Civil Engineers, "Friction Factors in Open Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY2, Pt. 1, Paper 3464, Mar. 1963, pp. 97-143.

Review of development of fixed-bed, open-channel resistance formulas; relationship of boundary layers to open-channel flow resistance; movable-bed channel resistance and criteria for determining when bed motion begins; comprehensive bibliography through approximately 1960 topics covered.

368. Commonwealth Engineer, "Control of Weeds in Channels and Drains," Commonwealth Engineer, Vol. 41, No. 7, Jan. 1954.

369. Constantinides, K., "Organization of Irrigation," Bulletin of the Greek Committee on Irrigation and Drainage, ICID, 8 Kronous St. Pal Faliron Greece, July-Aug. 1964, No. 11, pp. 8-21.

370. Constantine, T., and Medley, P.R., "Head Losses Across Isolated Ridges or Grooves in a Pipe Line," Journal of the Institution of Water Engineers, Parliament Mansions, Abbey Orchard Street, London, S.W. 1 (England), Oct. 1962, Vol. 16, No. 6, pp. 464-476.

Describe experiments conducted to determine head losses occurring at a badly made joint in a pipe line by means of circular, square-edged orifice plates; report on interesting phenomenon revealed by the orifice plates.

371. Cordes, T.K., "Spray Irrigation," World Crops, Vol. 7, No. 3, Mar. 1955, pp. 115-117.

372. Corey, A.T., and Duke, H.R., and Hedstrom, W.E., "Two-Dimensional Models for Drainage Systems, a Contribution to the Western Regional Research Committee," Department of Agricultural Engineering, Colorado State University, AER68-69 ATC2, Oct. 1968, W-51.

373. Corey, G.L., and McFall, R., "Measurement of Water Over Silted-In Weirs," Idaho Agricultural Experiment Station, Research Bulletin No. 47, Oct. 1960, 16 pages.

374. Corey, G.L., and Fitzsimmons, D.W., "Infiltration Patterns From Irrigation Furrows," Idaho Agricultural Experiment Station Research Bulletin, Moscow, Idaho (USA), Dec. 1962, No. 59, 16 pages.

375. Cossens, G.G., "Problems and Limitations of Irrigation in Central Otago," New Zealand Journal of Agriculture, Wellington, New Zealand, Oct. 15, 1963, Vol. 107, No. 4, pp. 288, 289, 293-296.

376. Costel, G., "Self-Powered Siphon Cuts Labor Costs," Crops Soils, Feb. 1962, Vol. 14, No. 5, pp. 12-13.

377. Costel, G., "Semi-Automatic Irrigation," Reclamation Era, (United States Bureau of Reclamation, Washington 25, D.C.), Feb. 1962, Vol. 48, No. 1. pp. 20-22.

378. Courtois, G., "Radioisotopes in Sedimentology," Proceedings of the Symposium on Isotopes in Hydrology, International Atomic Energy Agency and IUGG, Vienna, Nov. 14-18, 1966, Vienna, 1967, pp. 117-165.

Radioisotopes have two main uses in Sedimentology: they are used for the study of sediment movements in rivers and seas, and for continuous measurements of the amount of sediment suspended in a given medium. These two uses are considered in detail and brief accounts given of some other uses.

379. Coxon, W.F., "Flow Measurement and Control," Heywood and Company, London, 1959, 312 pages.

380. Crafts, A.S., and Robbins, W.W., "Weed Control," New York, McGraw-Hill, 1962, 660 pages.

381. Crickmore, M.J., "Measurement of Sand Transport in Rivers with Special Reference to Tracer Methods," Sedimentology, Vol. 8, No. 3, 1967, pp. 175-228.

The paper describes tests made on a small river to examine the practibility of measuring quantitatively, by tracer methods, sand transport occuring over a rippled bed in a natural channel. Three principal tracer methods, all previously verified under steady flow conditions in a laboratory channel were examined.

382. Crickmore, M.J., and Lean, G.H., "Measurement of Sand Transport by Means of Radioactive Tracers," Proceedings of the Royal Society, Ser. A, Vol. 266, No. 1326, Mar. 20, 1962, pp. 402-421.

Experiments for development of method of measuring sand transport in rivers by means of radioactive tracers; results show that transport rate can be deduced from mass distribution of tracer particles laid to depth sufficient to cover all levels of movement of bed ripples, or by measuring velocity of centroid of activity distribution together with independent point measurement of ripple movements.

383. Criddle, W.D., "Influence of Climate on Irrigation Agriculture," Proceedings of the First Intersociety Conference on Irrigation and Drainage, Mar. 1959, pp. 9-12.

384. Criddle, W.D., "Sprinkling for Profits," Sprinkler Irrigation Association, Open Technological Conference Proceedings, Santa Monica, California (USA), 1964, pp. 55-63.

385. Criddle, W.D., and Haise, H.R., "Irrigation in Arid Regions," United States Department of Agriculture Year Book, 1957, pp. 359-367.

386. Culling, W.E.H., "Analytical Theory of Erosion," Journal of Geology, Vol. 68, pp. 336-344.

A mathematical theory of erosion is developed along similar lines to the classical Fourier theory of heat flow in solids. The general theory is considered in some detail and a few representative examples of its application to stream profiles and valley slopes are suggested in outline.

387. Culp, M.M., "Some Notes on Drainage Structures," Transactions of the American Society of Agricultural Engineers, Vol. 3, No. 1, 1960, pp. 90-91.

388. Culver, R., and Sinker, R.F., "Rapid Assessment of Sprinkler Performance," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 92, No. IR1, Proc. Paper 4706, Mar. 1966, pp. 1-17.

388. Continued

An automated testing station for rapidly assessing the performance of irrigation sprinklers is described. Data from the station is handled by a digital computer to give the performance of a particular head under the test conditions of wind velocity, operating pressure, stand height, jet size on any given layout. The value of this rapid assessment of head behavior is evaluated in terms of known parameters. The relationship between Christiansen's uniformity coefficient and the ratio of maximum-minimum precipitation as well as the coefficient of variation are evaluated for the first hundred tests passed through the station. Areas of further work are outlined and the value of the present data in the design of new overhead systems and the correction of existing inadequate systems are analyzed.

389. Cummins, J.J., "Check Structures in Irrigation Channels," International Commission on Irrigation and Drainage, Annual Bulletin, 1959, pp. 52-56.

390. Cunha, L., "About the Roughness in Alluvial Channels with Comparatively Coarse Bed Materials," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A-10, Vol. 1, 1967, pp. 76.

The analysis of results of observations in Mondego River showed,on one hand, that the experimental points obey Meyer-Peter and Müller's law and, on the other, that the change of the river bed roughness in function of the mean velocity is different from the change usually observed. When the friction factor corresponding to the bed features, $\underline{f}$", was plotted in function of the flow parameter $\psi = \frac{(s-1)d_{35}}{R'I}$, the experimental points for values of ψ exceeding about 5.5 were seen to obey a law which is different from the one currently used for predicting discharge curves.

391. Curry, R.B., and Beasley, R.P., "Flow of Colloidal Suspensions Through Porous Media as Related to Reservoir Sealing," Transactions of the American Society of Agricultural Engineers, Saint Joseph, Michigan (USA), 1962, Vol. 5, No. 2, pp. 160-164.

392. Curtis, T.H., "Changing Irrigation Sets by the Clock," Irrigation Engineering and Maintenance, Dec. 1960, pp. 14-15.

Describes types of water control structure (canvas dam, gates) in border irrigation, which can be controlled by timers, as being used by a farmer in the soil conservation District in Ohio.

393. Dakshinamurti, C., Biswas, T.D., "Soil Erosion and Infiltration as a Function of Rainfall," Publication de l'Association Internationale d'Hydrologie Scientifique (Gentbrugge), 1962, No. 59, pp. 144-147, in English.

Total rainfall, intensity of rainfall, runoff, and evaporation on bare soil surface were recorded, and the relation between rainfall and runoff, as well as the effective rainfall reaching the groundwater surface, estimated.

394. Dalal, S.S., and Ullah, W., "Grassed Waterways for Erosion Control," Irrigation and Power (New Delhi), 1966, pp. 483-486, 23 (u), in English.

395. Dandekar, M.M., "Energy Loss in Hydraulic Jump," Institution of Engineers (India), Vol. 46, No. 9, Pt. CI5, May 1966, pp. 427-437.

Paper presents solution to loss of energy problem in hydraulic jumps in form of graphical curves, prepared on basis of rigorous equation derived using nondimensional parameters. Examples are given to illustrate use of curves.

396. Danel, P., "Suspension Load," Proceedings of the 2nd General Meeting of the International Association of Hydraulic Research, Stockholm, 1948, pp. 113-144.

397. Datta, A.K., "The Role of Grain-Size in the Process of Meandering," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 18, No. 3, Mar. 1961, pp. 218-223.

Discusses the causes of meandering briefly and brings out the significance of grain size and other pertinent factors.

398. Datta, R.R., "Design of Stable Channel in Coherent Alluvial," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 14, No. 1, Jan. 1957, pp. 96-104.

399. Datta, R.R., and Chatterjee, B.N., "Economical Alignment of Irrigation Channels," Journal of the Institution of Engineers (India), Vol. 36, No. 10, Pt. 1, June 1956, pp. 1784-1789.

400. Daubert, A., and Lebreton, I.C., "Experimental and Model Investigations of Erosion in Alluvial Channels, for both Stationary and Nonstationary Conditions," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Vol. 3, No. C4, 1967, pp. 26-37, French.

Most of existing literature on sediment transport and channel erosion deals with aspects of uniform bed load transport. Nonuniform transport has so far been treated only sporadically. The paper discusses two aspects of the problem: scouring due to channel constrictions and erosion in the tailwater section of hydropower plants.

401. Davis, J.R., "Concepts on Design of Border Irrigation Systems," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 36-44.

402. Davis, J.R., "Estimating Rate of Advance for Irrigation Furrows," Transactions of the American Society of Agricultural Engineers, 1961, pp. 52-54, 57.

403. Davis, J.R., "Design of Irrigation Tailwater Systems," Transactions of the American Society of Agricultural Engineers, Vol. 7, No. 3, 1964, pp. 336-338.

Systems for handling or returning runoff flows or tailwater flows from irrigated agricultural lands are specifically dealt with; emphasis is placed on farm irrigation systems and design of tailwater disposal systems; tailwater pumping systems design.

404. Davis, J.R., and Fry, A.W., "Measurement of Infiltration Rates in Irrigated Furrows," Transactions of the American Society of Agricultural Engineers, Vol. 6, No. 4, 1963, pp. 318-319.

Panoche clay loam were used to compare 4 methods for determining infiltration rates in furrows including cylinder infiltrometers, blocked-furrow infiltrometers, inflow-outflow measurements, volume-balance equation based on rate of advance of water.

405. Davis, J.R., and Fry, A.W., "What Price Sprinkler Uniformity," Irrigation Engineering and Maintenance, H.D. Peace Publications, 264 Gravier Street, New Orleans 12, Louisiana (USA), May 1963, pp. 10-11.

Explain how an obvious virtue of good design might nevertheless be an expensive one if it tips the balance of water distribution costs and crop yields.

406. Davis, J., and Zdrazil, K., "Conditions for Economical Operation of Furrow Irrigation," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 6, 1960, pp. C.7-C.19.

407. Davis, S., Pugh, W.J., and Evans, N.A., "Improvement in Irrigation Water Management," Progress Report, Texas Agricultural Experiment Station, College Station (USA), Nov. 1963, No. III, pp. 2.

408. Davis, S., and Schumaker, G.A., "Irrigation Practices for Increasing Sap Production and Mosquito Control," Transactions of the American Society of Agricultural Engineers, 1961, pp. 21-23.

409. Davis, S., and Willhite, F.M., "Border-Basin Irrigation on Mountain Meadows," Agricultural Engineering, Vol. 44, No. 10, Oct. 1963, pp. 545.

Combination border-basin irrigation system for efficient water use was installed on mountain meadow research area; wasteful runoff plus unequal distribution of irrigation water were reduced by plan to combine guide borders and storage basins.

410. Dawdy, D.R., "Discontinuous Depth-Discharge Relations for Sand-Channel Streams and Their Effect on Sediment Transport," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, Paper No. 35, pp. 309-314.

A discontinuity occurs in the depth-discharge relation of many sand-channel streams. Laboratory studies have been used to define the various regimes of flow in terms of configuration of the sandbed channel.

411. Dawdy, D.R., "Depth-Discharge Relations of Alluvial Streams, Discontinuous Rating Curves," United States Geological Survey, Water Supply Paper 1498-C, 1961, 16 pages.

Discontinuity occurs in depth-discharge relation of many alluvial streams; for higher part of relation, after discontinuity, Froude number and Chezy C remain constant; for gaged sites, Froude number may be used for extension of relation; for ungaged sites, Chezy C may be estimated on basis of bed-material properties.

412. Dawe, J.N., "Timely and Frequent Irrigation," Spreckels Sugar Beet Bulletin, Vol. 25, No. 3, May-June 1961, pp. 18, 24.

413. Dekker, G., "Sediment Transport Measurements and Computations on the Niger in Nigeria," Papers presented at CCTA/CSA Inter-African Conference on Hydrology, Nairobi, Jan. 16-26, 1961, pp. 5.

Gives some results of measurement of sediment transport as obtained on the Niger in Nigeria. Einstein, Meyer-Petter and Müller, Kalinske formula give similar results.

414. Dekker, G., "Why Sediment Transport Measurements and How," Papers presented at Commission for Technical Cooperation in Africa South of Sahara/ Scientific Council for Africa South of Sahara, Water Gate House, York Building, Pt. 0, Inter-African Conference on Hydrology, Nairobi, Jan. 16-26, 1961, pp. 7.

415. Dementiev, M.A., "An Experimental Study of Kinematics of Fluid Currents Carrying Suspended Load," Proceedings of the 8th General Meeting of the International Association for Hydraulic Research, Seminar II, 1959, pp. 14-SII/1-4.

416. Dementiev, M.A., Knoroz, V.S., and Levi, I.I., "The Sediment Transport Investigation in the USSR," Proceedings of the 8th General Meeting of the International Association for Hydraulic Research, Seminar II, 1959, pp. R3-SII/1-19.

417. Denison, N.Y., Bally, R.J., and Antonescu, I.P., "Interesting Form of Failure of Irrigation Canal," Geotechnique, Vol. 11, No. 4, Dec. 1961, pp. 319-324.

On canals of irrigation system situated in Lower Danube Plain, failures have been observed in form of cracks, settlement, and cavern formation, as well as loss of large amounts of water; failures occurred as consequence of entrainment of fine sand by irrigation water; damage was often caused by change in local moisture conditions and from thinning or removal of topsoil; remedial measures.

418. Deshpande, V.M., "Consideration About the Calculations with the Total Energy Head in the Trapezoidal Profiles," Indian Journal of Power and River Valley Development, Vol. 10, No. 7, July 1960, pp. 17-22.

A comparison of calculations with energy head with the conventional method and that with the relative numbers of K. Flierl.

419. Dewan, R.L., "Economic and Optimum Utilization of Irrigation Supplies," Indian Journal of Power and River Valley Development, Vol. 9, No. 3, Mar. 1959, pp. 11-15.

420. Dhir, R.D., "Subsurface Drainage and Irrigation: Trend in East European Countries," Indian Journal of Power and River Valley Development, No. 9, Sep. 1959, pp. 17-22.

421. Diaconu, C., "A Speedy Method of Measuring Suspended Load Discharge," Symposium on River Morphology, Association Internationale d'Hydrologie Scientifique, No. 75, 1967, pp. 501-506, French.

The paper starts by reporting the experience gained by Rumanian investigators in establishing the number of water sampling, points, and determing the turbidity when measuring the suspended-load discharge. A method is then described of determining water turbidity much more rapidly than by classical methods.

422. Diebold, C.H., "Factors Affecting Farm Irrigation Efficiency in the Middle Rio Grande Valley," Proceedings of the New Mexico Water Conference, University Park, New Mexico (USA), 9th Annual Conference, 1964, pp. 32-38.

423. Dirmeyer, R.D., "Report of Sediment Lining Investigations, Fiscal Year 1954-1955," Colorado State University, Report No. CER55IRDD7, June 1955.

424. Dirmeyer, R.D., "Use of Colloidal Clay Sediments in Sealing Irrigation Canals," 3rd Congress on Irrigation and Drainage, A5Q7.

425. Dirmeyer, R.D., and Shen, R.T., "Sediment Sealing of Irrigation Canals, Report of the 3 Years Period of 1957 through 1959," Colorado State University, CER60RDD33, July 1960, 124 pages.

426. Diskin, M.H., "An Exponential Equation for Critical Depth in Circular Channels," Water Power, Vol. 10, No. 9, Sep. 1958, pp. 350-351.

427. Diskin, M.H., "End Depth at Drop in Trapezoidal Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 87, No. HY4, Pt. 1, Paper 2851, July 1961, pp. 11-32.

427. Continued

Momentum equation is used to derive a general equation for end depth in prismatic channels in mild slopes at abrupt drop; equation is solved directly for exponential channels and in tabular form for trapezoidal channels; are compared with theoretical values of end depth derived by use of momentum equation.

428. Diskin, M.H., "Hydraulic Jump in Trapezoidal Channels," Water Power, Vol. 13, No. 1, Jan. 1961, pp. 12-17, 22.

Equation proposed by E.A. Elevatorski is cited; approximate solution is presented based on similar equation, but derived in different way; solution is exact for channels having exponential relationship between area and depth of flow; such as rectangular, parabolic, or triangular channels, and approximate for trapezoidal channels.

429. Diskin, M.H., "Rating Curves for Venturi Flumes with Exponential Throats," Water Power, Vol. 15, No. 8, Aug. 1963, pp. 333-337.

Method of producing rating curves for venturi or critical-depth flumes with exponential throats, preferable to rectangular venturi flumes where large variations in discharge are experienced, is presented; design considerations and numerical example for flume with parabolic throat for concrete-lined trapezoidal channel, 12 ft. bottom width and 1 to 1 side slopes, are given.

430. Diskin, M.H., "Specific Energy in Circular Channels," Water Power, July 1962, Vol. 14, No. 7, pp. 270-271.

431. District Engineer, U.S. Army Engineer District, "A Study of Methods Used in Measurement and Analysis of Sediment Loads in Streams; Report R - Progress Report - Electronic Sensing of Sediment," Federal Inter-Agency Sedimentation Project, Available from: District Engineer, U.S. Army Engineer District, St. Paul, Minnesota, 1964, 80 pages.

The possibility of measuring suspended fluvial sediments electronically was investigated as a phase of the continuing study on methods used in the measurement and anlysis of fluvial sediments.

432. Divis, J., "Apparatuses for Measurement of Irrigation Water," Proceedings of the 9th General Meeting of the International Association for Hydraulic Research, Seminar A, 1961.

433. Division of Scientific and Technical Information of the All-Union Research Institute of Hydrotechnics and Amelioration, "Sprinkling and Watering Machines," Transactions of the 4th Congress on Irrigation and Drainage, ICID, Vol. 4, R.9, 1960, pp. 12.153-12.165

434. Dixon, S.W., "Canal and Reservoir Lining with Asphalt," Civil Engineering Easton, Pennsylvania, May 1962, Vol. 32, No. 5, pp. 64-67.

Deals with three types of asphalt lining.

435. Dobbie, C.H., Kenerall, E.J.R., and Blenkharan, A., "Making Canals and Rivers Watertight," Civil Engineering and Public Works Review, Vol. 52, No. 616, Oct. 1957, pp. 1127-1137.

436. Doddiah, D., "Design of Combined Relieving Weir and Silt Ejector for Irrigation and Drainage Systems," 3rd Congress on Irrigation and Drainage, Report 21, Question 9.

Describes a level crossing consisting of a weir, siphon, silt pit, and protective works which automatically disposes of surplus water and ejects silt.

437. Doering, E.J., and Decker, D.L., "Apparatus for Measuring Low Rates of Water Flow," Proceedings of the Soil Science Society of America, Ann Arbor, Michigan (USA), Sep./Oct. 1964, Vol. 28, No. 5, pp. 716-718.

438. Dominy, F.E., "Design Considerations in the Economic Handling of Sediment in Irrigation Systems," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, No. 3, 1966, pp. 20.37-20.64

Sediment control is a major concern in water development projects and plays an important part in the investigation and planning of a river basin. Therefore, studies of the economical handling of sediments in water utilization must be connected with reliable engineering designs of sediment-control structures.

439. Dominy, F.E., "Design of Desilting Works for Irrigation Systems," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 92, No. IR4, Proc. Paper 4998, Dec. 1966, pp. 1-26.

439. Continued

Several considerations are used by the Bureau of Reclamation in the design of economic handling systems for the sediment encountered in irrigation systems. The sediment problem usually develops at the place in the stream where heavily laden sediment water is diverted from the river to the canal. To solve this problem some type of sediment excluder or ejector device is selected after considering six basic requirements. A knowledge and understanding of basic hydraulic and sediment principles is necessary to locating the diversion site and selecting the proper type of sediment removal device. Model studies are usually necessary in selecting a favorable location for the intake and in working out the details of arrangement of the structures. A variety of sediment removal devices has been developed from hydraulic model studies and constructed by the Bureau. Some of the devices are guide walls, vortex tubes, surface and bottom vanes, settling basins, drop inlet diversion structures, and Dufour types of automatic sand sluices. Based on the available information, some devices indicate satisfactory performance further substantiated by field personnel operating the diversion works. More studies are to be made in this area.

440. Dominy, F.E., "New Sources of Water Supply Through Improved Utilization and Management," Transactions of the 4th Congress on Irrigation and Drainage - International Commission on Irrigation and Drainage, Vol. 6, 1960, pp. C353-C363.

441. Donnan, W.W., "Drainage of Agricultural Lands Using Interceptor Drains," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 85, No. IR1, Paper No. 1964, Mar. 1959, pp. 13-23.

Results of theoretical research on design of interceptor drain line; report gathers together theories regarding function and behavior of interceptor drain.

442. Donnan, W.W., and Aronovict, V.S., "Plastic-Lined Mole Drains for Irrigated Areas," Proceedings of the American Society of Civil Engineers, Journal of Irrigation and Drainage Division, Vol. 88, No. IR4, Pt. 1, Paper 3371, Dec. 1962, pp. 39-42.

Field tests of plastic lined mole drains installed at depths of approximately 30 in. at 7 locations in irrigated areas of western United States to determine their feasibility under irrigated conditions; observations over 3 yr. period indicate that these drains were only partially successful; drains failed completely when installed in sandy soils.

443. Doubt, P.D., "Stabilized Channels," Agricultural Engineering, Vol. 43, No. 2, Feb. 1962, pp. 76-77, 85.

Discussion of hydraulic principles and tractive force theory applied for design and maintenance of stable channels; mathematical evaluation of tractive forces by determining frictional force caused by roughness of earth materials in wetted perimeter and producing energy loss at earth-water interface.

444. Doubt, P.D., "Design of Stable Channels in Erodible Materials," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 43, pp. 373-376.

The methods of permissible velocities, regime theory, and tractive force theory have been applied with various degrees of intensity for the design and maintenance of stable channels. The first two methods are empirical while the tractive force theory is analytical.

445. Douma, J.H., "High Velocity Flow in Open Channels," 11th Congress of the International Association for Hydraulic Research, Vol. 1, Paper 1.47, 1965, 8 pages.

Concrete lined open channels have proved effective in controlling high velocity flood flows in United States; concrete channels constructed by Corps of Engineers to convey flood flows through highly developed residential and industrial area; principle hydraulic design features considered in design of high velocity channels; hydraulic design criteria are summarized for flow resistance factors, water surface profiles, superelevated curves, bridge pier losses, channel junctions, air entrainment, sediment transportation, and model testing.

446. Downs, L.V., and Watson, W.O., "Tile Drains in Columbia Basin Project," American Society of Civil Engineers, Water Resources Engineering Conference, Preprint 372, May 16-20, 1966, 37 pages.

Surface and subsurface geological characteristics together with development of exclusive irrigated agricultural area of Columbia Basin Project, Washington, are reviewed as elements affecting installation of drainage systems required to remove accumulation of near-surface groundwater.

447. Drury, P.I., "Drainable Surplus Problems in Irrigated Areas," Symposium on Water Resources Development, West Pakistan Engineering Congress, Lahore, 1969, Vol. XI, Paper No. 91, pp. 41-64.

448. Dubois, R.H., "Effect of End Flares on Capacity of Irrigation Siphon Tubes," Agriculture Engineering, The Journal of the American Society of the Agricultural Engineers, Vol. 29, No. 8, Aug. 1948, pp. 355-356.

The use of short plastic, rubber, or metal tubes for siphoning water from irrigation ditches into furrows is favored over other methods of water distribution by many irrigators. The method facilitates uniform distribution of water, since all tubes of a given size and material will discharge the same quantity of water when operating under the same head.

449. Dumm, L.D., "Drain-Spacing Formula," Agricultural Engineering, The Journal of the American Society of Agricultural Engineers, Vol. 35, No. 10, Oct. 1954, pp. 726-730.

New formula for determining depth and spacing of subsurface drains in irrigated land. Practically every area, where irrigation has been carried on for any length of time, has land that has become waterlogged or salted or lands on which crop production has been affected by high water tables.

450. Dumm, L.D., "Subsurface Drainage By Transient-Flow Theory," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 94, No. IR4, Proc. Paper 6315, Dec. 1968, pp. 505-519.

The transient-flow theory is used as a basis for determining spacing relationships of subsurface drains. Steady-state flow theory does not adequately describe the changing conditions of subsurface drainage. Research work from Australia and Canada and data from a Bureau of Reclamation project were used for checking the validity of the mathematical developments of the transient-flow theory under many varying field conditions. An actual field problem is given as an example of how field investigational data and other available data are used in developing drain-spacing requirements under various specified conditions. Discharge formulas are given and their validity is verified by the Australian and Canadian research work.

451. Dumm, L.D., "Transient Flow Concept in Subsurface Drainage, Its Validity and Use," Transactions of the American Society of Agricultural Engineers, 1964, Vol. 17, No. 2, pp. 142-146.

Investigates validity of new drain-spacing equation using fourth-degree parabola to represent initial water-table conditions for case when drains are above barrier.

452. Dumm, L.D., and Winger, R.J., "Subsurface Drainage System Design for Irrigated Area Using Transient Flow Concept," American Society of Agricultural Engineers, 1964, Vol. 17, No. 2, pp. 147-151.

Describe the method of determining drain spacing developed by United States Bureau of Reclamation, which takes into account transient regimen of ground-water recharge and discharge, and it produces state of dynamic equilibrium at specific maximum water-table height under specific soil, irrigation, crop and climatic characteristics of area.

453. Dunk, W.P., "A Report Describing Recent Developments in the Chemical Control of Water Weeds," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 6, 1960, pp. C.69-C.80.

454. Dunk, W.P., "New Weedicide for Channel Cleaning," Aqua, Official Journal of the State Rivers and Water Supply Commission, Victoria, 100-110 Exhibition Street, Melbourne, C.I. (Australia), Sep. 1962.

455. Dunk, W.P., "Overseas Research and Practices in Irrigation and Drainage," State Rivers and Water Supply Commission (Victoria), 1961, 67 pages.

456. Dunk, W.P., "Weed Control in Irrigation Canals and Drains, Progress Report and Summary of Experimental Results," Aqua, Vol. 7, No. 3, and Vol. 7, No. 2, Nov. 1955 and Oct. 1955, pp. 67-71 and pp. 27-41.

457. Dunk, W.P., "Weed Control in Irrigation Channel and Controls," Aqua, Vol. 6, No. 2, Oct. 1954, pp. 14-21.

458. Dunk, W.P., "Weed Control in Irrigation Channels and Drains, Progress Report and Summary of Experimental Results, June 1954," Aqua, Vol. 5, No. 12, and Vol. 6, No. 1, Sep. 1954, and Oct. 1954, pp. 15-22 and pp. 14-21.

459. Dunn, I.S., "Tractive Resistance of Cohesive Channels," Proceedings of the American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, Vol. 85, No. SM3, Pt. 1, Paper 2062, June 1959, pp. 1-24.

Report of laboratory study on traction resistance characteristics of some cohesive soil samples taken from canal beds in order to discover set of characteristics useful in estimating resistance to erosion for soils in which waterways are proposed.

460. Dutta, R.R., "New Method of Finding Channel Section to Satisfy Kennedy's Equation," Irrigation and Power, Vol. 19, No. 5, May 1962, pp. 344-349.

Mathematical expression for determining channel section; example of use of equations.

461. Dvorak, J., and Holy, M., "Optimum Intensity of Spray Irrigation," Transactions of the 4th Congress on Irrigation and Drainage, ICID, Vol. 4, 1960, pp. 12.337-12.349.

462. Eakin, H.M., "Diversity of Current Direction and Load Distribution on Stream Bends," Transactions of the American Geophysical Union, Part II, 1935, pp. 467-472.

463. Eastwood, W., "The Effect of Bed Profile on the Hydraulic Losses in Open Channels," Water and Water Engineering, Vol. 61, No. 738, Aug. 1957, pp. 334-337.

464. Eastwood, W., "An Experimental Investigation of Flow in V-Shaped Channels," Civil Engineering and Public Works Review, Vol. 53, No. 625, July 1958, pp. 793-794.

465. Ede, A.N., "Innovations in Land Drainage Methods," Journal of the Institution of British Agricultural Engineers, Vol. 13, No. 4, Nov. 1957.

466. Edminster, T.W., "Land Forming and Smoothing for Efficient Production," Agricultural Engineering, American Society of Agricultural Engineers, Vol. 40, No. 2, Feb. 1959, pp. 84-86.

467. Edminster, T.W., and Reeve, R.C., "Drainage Problems and Methods," United States Department of Agriculture, Year Book, 1957, pp. 378-385.

468. Egiazaroff, I.V., "Calculation of Nonuniform Sediment Concentrations," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY4, Pt. 1, Paper 4417, July 1965, pp. 225-247.

Method of calculating sediment concentration and discharge for large range mixtures is presented; attempt is made to determine that part of hydraulic radii which is responsible for sediment discharge rate for granular beds with channel configurations; comparison of theoretical calculations using proposed method with field measurements and with results of H. Einstein 1950 method and its modification is made.

469. Egiazaroff, I.V., "Hydraulic Resistance of a Movable Channel Bed and Sediment Grading Influence," Proceedings of the 12th Congress of the International Association for Hydraulics Research," Paper A9, Vol. 1, 1967, pp. 68.

An approach to the solution of channel resistance on a theoretical base, is presented, covering not only uniform sediments, but also sediments with a wide grading. A method of analysis of the possibility of empirical presentation of the sediments grading curves is given with a hope of furthering granulometric investigations and their analysis.

470. Egiazaroff, V.I., "The General Equation for the Transport of Noncohesive Alluviums by a Current of Fluid," Proceedings of the 7th General Meeting of the International Association for Hydraulic Research, D43, 1957, pp. 1-10, French.

471. Ehrman, K.S., "Plastic Surgery on Irrigation Areas," Proceedings of the American Society of Civil Engineers Journal of the Construction Division, Vol. 90, No. CO1, Paper 3837, Mar. 1964, pp. 47-57.

Seepage from irrigation channels can be reduced, bank stability improved, and groundwater movement controlled by installation of vertical plastic-membrane cutoffs in or adjacent to channel bank; design considerations and construction methods used on installations on Columbia Basin Project, including use of shield on ladder-type excavator in unstable ground are presented.

472. Eidman, V.R., "Framework for Analysis of Irrigation Development," Great Plains Agricultural Council, Nov. 1967, Publication No. 30, pp. 90-102.

472. Continued

The maximization of the long run social welfare of the community is the dominant goal in water resource use. The optimum allocation of the available water supply on a farm is when the marginal value product of the water applied is equal in all of its uses and greater than or equal to the marginal cost of obtaining the water.

473. Einstein, H.A., "The Bed Load Function For Sediment Transportation in Open Channel Flows," United States Department of Agriculture, Technical Bulletin 1026, pp. 1-71.

Presents a complete analysis for bed material load transportation and friction factor from channel geometry and material gradation. Bed load function is integrated with suspended load function to yield total transport. Cross sectional area, wetted perimeter and hydraulic mean radius are divided in three parts for grain friction, wall friction and bed form roughness. Graphs of various functions are given and examples are solved to illustrate the method.

474. Einstein, H.A., "Needs in Sedimentation," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 87, No. HY2, Pt. 1, Paper 2756, Mar. 1961, pp. 1-6.

Discussion of factors affecting sedimentation in United States; sediment problems in rivers are caused mostly by large storage reservoirs; it is concluded that sediment transportation research should concentrate on study of river conditions upstream and downstream from such reservoirs.

475. Einstein, H.A., "Hydrodynamics of Sediment Movement in Waves," International Association for Hydraulic Research, 11th Congress (Leningrad), 1965, Vol. 6, pp. 578-608, in English.

The mechanism of sand movement on the bottom of submerged beaches and the longshore flow of sediments were investigated.

476. Einstein, H.A., and Krone, R.B., "Experiments to Determine Modes of Cohesive Sediment Transport in Salt Water," Journal of Geophysical Research, Vol. 67, No. 4, Apr. 1962, pp. 1451-1461.

Laboratory measurements were made on properties of San Francisco Bay clay sediments to determine modes of transport and deposition. Measurements of sediment suspensions, settling rates, rheological properties and deposition from flowing water showed a dependence of the mode of transport on the suspended sediment concentration and on flocculation kinetics.

477. Einstein, H.A., "Deposition of Suspended Particles in a Gravel Bed," Proceedings of the 7th International Sedimentological Congress, 1967.

Results are reported of laboratory-flume experiments on the deposition of suspended fine-grained particles between the pores of an artificial gravel bed. Two basic problems were studied: techniques for studying the behavior of suspended matter in a river or channel of many miles length in a short laboratory flume, and the laws of similarity for such a flume.

478. Einstein, H.A., "Deposition of Suspended Particles in a Gravel Bed," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 94, No. HY5, Paper 6102, Sep. 1968, pp. 1197.

479. Einstein, H.A., and Li, H., "Secondary Current in Straight Channels," Transactions of the American Geophysical Union, Vol. 39, No. 6, Dec. 1958, pp. 1085-1088.

Study of existence of straight uniform flows without secondary current; it is shown that laminar flows of this kind can remain without secondary currents independent of cross section and velocity distribution; conditions under which secondary flows develop in open channel.

480. Einstein, H.A., and Ning, C., "Transportation of Sediment Mixture with Large Range of Grain Sizes," Corps of Engineers, Missouri River Division, Omaha, Nebraska (USA), 1953.

481. Einstein, H.A., and Ning, C., "Effects of Heavy Sediment Concentration Near the Bed on Velocity and Sediment Concentration," Sediment Series No. 8, United States Corps of Engineers, Omaha Division, Omaha, Nebraska (USA), 1955.

482. Einstein, H.A., and Krone, R.B., "The Use of Radioactive and Fluorescent Tracers to Measure the Transport of Sediment," 20th International Navigational Congress, Baltimore, Maryland (USA), 1961.

483. Einstein, H.A., and Shen, H.W., "Study on Meandering in Straight Alluvial Channels," Journal of Geophysical Research, Vol. 69, No. 24, Dec. 15, 1964, pp. 5239-5247.

483. Continued

From laboratory flume studies two different types of meander patterns are found on sediment beds of straight alluvial channels with nonerodible banks; first type occurs when Froude number of flow is close to one and ratio between depth and width of flow is within certain range; second type of pattern has alternating scour holes and occurs predominantly when water is flowing between rough banks; causes of two types of pattern.

484. Elam, L., "Meter Takes Guesswork Out of Irrigation," Hoard's Dairyman, Aug. 25, 1960.

485. Eldad, B.Z., "Irrigation by Sprinkling," Transactions of the 4th Congress on Irrigation and Drainage, ICID, Vol. 4, 1960, pp. 12.495-12.504.

486. Elevatoriski, E.A., "Hydraulic Energy Dissipators," McGraw-Hill Book Company, 1959, 214 pages.

487. Elgabaly, M.M., "Irrigation and Water Use in United Arab Republic," United Nations Conference on Applied Science and Technology, Geneva, 1962, Oct. 4, 1962, Vol. 4, No. 161, pp. 7.

488. Elliott, N., "Farm Irrigation,"Chartered Land Agents' Society Journal, Vol. 60, No. 10, Oct. 1961, pp. 352-355.

489. Ellison, T.H., "A Note on the Velocity Profile and Longitudinal Mixing in a Broad Open Channel," Journal of Fluid Mechanics, London, Vol. 8, Pt. 1, May 1960, pp. 33-40.

490. Ellsperman, L.M., "Buried Asphalt membrane Canal Linings," 3rd Congress on Irrigation and Drainage, Report 7, Question 7, 1957.

491. El-Madany-Mohamed, "A Nomogrammeter for the Calibration of Regulators, Barrages and Dams in Egypt," Ministry of Public Works, Cairo, United Arab Republic, 1958.

Sets forth the mechanization of the hydraulic formula for calibration. Describes the techniques of application. Presents diagrams, their method of construction and application.

492. Elmadani, M., "The Self-Adjusting Weir," 3rd Congress on Irrigation and Drainage, Report 2, Question 9.

Turnout developed in Egypt which delivers fixed discharge irrespective of variations in upstream and downstream water levels.

493. El-Madani, M., "Sand Screens at Canal Intakes," International Commission on Irrigation and Drainage, Annual Bulletin, 1957, pp. 49-51.

494. El Samni, El-S, "Sprinklers for Soil Irrigation," Agriculture Magazine, Cairo, No. 6, Apr. 1959, pp. 101-110.

495. Engel, F.V.A., and Stainsby, W., "Broad-Crested Weirs: Some Notes on Discharge Coefficients," The Engineer, 28 Essex Street, London, W.C. 2 (England), Sep. 28, 1962, Vol. 214, No. 5566, pp. 537-538, Nov. 16, 1962, No. 5573, pp. 848.

Characterize free discharge conditions according to contraction phenomenon; establish that the theoretical contraction coefficients established for square-edged, thin-plate weirs are also applicable to broad-crested weirs.

496. Engel, F.V.A., and Stainsby, W., "Velocity-of-Approach Factors in Unified Weir Equation," Proceedings of the Institution of Civil Engineers (London), Vol. 9, Paper No. 6247, Feb. 1958, pp. 165-179.

497. Engel, F.V.A., and Stainsby, W., "Weirs for Flow Measurements in Open Channels," Water and Water Engineering, Vol. 62, No. 746, 747, 748, 749, 750, Apr., May, June, July, Aug. 1958, pp. 142-146,pp. 190-197, pp. 238-243, pp. 291-295, pp. 338-343.

"Unified" weir equation valid for long structures as well as sharp crested weirs in channels of rectangular cross section; discharge coefficient characteristics based on principles of fluid dynamics; geometry of weir design and its influence on discharge characteristics; limit of free discharge; weir design calculations.

498. Engelund, F., "A Sediment Transport Theory Based on Similarity," Basic Research-Progress Report-Hydraulic Laboratory, Technical University of Denmark, No. 13, 1967, pp. 2-8.

A new formula is offered for the rate of transportation of sediment in alluvial streams, based on the principle of similarity previously introduced by the author. A design chart facilitates calculations. The theory does not comprise the case of ripple covered bed, as the formation of ripples is related to the occurence of a viscous sublayer, so that simple similarity cannot be expected.

499. Engelund, F., and Hansen, E., "Comparison Between Similarity Theory and Regime Formulae," Basic Research-Progress Report-Hydraulic Laboratory, Technical University of Denmark, No. 13, 1967, pp. 14-16.

499. Continued

The authors compare several expressions obtained for the flow resistance and the total rate of sediment transport in alluvial streams, with some purely empirical regime relationships. They are found to be in satisfactory agreement.

500. Engelund, F., "Hydraulic Resistance of Alluvial Streams," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY2, Paper 4739, Mar. 1966, pp. 315-326.

Relationship between transport of bed load, formation of dunes, and hydraulic resistance of alluvial streams is evaluated; total resistance is caused partly by friction and partly by expansion losses, which may be estimated by Carnot's formula; only frictional part of total energy is effective in transport of bed load; number of dimensionless parameters necessary to characterize given flow regime is examined and it is argued that, for given slope and bed material, definite relationship must exist between water depth and bed load parameters.

501. Enger, P.F., and Merriman, J., "Progress Report of Canal Erosion and Tractive Force Study: Lower Cost Canal Lining Program," United States Department of the Interior, Bureau of Reclamation, Hydraulic Branch Report No.Hyd-435 (GEN-21), Denver, Colorado, Mar. 1957.

Field studies of erosion and tractive force were conducted on 18 test reaches consisting of fine cohesive soils. Channels which were stable, scouring, and where deposition was occuring were studied. Two field trips were made to each site for data collection. One trip was made while the channel was in a dry condition, and the other trip was made when the channel was flowing near maximum discharge. Data are classified, analyzed, and presented in the report.

502. Enger, P.F., Merriman, J., Prichard, B.A., and Ruffatti, M.J., "Progress Report No. 3 - Canal Erosion and Tractive Force Study, Correlation of Laboratory Test Data: Lower Cost Canal Lining Program," United States Department of the Interior, Bureau of Reclamation, Hydraulic Branch Report No. Hyd-464, Denver, Colorado, Oct. 1960.

Field and laboratory data were taken on cohesive earth materials to help develop design criteria for unlined and earthlined canals. Soil samples and hydraulic data were collected from 46 test reaches on Bureau of Reclamation projects. Critical tractive forces of the soils were obtained from a hydraulic erosion or tractive force apparatus. Results are presented in comprehensive tables and are supplemented with standard deviations and correlation coefficients. A logarithmic probability method, which lends itself to mathematical treatment, was used to define mechanical analyses of soils on a statistical basis.

503. Enger, P.F., "Tractive Force Distribution Around the Perimeter of an Open Channel by Point Velocity," University of Colorado, M.S. Thesis, 1960.

504. Enger, P.F., "Canal Erosion and Tractive Force Study - Analysis of Data Taken on a Boundary Shear Flume," Bureau of Reclamation, Hydraulic Branch Report No. Hyd-532, Denver, Colorado, Feb. 1964.

In recent years, studies have been in progress to establish better design criteria for earthlined and unlined canals constructed in fine, cohesive soils. To continue these studies, a recirculating flume was constructed and tests conducted on soil moisture content, and temperature of flowing water in the flume were well controlled. Samples were tested by gradually increasing the boundary shear acting on the sample until shear became critical and the sample began to erode. Tests indicated that the time increment used for increasing the boundary shear on the soil was not critical within the range used and that minor increases in temperature of the flowing water had little effect on the discharge necessary to produce erosion. For the soil tested, the boundary shear required to erode the soil was a function of the moisture content at which the soil was compacted. However, the tests were inconclusive regarding the effect of the soil densities.

505. England, H.N., "Problems of Irrigated Area," Water Resources, Use and Management, 1964, pp. 391-398.

506. Epstein, G., Field Analysis of Furrow Irrigation in Orchards," Journal of Soil and Water Conservation, Vol. 15, No. 5, Sep. 1960, pp. 221-225.

507. Erie, L.J., "Management: A Key to Irrigation Efficiency," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Sep. 1968, Vol. 94, No. IR3, Proc. Paper No. 6107, pp. 285-293.

Irrigated agriculture accounts for most of the water consumptively used. Losses of irrigation water that occur in its movement from source to ultimate use are described, and some unavoidable water losses in water management are identified. Various cultural practices, irrigation systems and consumptive use data are discussed, in relation to water conservation.

508. Escande, L., "Studies on the Simultaneous Functioning of Overflow and Bottom Discharge of Movable Weirs," Proceedings of the 2nd General Meeting of the International Association for Hydrological Research, Stockholm, 1948, pp. 419-444.

509. Escande, L., and Castex,L., "Experimental Study on the Maneuvering with Stop-Logs in Flowing Water," Proceedings of the 6th General Meeting of the International Association for Hydraulic Research, D 16, 1955, pp. 1-27, French.

510. Escoffier, F.F., "Stability Aspects of Flow in Open Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 88, No. HY6, Pt. 1, Paper 3331, Nov. 1962, pp. 145-166.

Graphical solutions for uniform open channel flow problems are developed using Manning formula; charts derived for design of rectangular, trapezoidal, and circular channels; analytical procedure for defining several types of open channel flow in which criteria for tranquil, rapid, and pulsating flows are combined in single chart.

511. Espey, W.H., "A New Test to Measure the Scour of Cohesive Sediments," Technical Report No. HYD01-6301, Hydraulic Engineering Laboratory, Department of Civil Engineering, University of Texas, Austin, Texas, Apr. 1963, pp. 42.

This is a detailed report outlining the development of a rotating cylinder test to measure the scour resistance of a cohesive sediment. Details of the apparatus, various test procedures, and the results of some controlled tests on Taylor Marl are included.

512. Evans, N.A., "Hydraulic Operating Characteristics of Low Gradient Border Irrigation Systems, Final Report to Natural Resources Center," Department of Agricultural Engineering, Colorado State University, OWRR, Washington, AER68-69NAE1, Dec. 1968.

513. Evans, N.A., "Stratum Survey Techniques for Drainage Investigation on Irrigated Land," Colorado State University Experiment Station, Technical Bulletin 67, Dec. 1968.

514. Evans, N.A., "Weed Seed and Trash Screens for Irrigation Water," Colorado State University Agricultural Experiment Station, Bulletin 522-S, Nov. 1964.

515. Evans, N.A., and Jensen, M.E., "Erosion Under Furrow Irrigation," North Dakota Agricultural Experiment Station, Reprint No. 326, Bimonthly Bulletin, Vol. XV, No. 1, Sep.-Oct. 1952, pp. 7-13.

Data on the rate of erosion in furrows were collected for furrows laid on slopes of 1%, 2% and 3-1/2%. Time rates of erosion were determined for disturbed furrows (recently cultivated and having surface soil in a loose state) and undisturbed furrows (not cultivated since previous irrigation). Based on collected data, an equation was derived relating rate of erosion to furrow slope and runoff.

516. Fagerberg, R.M., "Pitfalls in Operation and Maintenance of New Projects," National Reclamation Association Proceeding, Vol. 30, 1961, pp. 95-100.

517. Fangmeier, D.D., and Swanson, N.P., "A Device for Remote Measurement of Flow Depths in Shallow Streams," Agricultural Engineering, Saint Joseph, Michigan, Ames, Louisiana (USA), May 1962, Vol. 43, No. 5, pp. 290-291.

For measuring water depth in furrows, a device is described.

518. Faulkner, M.D., "Leveling Rice Land in Water," Transactions of the American Society of Agricultural Engineers, Vol. 8, No. 4, 1965, pp. 517-519.

Methods of moving soil from one area of field to another, and taking advantage of water wave action to move and smooth soil applied on coastal prairie of southwest Louisiana are described; procedures for leveling rice land in water were undertaken for farming agricultural lands, and for better irrigation water management and adequate drainage.

519. Federal Interagency Sedimentation Project, "Study of Methods Used in Measurement and Analysis of Sediment Loads in Streams," Saint Anthony Falls Hydraulic Laboratory, Report R, Dec. 1964, 79 pages.

520. Finfrock, D.C., "Plastic Levees in Rice Fields," Down to Earth; a Review of Agricultural Chemical Progress, Midland, Michigan, Vol. 16, No. 4, Spring 1961, pp. 18-19.

521. Finkel, H.J., and Nir, D., "Criteria for the Choice of Irrigation Method," Transactions of the American Society of Agricultural Engineers, Vol. 1, 1960, pp. 92-96.

522. Finkel, H.J., and Nir, D., "Determining Infiltration Rates in an Irrigation Border," Journal of Geophysical Research, American Geophysical Union, Vol. 65, No. 7, July 1960, pp. 2125-2131.

523. Finley, P.J., Khoo C. P., and Chin, J.P., "Velocity Measurements in a Thin Horizontal Water Layer," La Houille Blanche (Grenoble), 1966, Vol. 21, No. 6, pp. 713-721.

A series of careful measurements of velocity profiles in thin horizontal water layers is reported in terms of the two components description of the turbulent boundary layer proposed by Coles. The velocity near the bottom is found to be presented by the well-known "Law of the Wall".

524. Finn, F.N., and Kristof, L.H., "Asphalt Membranes for Canal Lining," Western Construction News, Vol. 31, No. 8, Aug. 1956, pp. 28-30.

525. Fischbach, P.E., and Swanson, N.P., "For Extra Bushels of Corn, Use Your Water Efficiently," Nebraska Agricultural Experiment Station Quarterly, 1960, pp. 7-9.

526. Fitzgerald, P.D., and Lauder, B.A., "Effect of Race Condition on Head Losses in Irrigation Ditches," New Zealand Engineering, Vol. 18, No. 1, Jan. 15, 1963, pp. 16-18.

Magnitude of differences in head losses was investigated under various flow conditions; experimental site and methods.

527. Flammer, G.H., "Ultrasonic Measurement of Suspended Sediment," United States Geological Survey, Bulletin 1141-A, 1962, pp. 48.

528. Flaxman, E.M., "Channel Stability in Undisturbed Cohesive Soils," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY2, Pt. 1, Paper 3462, Mar. 1963, pp. 87-96.

Erosion resistance of cohesive soils is defined by comparison of shear strength tests with field observations under specific flow conditions; coefficients of permeability obtained immediately preceding shear strength tests enable prediction of influence of flow duration and permeability on channel stability results are based on soils obtained along streams in 6 western states; stream measurements are used to estimate boundary between eroding and noneroding conditions.

529. Flaxman, E.M., "A Method of Determining the Erosion Potential of Cohesive Soils," Publication de l'Association Internale d'Hydrologie Scientifique (Gentbrugge), 1962, No. 59, pp. 114-123.

Application of conventional soil-mechanical tests used for predicting the erosion potential of cohesive soils is described. Investigations were specifically aimed at the solution of earth-channel design problems. Evidence is presented that the same methods are also suitable for predicting the erosion potential of non-agricultural upland soils.

530. Floyd, B., "Soil Erosion and Deterioration in Eastern Nigeria, A Geographical Appraisal," Nigerian Geographical Journal, 1965, Vol. 8, No. 1, pp. 33-44.

In Eastern Nigeria the gully type of erosion is noticed in the mountain area of Avka-Orlu and in the region Nsukka-Okigwi. Some gullies have a depth of more than 100 meters and a width of about 400 meters. Soil erosion is enhanced by the particular structure of the soil, its geological formation and land-scape, by the intensive rainfall (about 200 cm. per annum) and by man's interference (destruction of the natural plant cover).

531. Fok, Y.S., "Analysis of Overland Flow on a Porous Bed with Applications to the Design of Surface Irrigation Systems," Abstracts of Dissertations and Titles of Theses, Louisiana State University, Baton Rouge, Louisiana (USA), Dec. 1964, Vol. 6 No. 25, pp. 3467-3468.

532. Fok, Y.S., and Bishop, A.A., "Analysis of Water Advance in Surface Irrigation," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 91, No. IR1, Proc. Paper 4259, Mar. 1965, pp. 99-116.

Equations describing the advance of water on borders and furrows during surface irrigation have been developed. These equations yield good results as shown by comparisons with field data. Empirical equations of water surface profiles on the soil surface and water distribution profiles in the soil have been suggested and proven practical. Methods for the computation of surface storage and for the evaluation of the empirical exponent of the advance function have been formulated.

533. Foss, R.E., "Economic Comparisons of Low and High Pressure Sprinkler Systems," Golden Anniversary Meeting of the American Society of Agricultural Engineers, Paper No. 57-93, June 1957.

534. Foss, W.L., "Experiences with Canal Drops of Various Designs," Proceedings of the 8th General Meeting of the International Association for Hydraulic Research, Vol. II, 1959, pp. 1F/1-24.

535. Foster, G.R., "Analysis of Overland Flow on Short Erosion Plots," M.S. Thesis, Department of Agricultural Engineering, Purdue University, Lafayette, Indiana, 1968, pp. 138, (43 figures, 5 tables, 4 appendixes).

An analytical overland flow model of a watershed runoff hydrograph is proposed that satisfactorily predicts runoff for short agricultural slopes. The developed model is a kinematic model that mathematically is the combination of the continuity equation and the Chezy uniform flow relationship.

536. Fouss, J.L., and Donnan, W.W., "Plastic-Lined Mole Drains," Agricultural Engineering, Saint Joseph, Michigan, Sep. 1962, Vol. 43, No. 9, pp. 512-517.

Describes the experiments carried out at North Central Substation of Ohio Agricultural Experiment Station at Vickery.

537. Fox, R.L., Phelan, J.T., and Criddle, W.D., "Design of Subirrigation Systems," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 37, No. 2, Feb. 1956, pp. 103-107.

More extensive use of subirrigation is likely, if principles and applications were more fully understood, point out irrigation engineers in a report of an evaluation and application study of subirrigation systems. Design features, requirements, advantages, and even shortcomings of subirrigation are presented in this report.

538. Francis, J.R.D., "Friction Formulae in Rivers and Channels," Engineer, Vol. 20, No. 5280, Apr. 5, 1957, pp. 519-520.

539. Francis, J.R.D., and Chikwendu, L.N., "Flows in Non-Rectangular Open Channels," Water Power, Vol. 16, No. 10, Oct. 1964, pp. 423-427.

Calculations are presented to show that channel theory using equivalent rectangular section can be used for trapezoidal and vee-shaped channels without incurring errors greater than those introduced in other ways; calculation of critical depths in nonrectangular channels, shape effect, and effect of velocity distribution.

540. Franke, P.G., "About Backwater Flow in Uniform Channels," Indian Journal of Power and River Valley Development, Vol. 10, No. 3, Mar. 1960, pp. 5-7.

541. Franke, P.G., "Calculation with the Energy-Head," Indian Journal of Power and River Valley Development, Vol. 8, No. 2, Feb. 1958, pp. 19-24.

542. Franke, P.G., "Calculations with the Momentum Theorem," Indian Journal of Power and River Valley Devlopment, Vol. 8, No. 10, Oct. 1958, pp. 19-27.

Explains the application of the theorem with regard to the conditions in channels of rectangular cross-section.

543. Franke, P.G., "The Hydraulic Jump," Indian Journal of Power and River Valley Development, Vol. 11, No. 8, Aug. 1961, pp. 21-23, 29.

544. Framji, K.K., "Scour Below Weirs," Proceedings of the 2nd Meeting of the International Association for Hydraulic Research, Stockholm, 1948, pp. 361-380.

545. Franzini, J.B., and Hassan, N.A., "Hydraulics of Thin Film Flow," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 90, No. HY2, Proc. Paper 3816, Mar. 1964, pp. 23-36.

545. Continued

In considering thin-film liquid flow as occurring in a trickling filter, a theoretical expression is developed for the average time of contact of a thin liquid film as it flows steadily around a body of revolution whose axis of symmetry is vertical. Entry at the uppermost and exit at the lowermost points is assumed. The body does not have any sharp corners. Laminar flow is assumed, and surface tension is neglected. Application is made to an ellipsoid of revolution with major axis of major ellipse vertical and to an ellipsoid of revolution with major axis of major ellipse horizontal.

546. Frazer, W., "Hydraulic Jump in Prismatic Channels, Determination of Conjugate Depths," Engineering (Great Britain), Vol. 179, No. 4642, Jan. 1955, pp. 46 and 47.

547. Frazer, W., "The Behavior of Side Weirs in Prismatic Rectangular Weirs," Proceedings of the Institution of Civil Engineers, Vol. 6, Feb. 1957, pp. 305-328.

548. Freeman, A.M., "Six Federal Reclamation Projects and the Distribution of Income," Water Resources Research, 1967, Vol. 3, No. 2, Richmond, Virginia, pp. 319-332.

The major concern of this paper is the effect of Bureau of Reclamation Irrigation Projects on the size distribution of income and means of evaluating these effects. Estimates of the before and after project distributions of income for six recent projects are provided. All projects were redistributing income in the "right" direction. However, only one of the six projects had a welfare-weighted benefit-cost ratio greater than 1.

549. Friedkin, J.F., "A Laboratory Study of the Meandering of Alluvial Rivers," United States Waterways Engineering Experimental Station, 1945, 40 pages.

550. Frost, K.R., "Efficiency of Sprinkler Irrigation," Sprinkler Irrigation Association, Proceedings, Open Technical Conference, Santa Monica, California (USA), 1964, pp. 33-37.

551. Frost, K.R., "Efficiency of Sprinkler Irrigation," Irrigation Engineering and Maintenance, H.D. Peace Publications, 264 Gravier Street, New Orleans 12, Louisiana (USA), May 1964, Vol. 14, No. 5, pp. 22-23,28.

Reports investigations carried out in Arizona which show that the spray losses in most localities are relatively low.

552. Frost, K.R., "Factors Affecting Evapotranspiration Losses During Sprinkling," Transactions of the American Society of Agricultural Engineers, Vol. 6, No. 4, 1963, pp. 282-283, and 287.

Studies over several years indicate influence of various conditions on evapotranspiration during sprinkling, in which large weighing evapotranspirometer is used to determine gains or losses in soil moisture content of growing crop.

553. Frost, K.R., and Schwalen, H.C., "Evapotranspiration During Sprinkler Irrigation," Transactions of the American Society of Agricultural Engineers, 1960, pp. 18-20, 24.

554. Frost, K.R., and Schwalen, H.C., "Sprinkler Evaporation Losses," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 36, No. 8, Aug. 1955, pp. 526-528.

A study of spray losses in sprinkler irrigation was undertaken to determine the % of water reaching the ground or vegetative surfaces during application.

555. Fry, A.W., and Davis, J.R., "Flow Measurements for Sprinkler Irrigation Systems," Agricultural Engineering, Vol. 39, No. 10, Oct. 1958, pp. 649-651.

Study of methods of fabricating accurate yet inexpensive rate of flow measuring device, to reduce cost of commercial meters and encourage measurement of water applied through aluminum sprinkler lines; square edged eccentric orifice appears to be most accurate and easily fabricated; it can be used with air water manometer.

556. Fry, A.W., and Davis, J.R., "Simple and Accurate Device for Sprinkler Irrigation," California Agriculture, University of California, Vol. 14, No. 3, Mar. 1960.

557. Fucik, M., "The Role of Private Consulting Firms in Modern Water Resources Development," Symposium on Consulting and Contracting Practices in Pakistan, West Pakistan Engineering Congress, Lahore, Mar. 1965, Vol. VIII, No. 68.

558. Fuvioka, Y., "Suggestions for Improving Irrigation Efficiency," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 4, 1963, pp. 16.115-16.130.

558. Continued

Tests showed that effective soil moisture in field irrigated is situated between field capacity and centrifugal moisture equivalent, and irrigation should be begun when average soil moisture in effective root zone falls to centrifugal moisture equivalent.

559. Fukuda, H., "A Theoretical Computation of the Border Flow in Irrigation Relating to Ostromecki's Method," International Commission on Irrigation and Drainage, Annual Bulletin, 184, Golf Links, New Delhi 3 (India), 1962, pp. 27-29.

A sequel to Ostromecki's article on the suject published in the International Commission on Irrigation and Drainage, Annual Bulletin, 1960.

560. Galley, R.L., "Flow-Rate Measurement," Instruments and Automation (USA), Vol. 27, No. 12, Dec. 1954, pp. 93-100.

561. Garber, L.W., "Relationship of Soils to Earthflows in the Palouse," Journal of Soil and Water Conservation, 1965, Vol. 3, No. 20, pp. 21-23.

One striking form of soil erosion in the Palouse region of the Pacific Northwest is the earthflows that occur during the spring of the year. Several hundred tons of soil may move downslope in large earthflows. The properties of soils on which earthflows are likely to occur are described and these properties related to physical forces operative in the soils.

562. Garcia, L.F., "Irrigation Use of Water," United Nations Conference of Applied Science and Technology, Geneva, Oct. 12, 1962, Vol. 6, No. 280, pp. 6.

563. Garde, J., and Albertson, M., "Bed Load Transport in Alluvial Channels," La Houille Blanche, Vol. 16, No. 3, May-June 1961, pp. 274-281, French.

Theory of suspended load, saltation load, and contact load are explained; equations of bed load (contact load plus saltation load) are cited; new separate functional relationships are presented for plane-bed condition and dune-bed condition; practical use of presented formulas.

564. Garde, R.J., "Local Bed Variation at Bridge Piers in Alluvial Channels," Research Journal of the University of Roorkee, Vol. 4, No. 1, Nov. 1961, pp. 101-118.

565. Garde, R.J., and Hasan, S.M., "An Experimental Investigation of Degradation in Alluvial Channels," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Vol. 3, No. C5, 1967, pp. 38-45.

Results are presented of experimental investigation of channel-bed degradation and the formation of the self-reinforcing bed layer often termed "Armor coat". After defining and describing the phenomenon of bed degradation and its determining factors, the authors briefly outline the laboratory experimental unit.

566. Garde, R.J., and Paintal, A.S., "Velocity Distribution in Alluvial Channels," La Houille Blanche, Vol. 19, No. 6, Oct. 1964, pp. 719-726.

Exponential and logarithmic types of formulas are suggested to describe velocity distribution for turbulent flow over rigid boundaries for use in studies of scour, design of channels, silt excluders and extractors.

567. Garde, R.J., and Rangarajan, K.G., "Analysis of Resistance to Flow Over Alluvial Beds," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, Vol. 30, 1966, pp. 20.113-20.126

Results are reported of field investigations and theoretical analyses of flow resistances in alluvial channel beds. A brief review of some of the existing resistance equations is presented, and data obtained from tests in natural flumes, rivers and canals are analyzed. Factors affecting resistance to flow in alluvial channels are discussed.

568. Garde, R.J., and Rangaraju, K.G., "Regime Criteria for Alluvial Streams," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY6, Pt. 1, Paper 3705, Nov. 1963, pp. 153-164.

Present investigations reveal that criteria based mainly on flume data and use of shear stress as chief parameter do not predict regimes of flow accurately enough for natural streams, as compared with those in flumes; new criterion, using individual values of hydraulic radius and slope is based on all available data from flumes and natural streams and can be used for prediction regimes in problems involving resistances to flow, as well as sediment transport.

569. Garde, R.J., and Rangaraju, K.G., "Resistance Relationships for Alluvial Channel Flow," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY4, Paper 4869, July 1966, pp. 77-100.

Reliability of resistance relationships given by Einstein-Barbarossa, Liu-Hwang, and Shen was studied on basis of available data from flumes, canals, and natural streams.

570. Garde, R.J., and Rangaraju, K.G., "Resistance to Flow in Alluvial Streams," Institution of Engineers (India), Vol. 45, No. 9, Pt. CI5, May 1965, pp. 712-720.

Method of computing mean velocity in alluvial stream is presented; based on data collected by authors, several curves are drawn which can be used to obtain stage discharge curve for streams.

571. Garde, R.J., Subramanha, K., and Nambudripad, K.D., "Scour Around Obstructions," Irrigation and Power (New Delhi), 1961, Vol. 18, No. 7, pp. 651-660.

Dimensional analysis has shown that sediment size is important in determining the maximum scour depth. Equations have been derived for the average drag coefficient of the sediment and the depth of scour around obstructions placed at right angles to the flow in alluvial channels.

572. Garner, H.E., "Base Level Control of Erosion Surfaces," Arkansas Academy of Science Procedures, 1965, No. 19, pp. 98-104,

Slope control over a developing erosion surface by a regional base level requires an interaction commonly attributed to running water. The effectiveness and hence control of this interaction diminishes from humid to semi-arid to arid environments and therefore from humid peneplains through semi-arid pediplains to arid pediplains to the extent that any of these ultimate landforms exist.

573. Garton, J.E., "A Graphic Method of Solving Sprinkler Irrigation Application Problems," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 32, No. 11, Nov. 1951, pp. 615-616.

In the design of sprinkler irrigation systems an easy means of relating plot size, sprinkler discharge, and operating time is needed. The accompanying nomograph relates these variables involved in sprinkler design. The plot size is the distance between the nozzles on the lateral multiplied by the distance the laterals are moved at each setting. The primary factors affecting sprinkler spacings are the wetted diameter of the sprinkler-discharge pattern and wind conditions.

574. Garton, J.E., Beasley, R.P., and Barefoot, A.D., "Automation of Cut-Back Furrow Irrigation," Agricultural Engineering, Vol. 45, No. 6, June 1964, pp. 328-329.

How automated cut-back furrow irrigation system applies water uniformly through outlet tubes with canopy inlets with reduction of labor; system installed on Irrigation Research Station at Altus, Oklahoma is featured.

575. Gerabeck, K., "Austrian Problems Concerning Irrigation and Drainage," International Commission on Irrigation and Drainage, Annual Bulletin, 1957, pp. 42 and 48.

576. Gerber, J.F., and Harrison, D.S., "Sprinkler Irrigation for Cold Protection of Citrus," Transactions of the American Society of Agricultural Engineers, Madison, Wisconsin (USA) 1964, Vol. 7, No. 4, pp. 464-468.

Present a general theory which estimates the amount of water required based on the lowest anticipated temperature and the wind speed with field data which support its validity; conclude that sprinkler irrigation can be used successfully for cold protection, if sufficient water is used.

577. Ghani, B.A., and Safdar, A.G., "River Training," Golden Jubilee Publication, West Pakistan Engineering Congress, Oct. 1963, Part II, pp. 273-296.

Summarizes evolution of river training methods and their efficiency in West Pakistan.

578. Gibson, W., "Long-Barreled Sprinklers," Hawaii Sugar Technologists Reports, No. 20, 1961, pp. 262-263.

579. Gildea, A.P., and Wong, R.F., "Flood Control Channel Hydraulics," International Association for Hydraulic Research, 12th Congress (Ft. Collins Colorado), 1967, Vol. 1, No. A41, pp. 330-337.

579. Continued

Concrete-lined open channels, having a rectangular or trapezoidal cross section have become increasingly necessary and well justified to control floods for the protection of highly developed industrial and urban areas located on steep gradient streams in the United States.

580. Gill, M.A., "Rationalization of Lacey's Regime Flow Equations," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 94, No. HY4, Paper No. 6039, July 1968, pp. 983.

581. Gillard, M.E., "Surface Drainage Works in Irrigation Districts (Australia) Aqua, Official Journal of the State Rivers and Water Supply Commission, Victoria, Melbourne, CI, Australia, July 1963, pp. 255-260.

582. Girshkan, S.A., "Some Problems of Designing Irrigation Canals," International Commission on Irrigation and Drainage Annual Bulletin, 1959, pp. 34-38.

583. Glover, R.E., and Florey, Q.L., "Stable Channel Profiles," United States Bureau of Reclamation, Hydraulics Laboratory Report No. HYD-325, 1951.

584. Goodman, L.J., "Erosion Control in Engineering Works," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 33, No. 3, Mar. 1952, pp. 155-157.

Pursuant with efforts to combat erosion of certain airfields and ammunition depots, this paper summarizes 8 1/2 months of research on hydromechanical studies of soil erosion processes.

585. Gordienko, P.I., "The Influence of Channel Roughness and Flow States on Hydraulic Resistances of Turbulent Flow," Journal of Hydraulic Research, Vol. 5, No. 4, 1967, pp. 249-261.

In rough river channels there may be four main kinds of fluid motion in the quadratic area of resistances, viz: I) quiet, II) "overflowing", III) transitional, and IV) accelerated flow. There also is a special group of "circumcritical" flows including subcritical and supercritical flows close to the critical. The author describes the peculiarities of those states and the limits within which they occur.

586. Gottschalk, L.C., "Effects of Watershed Protection Measures on Reduction of Erosion and Sediment Damages in the United States," Publication de l'Association Internationale d'Hydrologie Scientifique (Gentbrugge), 1962, No. 59, pp. 426-447.

Sheet erosion leads to reduction of land productivity and income; channel erosion may result in severe damage and land depreciation. Sediment due to transport of eroded materials causes additional downstream damage to crops through deposition of floodplain land.

587. Govinda Rao, N.S., "Design of Siphons," Central Board of Irrigation and Power, Publication No. 59, Sep. 1956, pp. 122.

588. Govinda Rao, N.S., "Silt Ejectors in Canals," Proceedings of the 9th General Meeting of the International Association for Hydraulic Research, Bombay, 1951, pp. 135-142.

589. Govinda Rao, N.S., and Rajaratnam, N., "A Contribution to Turbulent Flow in Open Channels," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 17, No. 3, July 1960, pp. 419-428.

The article deals with the development of rational formulae for smooth turbulent, transition turbulent and rough turbulent flows.

590. Govinda Rao, N.S., and Rajaratnam, N., "Submerged Hydraulic Jump," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY1, Pt. 1, Paper 3404, Jan. 1963, pp. 139-162.

Theoretical and experimental equations for main flow parameters; equation is derived for energy loss in submerged jump; theoretical developments are experimentally verified for range of supercritical Froude numbers from 2.94 to 10.0 and for submergence factor to values of approximately 4.

591. Govinda Rao, N.S., and Subrahmanyam, V., "Elimination of Influence of Side-Wall in Computing Bed Shear in Smooth Walled Open Channel Flow," Irrigation and Power, Vol. 21, No. 4, Oct. 1964, pp. 619-624.

Method of computing bed friction factor and shear velocity of bed in smooth-walled open channels, allowing for different energy slopes and hydraulic radii for wall and bed sections; computational procedure and illustrative example.

592. Gowan, W.L., "Estimating Hydraulic Roughness Coefficients," Agricultural Engineering, Vol. 37, No. 7, July 1956.

Deals with a rational method for the selection and estimation of roughness coefficients in the Mannings Formulae for flow in open channels.

593. Goncharov, V.N., "Dynamics of Channel Flow," Translated from Russian by Israel Program for Scientific Translations, 1964.

594. Grace, J.L., and Priest, M.S., "Division of Flow in Open Channel Junctions," Alabama Polytechnic Institute, Engineering Experiment Station, Bulletin No. 31, June 1958, 28 pages.

Results of study on relation of characteristic depths and of discharge for open channel junctions with various channel widths and angles of juctions when channel cross sections are rectangular, bottoms are plane and horizontal, walls are joined in angular form, and flow is divided; results presented graphically.

595. Gradowczyk, M.H., and Folguera, H.C., "Analysis of Scour in Open Channels by Means of Mathematical Models," La Houille Blanche, Vol. 20, No. 8, Dec. 1965, pp. 761-769.

Scour in open channels and natural courses is discussed from analytical point of view; equations for dynamics of scour are derived; technique of mathematical models is used to establish system of relations between different unknown variables, which can be evaluated numerically in sequential form.

596. Graf, W.H., "On Determination of Roughness Coefficient in Natural and Artificial Waterways," International Association of Scientific Hydrology, Bulletin 11, No. 11, Mar. 1966, pp. 59-68.

Equation is developed which relates frictional behavior of cross-section in watercourse to its velocity profiles; field data, as well as laboratory data, confirm this theory; suggested theory is probably simpliest way to get information on roughness condition in cross-section of watercourse.

597. Granados, A.H., "Irrigation by Sprinkling and Comparison with Other Systems in the Present Conditions at the Cadiz Province and adjacent areas, Spain," Transactions of the 4th Congress on Irrigation and Drainage, International Congress on Irrigation and Drainage, Vol. 4, Report 21, 1960, pp. 12.379-12.400.

598. Grant, A.J., "Automatic Syphonic Spillways," International Commission on Irrigation and Drainage, Annual Bulletin, 1959, pp. 8-18.

599. Grant, A.J., "Automatic Syphons, Simple Devices Control the Flow of Surplus Water in Irrigation Channels," Aqua, Vol. 6, No. 9, and Vol. 6, No. 10, May 1955, June 1955, pp. 15-23, pp. 16-23.

600. Grant, A.P., "Channel Improvement in Alluvial Streams," Proceedings of the New Zealand Institution of Engineers, 1948, pp. 244.

601. Gray, A.S., "Aeration Irrigation With Sprinkling," Irrigation Engineering and Maintenance, Mar. 1960, pp. 20.

Describes the new slow application sprinkler method which brings greater yields of better quality crops and results in a number of benefits to the soil.

602. Gray, A.S., "Permanent and Solid Sprinkler Systems," Irrigation Engineering and Maintenance, H.D. Publications, 264 Gravier Street, New Orleans 12, Louisiana (USA), Jan.-Feb. 1964, Vol. 14, No. 1, pp. 12-13.

Discusses that (i) ordinarily a high cash return crop in a high labour cost area susceptible to heat and/or cold losses justify the cost of a solid set for heat/frost control, (ii) heat control measures be taken when temperature is above 95° F.

603. Gray, A.S., "Permanent and Solid Sprinkler Systems as Related to Irrigation, Heat Control, and Frost Control," Report of the Michigan State Horticultural Society, Lansing (USA), 1964, No. 93, pp. 81-86.

604. Gray, A.S., "The Solid Sprinkler System," Irrigation Engineering and Maintenance, Vol. 9, No. 3, Mar. 1958, pp. 27-29.

Discusses the advantage, economic feasibility, and present knowledge about a solid system in which the entire field is covered by sprinklers, generally on a spacing of 30 feet on the lateral with laterals spaced at 50 feet apart.

605. Gray, D.M., and Ahmed, M., "Rational Approach Applied to Design of Border Dike Systems," Canadian Agricultural Engineering, Vol. 7, No. 1, Jan. 1965, pp. 30-33, 44.

605. Continued

Attempt is made to demonstrate application of rational approach based on conservation of mass, to analysis and design of border dike irrigation systems.

606. Great Britain, Department of Scientific and Industrial Research, "Flow Measurement in Closed Conduits," London, 1962, Vol. I and II.

607. Green, G.C., "The Care and Feeding of Water Weeds," Irrigation Engineering and Maintenance, Apr. 1960, pp. 15.

Describes the aquatic herbicides "Aquabu" that is successful in killing submerged water weeds.

608. Green, K.D., "Irrigation and Drainage Techniques in Western United States," Government Printers for State River and Water Supply Commission, Victoria, Melbourne, 1958, pp. 112.

609. Green, K.D., "Some Problems of Irrigation Engineer," Commonwealth Engineer, Vol. 45, No. 7, Feb. 5, 1958, pp. 51-57.

610. Green, K.D., "Precast Concrete Irrigation Channel Flumes," International Commission on Irrigation and Drainage, Annual Bulletin, 1959, pp. 82-86.

611. Green, R.L., "A Photographic Technique for Measuring the Sizes and Velocities of Water Drops from Irrigation Sprinklers," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 33, No. 9, Sep. 1952, pp. 563-564, 566.

Physicists and meteorologists have been interested in the phenomena of the distribution of drop sizes and the velocities of raindrops for the past 75 years. In the past 15 years, the interest of engineers and other agricultural scientists has been focused to some degree on these phenomena in their efforts to determine the mechanics of soil erosion and its allied results of surface sealing, decreased aeration and infiltration capacities, and other damage to the soil structure detrimental to crop production.

612. Greenwood, N.H., "Feasibility of Transmountain Stream Diversion Across the White Mountains of Arizona," Journal of Geography, New York, Madison,etc. May 1963, Vol. 63, No. 5, pp. 203-209.

613. Griffin, A.E., "Multiple-Purpose River Basin Development," Proceeding of the Symposium on Conservation of Water Resources in the United Kingdom Institution of Civil Engineers (Great Britain), London, 1963, pp. 151-154.

614. Grigg, N.S., "Motion of Single Particles in Sand Channels," Ph.D. Dissertation, Colorado State University, Ft. Collins, Colorado, CER68-69NSG48, May 1969.

615. Grishanin, K.V., "The Similarity in Flows at Straight Reaches of Rivers," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A28, Vol. 1, 1967, pp. 226.

A hypothesis is proposed concerning the bond between the geometric similarity of river channels and dynamic similarity or river flows. Measurements made at the rivers in the plains of the USSR confirm the hypothesis surprisingly well.

As a result of considerations, the universal rating curve, approximately valid for river straight reaches of arbitrary width and depth, is plotted.

By the aid of this curve it is possible to determine the rough value of a water discharge in the absence of information about the channel resistance and the water surface slope.

616. Grissinger, E.H., "Resistance of Selected Clay Systems to Erosion by Water," Water Resources Research, 1966, Vol. 1, No. 2, pp. 131-138, (11 figures, 4 tables, 8 references).

Laboratory tests were made on a Grenada silt loam soil to which various clay minerals were added to simulate a wide range of natural conditions. The study included only resistance to scour and neglected the effects on volume of freeze and thaw, wetting and drying, etc. The results are discussed and liquid limit, plastic limit, and plasticity index values presented.

617. Groskopp, M.O., "Sprinkler Irrigating Sandy Soils of Central Wisconsin," Irrigation Engineering and Maintenance, H.D. Peace Publications, 264 Gravier Street, New Orleans 12, Louisiana (USA), Apr. 1964, Vol. 14, No. 3, pp. 18-19.

Describes tests carried out at the Kancock Experiment Station which show that supplemental irrigation of vegetable and field crops in practical and profitable on the sandy soils of central Wisconsin; gives comparative yield data of irrigated and unirrigated crops.

618. Grover, B.L., Ligon, J.T., and Kirkham, D., "Operational Characteristics of Laterals Near Edge of Tile Drainage System," Journal of Geophysical Research, Vol. 65, No. 11, Nov. 1960, pp. 3733-3738.

618. Continued

Surface of saturation between two outside tiles of drainage systems will have same shape and height as surface between any other two adjacent tiles of drainage system as long as all tiles flow without back pressure; discharge from laterals near side of drainage system, except for outside lateral, will be same as discharge from those near center.

619. Grzywienski, A., "The Effect of Turbulent Flow on Multi-Section Vertical Lift Gates," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1, pp. 76-85.

The author presents a short summary of his studies and model tests since 1959 concerning the effect of turbulent flow on sectionalized vertical lift gates under high head. As the result of these investigations, a new type of gate structure as well as lifting arrangement is proposed in order to obtain the safest and most economical features for wide spillways.

620. Gulati, T.D., "Behavior of Rivers," Indian Journal of Power and River Valley Development, Vol. 17, No. 7, 1967, pp. 29-30, 38.

621. Gulati, T.D., Taneja, J.R., and Handa, C.L., "Studies in Silt Exlusion at Canal Headworks," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research, 1951, pp. 205-220.

622. Gulhati, N.D., "Worldwide View of Irrigation Developments," Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol. 84, No. IR3, Sep. 1958, Paper 1751.

During the first half of the 20th Century, the population of the world has increased by 900 million; from 1,600 million in 1900 to 2,500 million in 1950. In the next ten years, not less than 200 million more people will be added to the world population and will have to be provided for. The increasing industrial development in various parts of the world is also making an ever increasing demand on the available water resources.

623. Gulick, L.H., "Irrigation Systems of the Former Sind Province, West Pakistan," Geographical Review, New York, (USA), Jan. 1963, Vol. 53, No. 1, pp. 79-99.

624. Gupta, G.P.,"Tile Concrete Lining for Canal Bed," Irrigation and Power (India), Vol. 19, No. 10, Oct. 1962, pp. 811-818.

Tile concrete lining used in various canals beds in India is better and cheaper than concrete lining and double layer tile lining; life of concrete (with shingle) will be many times life of plaster under moving water and so tile concrete lining will be ultimately much cheaper than single layer tile lining as well.

625. Gupta, S., "Problems and Possibilities of Utilization of Irrigation Waters," Indian Journal of Power and River Valley Development, Vol. 7, No. 9, Sep. 1957, pp. 73-74.

626. Gupta, S.N., "Sediment in Irrigation and Drainage Channels," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, No. 3, 1966, pp. 20.2-20.35.

This is a synopsis of 22 individual reports of the problem of sediments in irrigation and drainage channels. All the reports contain valuable information on numerous aspects of the problem.

627. Gupta, S.N., Gupta, R.D., and Goyel, C.P., "Investigations for Hydraulic Design of Sarda Sluices," Irrigation and Power, Journal of the Central Board on Irrigation and Power, Vol. 15, No. 3, July 1958, pp. 352-366.

628. Gutti, S.R., "Stability of an Overfall Founded on Permeable Soils," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 92, No. HY3, Proc. Paper 4821, May 1966, pp. 37-50.

The criteria for the stability of an overfall founded on permeable soils are examined. The magnitude of escape velocity (exit gradient) due to both subsoil and surface flows is taken as a basis for the stability in contrast to the existing exit gradient theories. With an increase in permeable foundation depth, the magnitude of the exit gradient, the rate of percolation, and the escape velocity also increase. The escape velocities contributed by the wavy surface flow are found to increase with an increase in wave steepness. This indicates that immediately downstream of the structure, occurrence of a flood wave of high amplitude and sinusoidal shape would contribute to an increase in the exit hydraulic gradient.

629. Guy, H.P., "Fluvial Sediment Measurement Based on Transport Principles and Network Requirements," Symposium: Design of Hydrological Networks, Quebec, June 15-22, 1965, Vol. 1, No. 67.

629. Continued

Fluvial sediment measurement is presently expensive and much limited in proportion to needs. The present techniques make use of manually operated depth-integrating stream samplers and time-consuming methods. Effort was done on the basis of network requirements and existing equipment for streamflow measurement, continuous sensing and recording of sediment data, and central computing systems.

630. Guy, H.P., Simons, D.B., and Richardson, E.V., "Summary of Alluvial Channel Data from Flume Experiments," United States Geological Survey, Professional Paper 462l.

631. Guyon, G., "Irrigation and the Use of Water; Tests of Spray-Irrigation Equipment," United Nations Conference on Applied Science and Technology, Sep. 28, 1962, Vol. 3, No. 121, pp. 4.

632. Guyot, M.T., Nougar, J., and Thirriot, C.L., "Numerical Study of Transient Conditions in Canals," La Houille Blanche, No. 13, Dec. 1960, pp. 814-832.

Numerical calculations of the propagation of solitary waves in free flow canals, considering transient conditions.

633. Gyorke, O., "Energy Dissipation in Protected Beds Downstream of River Barrages in the Case of Shallow Stilling Pools," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1, pp. 184-196.

The theory in the past was that the surplus energy content of water, released into the tailwater bed, is completely dissipated along the hydraulic jump ensuing on the tailwater apron, and the latter was designed accordingly. Recent investigations of turbulent flow have revealed, that intensive turbulence and velocity fluctuations are caused by the tailwater apron.

634. Gyorke, O., "On the Velocity Coefficient and Hydraulic Roughness in Meandering Water Courses," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A40, Vol. 1, 1967, pp. 324.

Changes in Chezy's velocity coefficient and absolute roughness ε in a meandering stream are dealt with in the present paper. Values of C and ε were determined on the basis of stages pertaining to several known rates of flow in several typical cross sections in the apex of the bend, at the point of counterflexure and along an approximately straight reach. Differences were found to exist between the values derived from these observation data and those calculated with the characteristic particle diameter of bed material, using the modified Manning-Strickler equation. In this connection the influence of currents in bends on hydraulic roughness is demonstrated.

635. Haddad, S.M., and Natour, F., "Irrigation and Farm Planning on the East Ghor Canal Project (Jordan)," 3rd Regional Irrigation Practices Leadership Seminar, Nesa Region, Lahore, Feb. 15-26, 1960, pp. 191-198.

636. Hagan, R.M., "Transforming Irrigation from an Age-Old Art Into a Modern Science Through Research and Technology," United Nations Conference on Applied Science and Technology, Geneva, 1962, Vol. 3, pp. 126-136.

637. Haindl, K., "Hydraulic Jump in Closed Conduits," Proceedings of the 8th Congress of the International Association of Hydraulic Research, Section D, 1957.

638. Haindl, K., and Dolezal, L., "Turbulent Pressure Fluctuations in a Complex Hydraulic Structure," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1, pp. 56-65.

The turbulent fluctuations of hydrodynamic pressure in complex structures, consisting of a power plant in the reservoir and a shaft spillway in the bottom of which there are canals from the bottom outlets and the turbine draft tube.

639. Haise, H.R., Kruse, E.G., and Erie, L., "Automating Surface Irrigation," Agricultural Engineering, AEP68-69EGK8, Department of Agricultural Engineering, Colorado State University, Apr. 1969, Vol. 50, No. 4, pp. 212-216.

640. Haise, H.R., Kruse, E.G., and Dimick, N.A., "Pneumatic Valves for Automation of Irrigation Systems," Agricultural Research Service, Bulletin 41-104, July 1965, 21 pages.

641. Hakias, N.A., "Evaluation of the Proper Water Supply Systems as a Basis for Planning Complete Programmes of Collective Irrigation," Journal of Agricultural Engineering Research, Silsoe, England, 1963, Vol. 8, No. 1, pp. 74-77.

642. Hall, G.W., "Analytical Determination of the Discharge Characteristics of Broad-Crested Weirs Using Boundary Layer Theory," Proceedings of the Institution of Civil Engineers, Great George Street, Westminster, London S.W. 1 (Great Britain), June 1962, Vol. 22, pp. 177-190.

Derives by the application of boundary layer theory a simplified model of the discharge characteristics of a two-dimensional broad-crested weir with square entry-edge.

643. Hall, W.A., and Butcher, W.S., "Optimal Timing of Irrigation," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 94, No. IR2, Proc. Paper 5993, June 1968, pp. 267-275.

A methodology is derived permitting determination by dynamic programming of the optimal timing of irrigation, to produce the greatest net return inclusive of the cost of irrigation. It will be particularly useful under conditions in which seasonal supply is inadequate but reasonably predictable. Analysis is based upon the principle that the adverse effects of deficiencies (nutrition, excessive salinity, soil moisture, etc.) are geometric when existing in combination. For general use, additional data concerning the yield coefficients will be required covering each of the critical stages in the growth of the crops independently.

644. Hall, W.A., "Design of Irrigation Border Checks," Agricultural Engineering, Vol. 41, No. 7, July 1960, pp. 439-442.

Proposed method of specifying border system for maximum application efficiency, based on predicted advance of wetting front; permits selection of optimum discharge rate and application depth, and probable application efficiency; values obtained are limited by erosion and salinity control, and drainage problems computation procedure outlined.

645. Hall, W.A., "Estimating Irrigation Border Flow," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 37, No. 4, Apr. 1956, pp. 263-265.

A practical method for predicting the rate of water advance down an irrigation border simplifies design of border-strip checks.

646. Hall, W.A., "Functional Analysis of Levees for Border Irrigation System," Transactions of the American Society of Civil Engineering, 33 West 39th Street, New York 18, New York, 1964, Vol. 7, No. 4, pp. 396-397, 401.

Presents a proposal for the design of levees for border irrigation, applicable to the flat ridge border levee; also proposes an operating procedure for use where the design equations would specify virtually no free-board.

647. Hall, W.A., "Performance Parameters of Irrigation Systems," Transactions of the American Society of Agricultural Engineers, Vol. 3, No. 1, 1960, pp. 75-76, 81.

648. Hall, W.A., and Buras, N., "Optimum Irrigated Practice Under Conditions of Deficient Water Supply," Transactions of the American Society of Agricultural Engineers, 1961, pp. 131-134.

649. Hallmark, D.E., and Smith, G.L., "Stability of Channels by Armorplating," Proceedings of the American Society of Civil Engineers, Journal of the Waterways and Harbors Division, Vol. 91, No. WW3, Pt. 1, Paper 4452, Aug. 1965, pp. 117-135.

Results of experimental and theoretical investigations are presented for certain sediment characteristics found pertinent to control of localized scour in alluvial channels; relationship between fall velocity of sediment particle, velocity at beginning of sediment motion, tractive force, and bed shear velocity is developed in terms of nominal particle diameter; example of practical use of data is provided; results are presented in form of graphs.

650. Hamilton, F.B., and Schrunk, J.F., "Sprinkler Vs. Gravity Irrigation, A Basis for Choice of the Best Systems," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 34, No. 4, Apr. 1953, pp. 246-250.

Some characteristics of sprinkler and gravity irrigation systems under the conditions prevailing in the Great Plains states will be examined in this paper and a basis for choice of the best system suggested for an individual farm. The extent to which sprinkling will eventually replace gravity types.

651. Hamilton, J.M., "Stabilization of Channels in Coarse Non-Uniform Bed Material," M.S. Thesis, Colorado State University, Ft. Collins, Colorado, CET68-69JMH10, 1968.

652. Hammad, H.Y., "Depth and Spacing of Tile Drain Systems," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 88, No. IR1, Paper No. 3084, Mar. 1962, pp. 15-34.

Paper discusses saturation of agricultural soil by over-irrigation or rain; downward seepage flow through porous soil to system of paralell tile drains is studied, and theory of hydrodynamics is developed for providing scientific basis for design; new spacing formula is obtained based on time variation of water table.

653. Hammad, H.Y., "Design of Tile Drainage for Arid Regions," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 90, No. IR3, Pt. 1, Paper 4036, Sep. 1964, pp. 1-15.

Tile drainage systems for irrigated zones are investigated; distribution of moisture in capillary zone, drainage and irrigation requirements, water table flunctuation, and depth and spacing of tiles are studied; solution gives set of equations sufficient for determination of different parameters necessary for design of tile drainage; treatment is based on soil properties, quality of irrigation water and salt tolerance of plants.

654. Hammad, H.Y., "Seepage Losses from Irrigation Canals," Proceedings of the American Society of Civil Engineers, Journal of the Engineering Mechanics Division, Vol. 85, No. EM2, Apr. 1959, pp. 31-36.

655. Hanan, J.J., and Langhans, R.W., "Constant Water Table Irrigation," New York State, Flower Growers' Bulletin, Ithaca, Mar. 1963, Bulletin No. 208, pp. 2-3.

656. Handa, C.L., "Power and Irrigation Projects: Their Efficient Execution: Some Suggestions," Indian Journal of Power and River Valley Developments, Calcutta, India, Dec. 1963, Vol. XIII, No. 12, pp. 14.

657. Hanko, Z., "Investigations to Determine the Necessary Length of the Lining Following the Stilling Basin of the Bottom Drops on Small Water Courses," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 4, pp. 1029-1042.

In order to determine the necessary length of the lining on a small water course after a bottom drop formed with a hydraulically scaled stilling basin, we have carried out measurements in the concrete bed model of 1:15 scale, built in the experimental flume of the Laboratory of the Research Institute for Water Resources.

658. Hanks, R.J., and Klute, A., "A Numerical Method for Estimating Infiltration, Redistribution, Drainage and Evaporation of Water From Soil," American Society of Agricultural Engineers, 1968 Annual Meeting, Logan, Utah, June 1968, Paper 68-214.

A numerical method was developed for estimating one-dimensional infiltration of water into soil where water added by precipitation at the surface was equal to or greater than the infiltration rate.

659. Hansen, V., "Hydraulics of Irrigation Water Application as Affected by Soils and Other Factors," Intersociety Conference on Irrigation and Drainage (USA), Apr. 29-30, 1957.

660. Hansen, V.E., "Mathematical Relationships Expressing the Hydraulics of Surface Irrigation," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 29-35.

661. Hansen, V.E., "New Concept in Irrigation Efficiency," Transactions of the American Society of Agricultural Engineers, Vol. 3, No. 1, 1960, pp. 55-57, 61, 64.

662. Hansen, E., "On the Formation of Meanders as a Stability Problem," Basic Research, Progress Report, Hydraulic Laboratory, Technical University of Denmark, No. 13, 1967, pp. 9-13.

The macrostructures of alluvial streams, viz., the formation of meanders, is considered. It is investigated whether it is possible to account for the formation of meanders by the usual methods for stability analysis. The final theoretical result of the investigation is that alluvial streams having a dune-covered bed show a tendency to meander or shoal.

663. Hansen, V.E., "Unique Consumptive Use Curve Related to Irrigation Practices," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 89, No. IR1, Mar. 1963, Paper 3449, pp. 43-50.

663. Continued

Analysis of consumptive use-evaporation ratio to show how unique comsumptive use curve, which applies to essentially all crops, can be developed and to relate curve to irrigation practice; how stage of growth affects irrigation practice.

664. Hanson, E.G., "Research in Ditch Linings to Save Irrigation Water," Proceedings of the Water Conference, New Mexico A and M College, 9th Annual Conference, 1964, pp. 46-47.

665. Harding, H.E., "Maintenance of Works in Irrigation Districts," Aqua, Vol. 5, No. 11, July 1954, pp. 3-12.

Reviews the maintenance of channels, irrigation structures, meter wheels and drains as practised in Irrigation Districts in Victoria.

666. Harding, H.E., and Tisdall, A.L., "Land Settlement and Irrigation Postwar Progress and Possible Future Extensions," Aqua, Vol. 8, No. 11, July 1957, pp. 219-227.

667. Hardy, E., "The Chemical Control of Water-Weeds," Water Power, Vol. 13, Oct. 1961, pp. 397-399.

668. Harr, M.E., "Ground Water and Seepage," New York, McGraw-Hill, 1962, 315 pages.

669. Harris, W., and Jacks, J.F., "Surface Field Ditch Studies in Northeastern Arkansas," Arkansas Farm Research, Arkansas Agricultural Experiment Station, Vol. 10, No. 6, Nov.-Dec. 1961, pp. 11.

670. Harris, D.D., and Richardson, E.V., "Stream Gauging Control Structure for the Rio Grande Conveyance Channel Near Bermardo, New Mexico," United States Geological Survey, Water Supply Paper 1369-E, 1964, 32 pages.

Describes the problems and site conditions for the conveyance channel, the recommended control design and position in the channel, and the details of the model study.

671. Harris, W.S., Wait, J.C., and Benedict, R.H., "Warped Surface Method of Land Grading," Transactions of the American Society of Agricultural Engineers, Vol. 9, No. 1, 1966, pp. 64-65.

New method was developed for preparing land-grading design with non-uniform grades to provide desired grades for field drains; design method is adapted to digital computer programming and has been programmed in SOAP II, and FORTRAN IV languages.

672. Harrison, A.J.M., "Design of Channels for Supercritical Flow," Institution of Civil Engineers, Vol. 35, Nov. 1966, pp. 475-490.

Methods proposed by other authors to reduce amplitude of oblique standing waves formed on surface of supercritical flow and superelevation of water surface at bends are reviewed and are shown to be applicable only to design of channels of wide, rectangular cross section. More general wave theory which applies to channels with trapezoidal shape is presented.

673. Harrison, D.S., "Some Essentials in Planning an Irrigation System," Citrus and Vegetable Magazine, Aug. 1964, Vol. 27, No. 12, pp. 19-21.

674. Harrison, A.S., and Lidicker, H.C., "Computing Suspended Sand Loads from Field Measurements," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 56, pp. 484-492.

Two sediment samples were in each vertical, one depth-integrated sample and one point sample at a reference depth, obtained with a P-46 sampler. A vertical velocity distribution is also measured with a current meter.

675. Harrison, A.S., and Mellema, W.J., "Movable Bed Model for Alluvial Channel Studies," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A25, Vol. 1, 1967, pp. 202.

The Corps of Engineers has developed a movable bed model facility for studying problems in the design and maintenance of the channel stabilization and navigation project on the Missouri River. The bed material is ground walnut shells. Several practical constraints on the choice of scales are discussed. The selection of scales for modeling navigation channel problems in two Missouri River reaches is described. Techniques have been developed for measuring geometrical, hydraulic, and sedimentation characteristics in the model with reasonable precision.

676. Hart, W.E., "Overhead Irrigation in the Hawaiian Sugar Industry," Reports, Hawaiian Sugar Technologists, Honolulu (USA), 1962 (Published 1963) pp. 48-58.

677. Hart, W.E., "Overhead Irrigation Pattern Parameters," Agricultural Engineering, Vol. 42, No. 7, July 1961, pp. 354-355.

Commonly used overhead irrigation pattern parameters and their interrelations; discussion is based on assumption of normal distribution under overlapped sprinkler pattern; method of matching pattern parameter with irrigation requirements.

678. Hart, W.E., "Sprinkler Distribution Analysis with Digital Computer," Transactions of the American Society of Agricultural Engineers, Vol. 6, No. 3, 1963, pp. 206-208.

Paper describes digital computer program for analyzing patterns for irrigation sprinklers; program was written in symbolic programming system language for IBM 1620; it is intended for use on basic 20K machine with paper tape punch; program accepts observations from single sprinkler and overlaps them to generate rectangular patterns for spacings desired; multiple sprinkler tests can also be handled.

679. Hart, W.E., Bassett, D.L., and Strelkoff, T., "Surface Irrigation Hydraulics and Kinematics," Journal of the Irrigation and Drainage Division American Society of Civil Engineers, Vol. 94, No. IR4, Proc. Paper 6284, Dec. 1968, pp. 419-440.

The study of the hydraulics of surface irrigation is separated into kinematic and dynamic approaches. Only the former is considered herein and discussion is limited primarily to the advance phase. The basic equation applicable in the kinematic approach is that of mass conservation, i.e., the total water discharged into the head of a furrow or border is equal to the sum of the amounts stored in the soil and on the surface of the ground, respectively. Methods of numerically solving the mass-conservation equation are developed and discussed.

680. Hart, W.E., and Reynolds, W.N., "Analytical Design of Sprinkler Systems," Transactions of the American Society of Agricultural Engineers, Vol. 8, No. 1, 1965, pp. 83-85,89.

Interrelationships between sprinkler-water distribution, water made available to plant, water lost through deep seepage, and water deficits within areas irrigated by sprinklers are discussed in light of assumed normal distribution of overlapped pattern values; it is demonstrated how related parameters can be used for evaluating expected performance from proposed installation.

681. Harvey, W.A., "Weeds," Proceedings of the First Intersociety Conference on Irrigation and Drainage, Mar. 1959, pp. 77.

682. Hassan, Z., "Control and Distribution of Irrigation Water by Means of Hydraulic Structures," 3rd Congress on Irrigation and Drainage, Report 1, Question 9.

683. Haswell, J.R., "Some Tile Drainage Experiments," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 30, No. 2, Feb. 1949, pp. 81-83, and 85.

The shortage of farm labor forced the use of a possible labor-saving equipment, which could not travel through bog holes. A desire to increase food production called for the drainage of many wet spots in good fields. Most of the areas had been in production with horses, but tractors could not do a satisfactory job.

684. Hawkins, G.P., "High Elevation Pumping for Irrigation. Is it Practical?" Irrigation Engineering and Maintenance, H.D. Peace Publications, 264 Gravier Street, New Orleans 12, Louisiana (USA), Oct.-Dec. 1964, Vol. 14, No. lo.

Describes the Dalles Project, cost $6.5 million, which involves pumping from the Columbia River to the high elevations of farm land 1,100 feet above the Dales.

685. Hawkins, G.P., "Sprinkler Irrigation Reference Data Book," Rainway Irrigation Co. Box 4226, Station B, Spokane, Washington, 1956, 41 pages.

686. Haws, F.W., and Lauritzen, C.W., "For Lining Ditches with Concrete, New Slipform Uses Free-Flow Hopper," Farm and Home Science, Utah State University, Logan, Utah, Sep. 1962, Vol. 23, No. 3, pp. 63-65.

687. Haynie, R.M., "Design of Stable Channels in Alluvial Material," Ph.D. Dissertation at Colorado State University, June 1964.

688. Haynie, R.M., and Simons, D.B., "Design of Stable Channels in Alluvial Materials," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 94, No. HY6, Paper No. 6217, Nov. 1968, pp. 1399.

689. Hazen, C.S., "Conjunctive Use of Surface Water and Ground Water Supplies in the Principal Canal Irrigated Areas of West Pakistan," Symposium on Waterlogging and Salinity in West Pakistan Golden Jubilee Session, West Pakistan Engineering Congress, Lahore, Oct. 1963, Vol. 7, No. 57.

690. Hazen, A.G., Promersberger, W.J., and Olson, H.M., "New Irrigation Station at Carrington," North Dakota Experiment Station, Bimon, Bulletin 21, No. 2, Nov.-Dec. 1959, pp. 10-13.

691. Headley, J.C., "Factors Associated with the Location of Supplemental Irrigation in the Humid Area," Land Economics, Vol. 37, No. 2, May 1961, pp. 187-190.

692. Heermann, D.F., "Hydraulics of Surface Irrigation," Progress Report to Regional Technical Research Committee, 1964, 1965, 1966, 1967, 1968, Agricultural Engineering Department, Colorado State University, 1968.

693. Heermann, D.F., and Kincaid, D.C., "Pressure Distribution on a Center-Pivot Sprinkler Irrigation System," Published as Scientific Series Paper No. 1390, Colorado State University Experiment Station, AEP68-69-DCK-DFH4, Department of Agricultural Engineering, Colorado State University, 1968, Paper No. 1390.

694. Heikes, E., "Aquatic Weed Control in Ditches and Ponds," Montana State College Extension Service, Bulletin 311, Nov. 1960, 20 pages.

695. Hekkel, H., "Stable Channel Design and Sediment Control in Kushtia Irrigation Project," Paper presented to the Water Resources Conference, Dacca, Institution of Engineers, Oct. 1961.

696. Hellström, B., "Solids in Stream Flow," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research, 1951, pp. 531-551.

In connection with an investigation of the utilization of water power in Australia a study of the formation of silt in the Wollomombi, Chandler, Oaky, and Styx rivers in New South Wales. As a rule, Swedish rivers carry very little silt, one of the exceptions being the Fyris river, situated about 65 km. east of Stockholm. The content of silt and dissolved salts in this river has been investigated. Since it is of interest to compare the silt content of rivers in different countries, a summary is also given of the observations.

697. Henderson, D.C., "Inventory of Irrigation Areas and Determination of Consumptive Use by Areas," Agricultural Experiment Station, New Mexico State University Final Report, Jan. 1967, pp. 3, OWRR Project A-007-New Mexico.

A map was constructed showing location of irrigated lands and source of water and areas of similar consumptive use factors in New Mexico.

698. Henderson, F.M., "Open Channel Flow," The McMillan Company (New York), 1966.

699. Henderson, F.M., "Stability of Alluvial Channels," Tranactions of the American Society of Civil Engineers, Vol. 128, 1963.

700. Henderson, D.W., Hagan, R.M., and Mikkelsen, D.S., "Water Use Efficiency in Irrigation Agriculture," American Potash Institute, Inc. Washington, D.C. (USA), 1963, pp. 42-49.

701. Hendry, A.W., "Model Experiments on Canal Regulators," Civil Engineering and Public Works Review, Vol. 50, No. 590, Aug. 1955.

702. Herber, B., "Some Technical Problems of Our Irrigation Equipment," Soil Water, Dec. 1964, Vol. 1, No. 2, pp. 11-14.

703. Herbich, J.B., and Shultis, S., "Large-Scale Roughness in Open-Channel Flow," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 90, No. HY6, Paper 4145, Nov. 1964, pp. 203-230.

New method of predicting resistance to flow in open channels with large roughness elements is proposed; roughness elements investigated consisted of 6 in. and 3.75 in. cubes; these were arranged in variety of symmetric and random patterns; it was found that systematic relationships do exist among Manning's "n", Reynolds number, Froude number, and special quantitative parameter of roughness pattern.

704. Hermsmeier, L.F., Young, R.A., "Anti-Sedimentation Device for Measuring Flumes," Agricultural Engineering, Vol. 43, No. 11, Nov. 1962, pp. 648-649.

Auxiliary equipment for using anti-sedimentation device while measuring runoff from rainulator erosion plots; tests to determine effectiveness of device in removing sand from flume and effect of sand on calibration of flume.

705. Herpich, R.L., "Kansas Irrigation Potential," Kansas Board of Agriculture Report, No. 42, 1958-1959, pp. 50-52.

706. Hickey, H.C., and Dortignac, E.J., "An Evaluation of Soil Ripping and Soil Pitting on Runoff and Erosion in the Semiarid Southwest," International Association of Scientific Hydrology, 1963, No. 65, pp. 22-23.

A cooperative study was started in 1958 to evaluate the relative effectiveness and duration of mechanical treatments produced by a soil "ripper" and soil "pitter". Subsoil ripping was more effective in reducing runoff and erosion from test plots than were artificially built surface depressions or pits.

707. Hickey, M.E., and Jones, B.V., "Membrane Linings for Canal Construction," Civil Engineering, Apr. 1968, pp. 51.

708. Hill, H.M., "Bed Forms Due to Fluid Stream," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY2, Paper 4724, Mar. 1966, pp. 127-143.

General investigation of occurrence of bed forms is reported; relationship is determined for finding point at which ripples would replace flat bed; empirical relationship for determining point at which flat bed is replaced by dunes was found to be applicable for all experiments in which sand was used as bed material; factors affecting collision region were investigated.

709. Hill, L.W., "Improving Irrigation Efficiencies in River Basin," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 4, 1963, pp. 16,197-16.223.

Methods on improving where water is limiting factor in irrigation development are discussed; projects of Rio Grande Basin are cited to show measures that can be used to conserve limited water supply and improve irrigation efficiencies of river basin where water is allocated by interstate and international treaties.

710. Hill, R., "Irrigation:Light and Frequent," Holly Agricultural News, Summer 1964, Vol. 12, No. 2, pp. 7.

711. Hill, R.A., "Operation and Maintenance of Irrigation Systems," Tranactions of the American Society of Civil Engineers, Vol. 117, 1952, pp. 72-88.

712. Hiranandani, G.M., and Saxena, P.C., "Effect of Temperature and Boundary on Current Meter Ratings," Central Water and Power Research Station (India), Technological Memo 1, 1960, 13 pages.

713. Hiranandani, G.M., et al., "Spillways and Energy Dissipators - Hydraulic Model Investigation," Central Water and Power Research Station, Poona (India), 1962, 42 pages.

714. Hirth, G., "A Simple Water-Level Indicator," Aqua, Vol. 12, No. 4, Dec. 1960, pp. 93-95.

715. Hoare, E.R., "Water Use in Large Scale Irrigation Schemes," Irrigation Research Laboratory, Griffith, New South Wales, Australia, 17th International Horticulture Congress Proceedings, 1967, Vol. 2, pp. 105-112.

The semiarid areas of the world have been ideally suited to the growing of tree fruit due to higher sunlight intensity, suitable soils and low humidity. Prior to the 1940's the approach to water usage by plants was botanical in concept.

716. Hoare, E.R., and Fleming, P.M., "Sprinkler Irrigation: General Design Consideration," United Nations Conference on Applied Science and Technology, Oct. 22, 1962, Vol. 7, No. 329, pp. 4.

717. Hobbs, E.H., and Krogman, K.K., "Water Use in a Southern Alberta Irrigation District," Transactions of the American Society of Civil Engineering, 1963, Vol. 6, No. 3, pp. 266-267.

718. Hockensmith, R.D., and Steele, J.G., "Soil Erosion - The Work of Uncontrolled Water," USA Soil Conservation Service, Agricultural Information Bulletin 260, US Government Printing Office, Washington, July 1962, 16 pages.

Explain soil erosion phenomenon by water; illustrate with photos the situations arising and suggest remedial measures for control.

719. Hoekstra, P., "Moisture Movement in Soils Under Temperature Gradients with the Cold-Side Temperature Below Freezing," Water Resources Research, 1966, Vol. 2, No. 2, pp. 241-250.

719. Continued

Moisture movement to a freezing point in an unsaturated porous medium of Fairbanks silt was measured by γ ray attenuation. It was shown that the presence of an ice phase greatly enhances the amount of moisture transfer under temperature is calculated.

720. Holland, D.A., "A Method of Forecasting Irrigation Requirements," Report of the East Malling Research Station, East Malling (USA), 1964, No. 51, pp. 79-83.

721. Holloway, G., and Burton, R.E., "Rapid Technique for Estimating Seepage Discharge," Civil Engineering and Public Works Review, London, England, Nov. 1964, Vol. 59, No. 700, pp. 1395-1399.

Describe the development of the electrical analogue technique which enables the determination of the rate of seepage flow beneath water retaining structures founded on permeable soil.

722. Holtz, W.G., "Thick Compacted Earth Linings for Canals," 3rd Congress on Irrigation and Drainage," Report 6, Question 7.

723. Hom-ma, M., "An Experimental Study of Water Falls," Proceedings of the 5th General Meeting of the International Association for Hydraulic Research, 1953, pp. 477-481.

724. Hoon, R.C., and Malhotra, A.N., "Bed Material Survey of Rivers: Its Utility for Development of Regime Flow Concept," Irrigation and Power (New Delhi), 1960, Vol. 17, No. 4, pp. 572-603.

A survey of bottom sediments in the Jhelum river in India was carried out with a view to determining the river's flow characteristics and the critical velocity expected to maintain equilibrium conditions of flow, according to Lacey's formula.

725. Hooper, L.J., "Discharge Measurements by Sharp-Edged Orifices and Salt Velocity Methods," The American Society of Mechanical Engineers, 20th and Northampton Street, Easton, Pennsylvania (USA), 1962, Paper No. 62-HYD-9, pp. 1-4.

726. Horsfall, R.A., "Water Conservation and Distribution," Aqua, May 1964, Vol. 15, No. 9, pp. 195-200.

727. Horsky, T., "The Gradually Varied Flow in Nonprismatic Channels," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A34, Vol. 1, 1967, pp. 272.

In this paper the modification and integration of the differential equation for a gradually varied flow in nonprismatic channels are described. For solution an arbitrary formula of velocity can be used.

728. Horvath, V., and Brödi, B., "Determination of Natural-Slope Category Limits by Function Identity of Erosional Intensity," Publication de l'Association Internationale d'Hydrologie Scientifique (Gentbrugge), 1962, No. 59, pp. 131-143.

To eliminate subjective factors in soil conservation planning, the development of erosion intensity by slope angle was examined and slope-category limits were established on this basis, governed by the identical function of erosion intensity and by the possibility of using farm machinery on the slopes.

729. Hossain, A., and Huda, M.N., "Coefficient of Roughness of Natural Streams," Institution of Engineers (Pakistan), Vol. 14, 1962, pp. 95-100.

Open channel formulas governing flow of water, particularly Manning's formula, are reviewed; results of actual observation on Manning's coefficient of roughness in natural streams of East Pakistan and its relationship with stage and sediment content of rivers are reported.

730. Houk, I.E., "Irrigation Engineering," Wiley, Vol. 1 and 2, 1956.

731. Houston, C.E., "Drainage Irrigated Land," California Agricultural Experiment Station, Circular 504, Nov. 1961, pp. 40.

732. Houston, W.R., "Effects of Water Spreading on Range Vegetation in Eastern Montana," Journal of Range Management, Vol. 13, No. 6, Nov. 1960, pp. 289-293.

733. Howe, O.W., and Heermann, D.F., "Efficient Border Irrigation and Operation," Presented at the 1968 Winter Meeting of the American Society of Agricultural Engineers, AEP68-69 DFH1, Department of Agricultural Engineering, Colorado State University, 1968.

734. Howe, O.W., "Is Controlled Irrigation the Answer?," Agricultural Leaders Digest, Vol. 41, No. 9, Oct. 1960, pp. 14.

735. Howell, D.T., "Nonuniformity and Sprinkler Application Efficiency," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 90, No. IR3, Pt. 1, Paper 4052, Sep. 1964, pp. 41-53.

General expression derived is used in conjunction with some hypothetical nonuniform distribution patterns and one real pattern to give graphical indication of form of relationships between 3 quantities, including Christiansen uniformity coefficient, mean application ratio, and application efficiency factor due to nonuniformity; effects of skewness of distribution of precipitation are shown; analysis is based on assumption that depth of soil wetted at any point is proportional to precipitation that has fallen at that point.

736. Howell, D.T., "Sprinkler Nonuniformity Characteristics and Yield," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 90, No. IR3, Pt. 1, Paper 4053, Sep. 1964, pp. 55-67.

Characteristics of nonuniformity of sprinkler application that affect yield of useful plant growth are shown to depend on form of relationship between yield per unit area and local depth of water applied; by using example it is shown that if this yield relationship can be expressed as polynomial of order r, significant characteristics of nonuniform application pattern are shown to be moments to order r of distribution of application depths.

737. Howell, D.T., "Some Considerations in the Economic Use of Sprinkler Irrigation," Wool Technology and Sheep Breeding, Vol. 8, No. 1, July 1961, pp. 71-77.

738. Howell, D.T., and Beale, J.G., "Relationships Among Sprinkler Uniformity Measures," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 92, No. IR1, Paper 4720, Mar. 1966, pp. 41-48.

From among many different measures of uniformity (or nonuniformity) of application of water by sprinkler irrigation, five are defined; they have been termed Christiansen coefficient of uniformity, coefficient of variation, Wilcox-Swales uniformity coefficient, United States Department of Agriculture pattern efficiency, and "higher" pattern efficiency.

739. Howell, F.W., "Controlling Irrigation by Radio," American Cattle Producer, Denver, Colorado (USA), Nov. 1964, Vol. 46, No. 6, pp. 6.

740. Howland, W.E., "Selecting Irrigation Pipe Size for Economy," Agricultural Engineering, Vol. 38, No. 7, July 1957, pp. 530-534.

741. Hubbell, D., "Apparatus and Techniques for Measuring Bed Load," United States Geological Survey, Water Supply Paper 1748, 1964, 74 pages.

The need for accurate determination of the total sediment discharge of particles of bed-load size has prompted this investigation of available and possible measuring apparatus and proceedures.

742. Hudson, J.P., "Characteristics of the Trickle Irrigation System," Proceedings of the 15th International Horticultural Congress, 1962, No. 3, pp. 264-272.

743. Hudson, J.P., "Precision Irrigation in the Tropics," Spanish Shell Public Health and Agricultural News, London, England, 1964, Vol. 7, No. 2, pp. 83-85.

The main purpose of irrigation is to maintain the leaf water status at such a level that there is no need for stomata to close during day time. Better yields can be obtained with less water by relating irrigation to soil, plant and weather conditions.

744. Hudson, Sir W., "Irrigation in Australia," Engineer, London, June 26, 1964, Vol. 217, No. 5657, pp. 1114-1116.

Describes the development of irrigation in Australia up to 1961 and also the scope for its future development.

745. Hughes, W.F., "Some Considerations in the Evaluation of Irrigation Systems," Oklahoma Current Farm Economics, Stillwater, Oklahoma (USA), Sep. 1964, Vol. 37, No. 4, pp. 60-66.

746. Humpherys, A.S., "Automating Surface Irrigation," Agricultural Engineering, Vol. 48, No. 6, June 1967, pp. 338-340.

It is shown how automation of surface irrigation provides improved water use efficiency and labor reduction; various automatic structures are tested in recirculating flume and in experimental ditch.

747. Humpherys, A.S., and Lauritzen, C.W., "Shape Factors for Hydraulic Design of Lay-Flat Irrigation Tubing," Transactions of the American Society of Agricultural Engineers, Saint Joseph, Michigan, (USA), 1962, Vol. 4, No. 12.

748. Hurley, P.A., "Predicting Return Flows From Irrigation," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 94, No. IR1, Paper 5838, Mar. 1968, pp. 41.

749. Hussain, M., "Land and Water Management in West Pakistan," Proceedings of the West Pakistan Engineering Congress, Lahore, 1969, Vol. 51, Paper No. 394.

750. Hussain, M., "Scientific Land and Water Use for Increased Production in West Pakistan," Proceedings of West Pakistan Engineering Congress, Lahore, 1968, Vol. L, Paper No. 384.

751. Hussain, M., and Nur-Ud-Din, A., "Impact of Irrigation Research on the Developing Economy of West Pakistan, Symposium on Role of Engineering Research in Developing Economy of Pakistan, West Pakistan Engineering Congress, Lahore, Oct. 1966, Vol. 9, No. 82.

752. Hussaini, N.A.Z., "Problems for Dispersal of Surface Water and Depression of Groundwater in West Pakistan," Annual Convention of the Institution of Engineers (Pakistan), Technical Papers Vol. 13, Apr. 1963, pp. 7-17.

Problems of waterlogging and salinity are considered and appraisal of efficiency of familiar solutions such as lining of canals, tubewells and deep drainage system is made; study of replenishment zone and flood ways is presented; unconventional remedies are suggested involving conversion from perennial to nonperennial crops, change of crop pattern from high delta to low delta crops on nonperennial areas, and replacement and expansion of irrigation in new areas in desert.

753. Huston, W.E., and Crawford, P.A., "Measuring Water," Gainesville Agricultural College, Extension Bulletin 613, Sep. 1960, 12 pages.

754. Hutton, S.P., "The Prediction of Venturi Meter Coefficients and Their Variation with Roughness and Age," Proceedings of the Institution of Civil Engineers, Pt. 3, Vol. 3, No. 1, Apr. 1954, pp. 216-241.

755. Hutton, S.P., and Spencer, E.A., "Gauging Water Flow by the Salt-Dilution Method," Proceedings of the Institution of Civil Engineers, London, Mar. 1962, Vol. 21, pp. 667-677.

Conclude with discussion of their paper No. 6446 published in Aug. 1960 issue, Vol. 16, pp. 395-418.

756. Hydraulics Research Station, Wallingford, "Charts for the Hydraulic Design of Channels and Pipes," Hydraulics Research Paper, Hydraulics Research Station, Wallingford, 1958.

757. Ibad-Zabe, Y., and Kiyasbeili, T.N., "The Bed Form on Rectilinear and Curvilinear River and Big Channel Sections," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A43, Vol. 1, 1967, pp. 345.

To have the bed formed in desired shape and size it is necessary to know the laws of its shaping in order to correct the river flow activity by bed formation. The analytic research with application of classic methods in calculus of variations is carried out. The obtained results also give an opportunity to set forth the hydraulic flow elements and to calculate the discharge of the water passing over the bed of the given form. The comparison with natural data gives sufficient results.

758. Ibrahim, M., "Liquid Flow and Silt Transport," Proceedings of West Pakistan Engineering Congress, Lahore, 1951, Vol. 36, Paper No. 293.

759. Ibrahim, M., and Ahmed, M., "On Silting of Distributors and Factors Affecting Sediment Exclusion From Canals," Proceedings of the West Pakistan Engineering Congress, Vol. 38, Paper No. 301, 1954.

Means are sought to distribute the silt proportionally into the off-taking channels. Divide walls are used and criteria for such design are studied.

760. Ichikawa, M., "On the Debris Supply from Mountain Slopes," Proceedings of the International Geographical Union Regional Conference in Japan (Tokyo), 1957, 1959, pp. 137-144.

Six watersheds in Japan are analyzed with a view to: (1) determining the degree of control exercised by the types of rock on the size of debris and of weathered soil particles; (2) estimating the quantity of debris supplied by mountain slopes.

761. International Commission on Irrigation and Drainage, "Bibliography on Irrigation , Drainage, River Training and Flood Control," International Commission on Irrigation and Drainage, 1954, 58 pages.

Bibliography, partly annotated, on the broad field of irrigation, drainage, river training, and flood control. Volumes available so far: 1954-1956, and yearly from 1957 to 1964.

762. International Commission on Irrigation and Drainage, "Multilingual Technical Dictionary on Irrigation and Drainage," International Commission on Irrigation and Drainage, Chapter V: Design of Irrigation Channels, 1959, 31 pages.

763. India - Central Board of Irrigation and Power, "A Handbook of Irrigation and Power Data," New Delhi, Mar. 1962, 94 pages.

Reviews progress of water resources development in India since Independence (1947); collects statistical figures on irrigation and power; makes available statistical figures of area irrigated (latest); enumerates organizations dealing with engineering research, irrigation and power in India and abroad.

764. India - Central Board of Irrigation and Power, "Irrigation and Power Research in India," New Delhi, India, 1963, 47 pages.

This pamphlet briefly describes the work done at various research stations in India during 1962-1963.

765. India - Gujarat Government - Irrigation Department, "Irrigation Development in Gujarat," Irrigation and Power, Journal of the Central Board of Irrigation and Power, New Delhi, India, Apr. 1964, Vol. 21, No. 2, pp. 357-365.

Describes the physical features, soils, agriculture practices and development of irrigation in the state in the past and during the plan periods.

766. India - Maharashtra Government, Irrigation and Power Department, "Irrigation Development in Maharashtra," Irrigation and Power, Journal of the Central Board of Irrigation and Power, New Delhi, India, Jan. 1964, Vol. 21, pp. 125-135.

Describes the general and physical features, climate, irrigation planning, irrigation in the past and plan efforts and future planning in the state.

767. Inglis, C.C., "Historical Note on Empirical Equations Developed by Engineers in India for Flow of Water and Sand in Alluvial Channels," Proceedings of the 2nd General Meeting of the International Association for Hydraulic Research, Stockholm, 1948, pp. 93-106.

768. Inglis, C.C., "The Effect of Variations of Charge and Grade on the Slopes and Shapes of Channels." Proceedings of the 3rd General Meeting of the International Association for Hydraulic Research, Grenoble, Paper No. II-1, 1949, pp. 1-10.

769. Inoue, H., "Mean Drop Size and Maximum Drop Size of Sprays Emitted by Sprinklers," Transactions of the 5th Congress of the International Commission of Irrigation and Drainage, Vol. 4, 1963, pp. 16.99-16.114.

Theoretical and experimental studies were performed and equation derived for relationship of Weber and Reynolds Numbers, and dimensionless mean drop diameter; it was concluded that experimental data of jet of water proved that explanation of turbulence was possibly correct for flow rates used; relationship for maximum droplet diameter of droplets produced by sprinkler nozzle was obtained.

770. International Association of Hydraulic Research, "Hydraulic Research 1959," International Association of Hydraulic Research, Vol. 15, Oct. 1960, 418 pages.

Contains list of experimental studies being carried out in hydraulic research laboratories in different countries of the world. Yearly publication available till 1968.

771. International Commission on Irrigation and Drainage, "Development of Irrigation in the Madras State," International Commission on Irrigation and Drainage, Annual Bulletin, 1958, pp. 96-98.

772. International Commission on Irrigation and Drainage, "Multilingual Dictionary on Irrigation and Drainage - Draft Definition, Chapter VII, Headworks," New Delhi, India, 1962, 128 pages.

Draft Definitions, with illustrations where necessary, are classified under four sub-chapters - (1) Dams, Weirs and Barrages, (2) Surplussing Works, (3) Energy Dissipation Devices, (4) Gates on Valves.

773. International Commission on Irrigation and Drainage, "Proceedings of the Seminar on Irrigation and Drainage, Tokyo, 1963," New Delhi, India, 1963, 66 pages.

774. Ippen, A.T., and Drinker, P.A., "Boundary Shear Stresses in Curved Trapezoidal Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulic Division, 1962.

A laboratory investigation of distribution and magnitudes of boundary shear stresses in curved smooth trapezoidal channels under subcritical flow. Shear measurements made with Preston's Stagnation tube.

775. Irmay, S., "Accelerations and Mean Trajectories in Turbulent Channel Flow," Proceedings of the American Society of Mechanical Engineers, Paper No. 60 HYD3, 1960, pp. 1-8.

776. Irrigation and Power, "Sediment Problems in Irrigation and Drainage Channels," Irrigation and Power, Vol. 22, No. 2, 1965, pp. 142-148.

777. Irrigation Engineering and Maintenance, "How Good are Plastic Lining Materials," Irrigation Engineering and Maintenance, Feb. 1960, pp. 11.

It is reported that most plastic specimans buried by the United States Bureau of Reclamation researches for ten years were in excellent condition.

778. Irrigation Engineering and Maintenance, "Plastic Linings for Irrigation Ditches," Irrigation Engineering and Maintenance Oct. 1960, pp. 12.

Describes the use of plastic liner for reducing seepages from ditches in the San Joaquin Valley.

779. Irrigation Investigations at the Winchmore Irrigation Research Station, Ashburton, New Zealand, "Australian Irrigator - Pasture Improver, Sydney, Australia," Vol. 8, No. 1, Dec. 1962, pp. 19-22.

Describes investigations on advance and recession curves under various flow regime in border check system, infiltration characteristics, and other problems related to the optimum utilization of irrigation water.

780. Irrigation Research Institute, Lahore, "Forty Years of Research in the Irrigation Research Institute, Lahore," Irrigation Research Institute, West Pakistan Irrigation Department, Lahore, Vol. I,II, Parts A and B, 1969.

Contains synopsis of papers published by the personnel of the Institute since its establishment in 1924 to 1964. Work is separated into three divisions: (1) Hydraulics, (2) Engineering Physics, Hydrology and Ground Water, Soil Mechanics and Materials, and (3) Mathematics. Volume I Pertains to 1924-1964, and Volume II covers the post independence period. Part A of each volume lists the titles of authors, papers and sources, and Part B includes a synopsis of the papers discussed.

781. Irrigation Research Institute, "An Investigation of Crump's Adjustable Proportional Modules, for Coefficient of Discharge and Minimum Modular Head," Irrigation Research Institute, Lahore, Pakistan.

782. Irrigation Research Institute, Lahore, "Annual Report of the Irrigation Research Institute," Irrigation Research Institute, West Pakistan Irrigation Department, Lahore.

Annual publication, summarizes work done in the Institute. Published serially since 1935.

783. Irrigation Research Institute, Roorkee, "Basic Study on Canal Falls," Irrigation Research Institute, Roorkee, 1960, 22 pages.

784. Irrigation Research Institute, Roorkee, "Determination of Seepage Losses Upstream of Pathri Power House," Irrigation Research Institute, Roorkee, Mar. 1961, 6 pages.

785. Irrigation Research Station, Poondi, India, "Experiments on a Flumed Canal Drop," Irrigation Research Station, Poondi, Annual Report, 1954.

786. Ishar Das, "Design of Lined Channels," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research, 1951, pp. 41-79.

787. Isherwood, J.D., "Water-Table Recession in Tile-Drained Land," Journal of Geophysical Research, Vol. 64, No. 7, July 1959, pp. 795-804.

788. Israelsen, O.W., and Hansen, V.E., "Irrigation Principles and Practices," John Wiley and Sons, Inc., New York, 1964, 447 pages.

This book has been compiled with a view to be useful to the agronomy and and engineering students as well as to the nontechnical people in so far as it deals with aspects of irrigation engineering as applied in agriculture and general hydraulic engineering.

789. Iuditski, G.A., "Cavitational Erosion of Energy Dissipators of Spillway Dams, and Methods for its Prevention," International Association for Hydraulic Research, 11th Congress (Leningrad), 1965, Vol. 1, No. 118, pp. 1-13, French.

Results are presented of laboratory research on formation of vacuum (and ensuing cavitational erosion) in three types of energy dissipators: solid stilling wall, sectioned stilling wall, and trapezoidal energy dissipators located near the upturned bucket of the downstream damface.

790. Jackson, W.H., "Photoelectric Siltmeters," Dock and Harbour Authority, Vol. 42, No. 405, Jan. 1962, pp. 291-294.

Instrument which measures amount of light that penetrates sample was developed. A Microammeter is connected in series with photocell to read current flowing through it; electrical circuit is adjusted to give full scale deflection of microammeter when gap between bulb and photocell is filled with clear water; portable and continuous recording types are described.

791. Jacobson, P., "Remaking the Surface of the Earth to Fit Man's Needs," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 47, No. 8, Aug. 1966, pp. 428-429, 440.

There are many reasons for changing the earth's surface. In western irrigated areas the major reason is to permit uniform, efficient application of water. In semiarid areas the conservation of water is of prime importance. In humid areas where water is plentiful, erosion control, improved machine operation, and efficient removal of excess water are major factors leading farmers to develop systems of land grading and water control.

792. Jaeger, C., "Model Tests on Discharge Regulators for Irrigation Supply," International Commission on Irrigation and Drainage, Annual Bulletin, 1954.

Gives comments on several series of model tests to establish the probable depth of erosion by the dispersed jet.

793. Jain, B.K.S., "Sprinkler Irrigation in India," World Farming, Aug. 1962, Vol. 4, No. 8, pp. 20-21, 42.

794. Jain, B.K.S., "Sprinkler Irrigation Techniques," Publicity Department Voltas Ltd., 19 Graham Road, Bombay, July 1961, pp. 48.

795. Jain, J.K., "Minor Irrigation Systems by India, Part I," Proceedings Near East and South Asia Region, 5th Irrigation Practices Seminar, New Delhi, 1964, pp. 353-367.

Deals with classes of wells, water lifting devices, yield, performance and irrigation methods in irrigation by wells; brings out that economics of well irrigation is improved by boring and installation of electrical pumpsets; discusses advantageous role of wells.

796. Jain, J.P., "Sarda Sediment Ejector; Economic Aspects of Sediment Extraction Thereof," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, No. 3, pp. 20.309-20.324.

The paper discusses the results of model tests of a sediment ejector installed at the Sarda Power canal. Previously, the canal had to be closed during the monsoon season because of a large amount of debris and coarse-grained solid load entering the channel.

797. Jarocki, W., "The Relation Between the Quantity of the Suspended Load and the Bed-Load in Rivers," Proceedings of the 8th General Meeting of the International Association for Hydraulic Research, Seminar II, 1959, pp. 10-SII-1/2.

798. Jarocki, W., "Effects of Piers on Water Streams and Bed Form," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 4, pp. 1147-1152.

The paper describes the mechanics of water movement in bed in which the piers are placed. The paper shows also the configuration of bottom in axis of opening and near a pier after flow of water. The effect of streams on the bed upstream and downstream is described and the methods are shown for the computation of the erosion depth. This paper is based on the results of laboratory tests, river observation and analytical computation.

799. Jensen, M.C., and King, L.G., "Design Capacity for Irrigation Systems," Agricultural Engineering, Vol. 43, No. 9, Sep. 1962, pp. 522-525.

799. Continued

Procedure for computing design capacity, as applied to both individual farm systems and project-wide systems; computing maximum consumptive-use rates for different frequencies of occurrence is included; actual evaporation and theory of extreme values applied to evaporation data are used to compute comsumptive use; design capacity is computed by dividing maximum consumptive-use rate by efficiency of irrigation system.

800. Jensen, M.E., "Evaluating Irrigation Efficiency," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR1, Proc. Paper 5145, Mar. 1967, pp. 83-98.

Studies in water resources planning and utilization have emphasized the need to critically evaluate the efficiency of irrigation projects. Evaluation of irrigation efficiency requires the delineation of necessary and beneficial water uses, uniform evaluation procedures, and acceptable standards for comparative purposes. Necessary and beneficial uses of water for irrigation are defined, along with practical and economical methods for evaluating irrigation efficiency. Examples are presented to illustrate the probable accuracy of various measurements used to evaluate irrigation efficiency. Alternative methods for evaluating components affecting irrigation efficiency are presented.

801. Jensen, M.E., and Howe, O.W., "Operational Characteristics of Border Checks on a Sandy Soil," International Commission on Irrigation and Drainage, Annual Bulletin 1961, pp. 5-10.

Presents examples of water surface profiles, intake opportunity time, uniformity of application, and irrigation application efficiency using low gradient border checks.

802. Jenson, M.E., and Howe, O.W., "Performance and Design of Border Checks on Sandy Soil," Transactions of the American Society of Agricultural Engineers, Vol. 8, No. 1, 1965, pp. 141-145.

Field evaluation of performance and operating characteristics of border check irrigation indicated that water application efficiencies of 80 to 95% are easily attained; rate of water application for maximum efficiency and uniformity of irrigation should be from three to five times average intake rate; procedures for estimating total drop or slope for maximum efficiency and uniformity were developed; coefficients for water-balance equation to predict advance of water in low gradient border checks were derived from experimental data.

803. Jeppson, R.W., "Free-Surface Flow Through Heterogeneous Porous Media," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 95, No. HY1, Proc. Paper 6364, Jan. 1969, pp. 363-381.

Methods are developed for obtaining finite difference solutions to steady-state, free-surface saturated seepage flows through nonhomogeneous porous media. The formulation considers the total fluid head and the stream function as the independent variables and the coordinates x and y as the dependent variables. The methods are applied to obtain solutions to problems of seepage from canals through nonhomogeneous porous media to a drained layer at some specified depth. Several representative flownets from these solutions are presented.

804. Jeppson, R.W., "Seepage from Ditches - Solution by Finite Differences," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 94, No. HY1, Paper No. 5763, Jan. 1968, pp. 259.

805. Joglekar, D.V., "Theory of Flow in Alluvial Channels," Irrigation and Power (New Delhi), 1959, Vol. 16, No. 4, pp. 519-530.

The flow regimen in alluvial channels is discussed with reference to Lacey's formula. The significance of model experiments in ascertaining riverbed movements is explained and the mechanics of measuring is given in detail, using examples from Indian rivers.

806. Joglekar, D.V., "River Training for Protection of Bridges," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 16, No. 2, Apr. 1959, pp. 219-231.

807. Joglekar, D.V., "Control of Sand Entering Canals," Irrigation and Power (New Delhi), 1959, Vol. 16, No. 2, pp. 177-190.

Both preventive and corrective methods of sediment control at irrigation canal off-takes are discussed, and various types of structures and their operation are described. All methods discussed are confined to control of coarse particles.

808. Joglekar, D.V., Chotankar, S.T., and Kulkarni, P.K., "A Review of Some Aspects of the Design of Headworks to Exclude Coarse Bed Sand from Canals," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research, 1951, pp. 221-259.

This paper presents a review of some aspects of exclusion of coarse sand from canals. Part I deals with outlines on broad principles with the aid of specific cases of sand exclusion dealt with by the C.W.I.N.R. Station, Poona. Part II embodies various factors affecting the discussion on the control of sand into canals.

809. Joglekar, D.V., and Wadekar, G.T., "The Effect of Weirs and Dams on the Regime of Rivers," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research, 1951, pp. 349-363.

The note outlines the major changes in regime of rivers as a result of the phenomena of accretion upstream and retrogression downstream of dams and weirs and stresses the need for collecting and analysing the available data of retrogression observations. The general principles outlined are corroborated in light of the analysis of the extensive observations made at the Sukkur Barrage on the Indus and the Boulder Dam in U.S.A. A reference is also made to weirs in the Punjab where the most costly failure occurred due to retrogression.

810. Joglekar, D.V., Desai, S.C., and Wadekar, G.T., "Training of Rivers for Sand Control at Canal Headworks with the Aid of Hydraulic Models," International Commission on Irrigation and Drainage, Annual Bulletin, 1954.

Describes the principles and practices of training of rivers to create favourable curvature of flow for sand exclusion from irrigation canals at offtake.

811. Joglekar, D.V., and Gole, C.V., "Sand Control of Channels Taking off from Alluvial Rivers," Proceedings of the Regional Technical Conference on Water Resources Development in Asia and the Far East, Flood Control Series No. 9, 1956, pp. 314-318.

812. Joglekar, D.V., and Gole, C.V., "Small Irrigation Structures in India," Proceedings of the 9th General Meeting of the International Association for Hydraulic Research, Seminar A, No. 1, 1961, pp. 1313.

813. Joglekar, D.V., and Phansalkar, S.D., "Hydraulic Structures on Irrigation and Drainage Systems for Measurement of Water," 3rd Congress on Irrigation and Drainage, Report 19, Question 9.

Discuss important aspects of the design of standing wave flume and Gibb module, some of the structures commonly used in India for measuring flow of water in irrigation channels.

814. Johns, W.M., "Spray Irrigation in Tasmania," Tasmanian Journal of Agriculture, Hobart, Aug. 1964, Vol. 35, No. 3, pp. 207-219.

815. Johnson, B., "The Missouri River Development Program Irrigation and Power," International Seminar on Soil and Water Utilization Proceedings, 1964, pp. 234-236.

816. Johnson, E.G., "Soil-Cement for Channel Stabilization Evaluation of Compacted and Plastic Soil-Cement Linings," Agricultural Engineering, Saint Joseph, Michigan, Ames, Louisiana (USA), July 1962, Vol. 43, No. 7, pp. 402-404.

817. Johnson, T., "Precast Concrete Structures for an Irrigation District," Civil Engineering, Easton, Pennsylvania, July 1962, Vol. 32, No. 7, pp. 38-40.

Describes a ten-year replacement programme of the wooden irrigation control structures by precast concrete in Central Nebraska Public Power and Irrigation District.

818. Johnston, C.N., "Irrigation Sprinkler Characteristics," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 28, No. 4, Apr. 1947, pp. 160-164.

The motive power available as the result of reaction forces from water jets is used in operation of many revolving forms of sprinklers. Most sprinkler jets issue from nozzles, but orifice plates of the sharp-edge or square-edge type could be used. Some of the measurable variables are diameter, pressure or head, thrust, quantity and characteristic of the stream.

819. Johnston, W.R. et al., "Insecticides in Tile Drainage Effluent," Water Resources Research, Vol. 3, No. 2, Richmond, Virginia, 1967, pp. 525-537.

819. Continued

Only relatively small quantities of chlorinated hydrocarbon residues were found in tile drainage effluent, but higher concentrations were found in effluent from open drains where both surface and subsurface drainage waters were collected. Traces of residue were found in the irrigation water applied to tile drained farms.

820. Johnston, W.R., Letey, J., and Pillsbury, A.F., "Tile Drainage Performance Compared to Theoretical Predictions," Transactions of the American Society of Agricultural Engineers, Vol. 8, No. 4, 1965, pp. 548-549, 552.

821. Jones, B.A., "Effect of Crack Width at at Tile Joints on Soil Movement into Drain Tile Lines," Transactions of the American Society of Agricultural Engineers, Vol. 3, No. 1, 1960, pp. 33-35, 41, 54.

822. Jones, E.E., and Bailey, W.A., "Measuring Farmstead Water Use," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 46, No. 4, Apr. 1965, pp. 204-207.

The goal of this study is to provide answers: 1. How much water is used?, 2. Where is it used?, 3. When is it used?, 4. What is it used for?, 5. What is the rate of use?. It was decided to adopt an automatic measuring and recording system that could feed a computer directly.

823. Jones, L.D., "Border Layout for Pasture Irrigation," Aqua - Official Journal of the State Rivers and Water Supply Commission, Victoria, 100-110 Exhibition Street, Melbourne, C.I. (Australia), Apr. 1962.

824. Jones, L.E., and Tripathy, B.N., "Generalized Critical Slope for Trapezoidal Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulic Division, Vol. 91, No. HY1, Pt. 1, Paper 4202, Jan. 1965, pp. 85-91.

Critical slope relations for general trapezoidal channel are examined in detail on basis on Manning's equation and are presented in simple graphical form on dimensionless coordinates; it is shown that for trapezoidal channel, with given roughness coefficient and given bed width, there may be no, one, two, or three depth(s) corresponding to given critical slope, depending on inclination of sides of channel.

825. Jordan, P.R., "Fluvial Sediment of the Mississippi River at St. Louis, Missouri," United States Geological Survey, Water-Supply Paper 1802, 1965, 89 pages.

An investigation of the fluvial sediment of the Mississippi River at St. Louis, Missouri, was begun in 1948. Most data have been obtained to determine the daily suspended-sediment discharge and the particle-size distribution of suspended sediment and bed material, the flow resistance, the vertical distribution of sediment and velocity, and the bed-material discharge.

826. Joshi, N.S., "Design of Open Channels in Rocky Cuts: Values of Rugosity Coefficient n," Journal of the Institution of Engineers (India), Vol. 34, No. 4, June 1954.

827. Juusela, T., "Mole Drainage with Plastic Strip Lining," Transactions of the 4th Congress on Irrigation and Drainage, International Congress on Irrigation and Drainage, Vol. 6, 1960, pp. C.387-C.390.

828. Kachroo, P., "D.V.C. Canal Maintenance," Bhagirath, Vol. VII, No. 9, Mar. 1961, pp. 342-344.

Describes factors governing flow in channels and suggests checks for aquatic and weed growth.

829. Kalinske, A.A., "The Twin-Throat Venturi; A New Fluid-Flow Measuring Device," American Society of Mechanical Engineers, Paper No. 59-A-154, 1959, pp. 1-4.

830. Kally, E., "An Instrument for Free-Flow Computation in Canals and Pipes," International Commission on Irrigation and Drainage, 1960, pp. 118-121.

831. Kamal, A.A., "The Control and Distribution of Irrigation Water in the United Arab Republic," United Nations Conference on Applied Science And Technology, Geneva, Sep. 29, 1962, Vol. 3, No. 2, pp. 5.

832. Kansas Water Resources Board, Topeka, "Irrigation in Kansas," Kansas Water Resources Board, Sep. 1967, No. 16(e), 23 pages.

Data on irrigation in Kansas, including the amounts of surface water and groundwater used, well yields, water quality, saturated thickness of unconsolidated deposits, the amount of land suitable for irrigation.

833. Kantor, S., "Sprinkler Versus Surface Irrigation," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, 1960, pp. 12.481-12.493.

834. Kanwar, S., "Design of Channels," Transactions of the Second Congress on Irrigation and Drainage, C.7, 1954.

Gives diagrams for calculating the dimensions of bed width, depth, slope for a particular discharge and Lacey's silt factor.

835. Kanwar, S., "Saving Water in Storage Reservoirs and Irrigation Canals," Indian Construction News, Nov. 1957, pp. 8.

836. Karpov, A.V., "Indus Valley, West Pakistan's Lifeline," Journal of the Hydraulics Division, American Society of Civil Engineers, Jan. 1961, Vol. 90, No. HY1, Paper 3774, pp. 207-242.

837. Karpov, A.V., and Nebolsine, R., "West Pakistan and the Indus Valley," Indus, West Pakistan Water and Power Development Authority, Lahore, West Pakistan, Feb. 1964, Vol. 5, No. 1, pp. 5-32.

Indus Treaty and agreements, low agricultural productivity of the Indus valley, surface water, rainfall distribution, present pattern of discharge of main rivers, subsurface configurations, zones of restrained ground-water flow, salinity of ground water, sodium damage soils, economic use of water.

838. Kassiff, G., Etkin, A., and Zeitlen, J.G., "Failure Mechanism of Canal Lining in Expansive Clay," Proceedings of the American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, Vol. 93, No. SM1, Jan. 1967, pp. 95-118.

Results of study in wide field measurements of moisture, movement and swelling pressure variations underneath concrete canal lining in expansive clay are presented.

839. Kayashta, S.L., "Some Aspects of Soil Erosion and Conservation in India," National Geographical Journal of India, 1965, Vol. 11, No. 1, pp. 22-29.

Almost one quarter of the Indian soil is exposed to erosion. According to tentative data two-thirds of the arable land need special soil conservation, while about 40.5 million hectares are already strongly eroded.

840. Kazó, B., and Klimes-Szmik, A., "A Method of Artificial Sprinkling for the Investigation of the Processes of Erosion," Publication de l'Association Internationale d'Hydrologie Scientifique, No. 59, 1962, pp. 52-61.

A sprinkler has been designed, capable of covering an area with accurate regulation of the sprinkling intensity.

841. Kazushi, O., "Comparison Between Sprinkler Irrigation Method and Furrow Irrigation Method in Japan," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 20, 1960, pp. 12.369-12.377.

842. Keller, J., "Effect of Irrigation Method on Water Conservation," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 91, No. IR2, Paper 4364, June 1965, pp. 61-72.

Water use efficiency and economic factors for selection of irrigation methods for farm systems and projects are examined; review of comparative studies of water application and operational efficiencies is presented which indicates that farmers obtain approximately same application efficiency with sprinkler irrigation as do research workers.

843. Keller, J., "Less Soil Compaction with Low Application Rate Sprinkling," Sprinkler Irrigation Association, Santa Monica, California (USA), Open Technological Conference Proceedings, 1964, pp. 45-50.

844. Keller, J., "Selection of Economical Pipe Sizes for Sprinkler Irrigation Systems," Transactions of the American Society of Agricultural Engineers, Vol. 8, No. 2, 1965, pp. 186-190, 193.

New method was developed for arriving at direct economic solution for pipe size selection of simple mainlines which are not on steep downhill slopes or powered by variable-speed power units; discrete adjustments are discussed and sample problems given for sub and branch mainlines, steep downhill mainlines, of direct economic approach is demonstrated.

845. Keller, J., "Sprinkler Application Rates on Soil Structures," Irrigation Engineering and Maintenance, H.D. Peace Publications, 264 Gravier Street, New Orleans 12, Louisiana (USA), June-July 1964, Vol. 14, No. 6, pp. 16-17, 25.

Describes laboratory experiments which show a simple, direct relationship between percent saturation of soil and water application rates.

846. Kellerhals, R., "Stable Channels with Gravel-Paved Beds," Proceedings of the American Society of Civil Engineers, Journal of the Waterways and Harbors Division, Vol. 93, No. WW1, Paper 5091, Feb. 1967, pp. 63-84.

Hydraulics of naturally gravel-paved channels are examined on basis of field and laboratory data covering discharge range from 1 to 100,000 C.F.S. and bed-material-size range from 0.5 to 18 in.

847. Kelley, W.P., "Maintenance of Permanent Irrigation Agriculture," Soil Science The Williams and Wilkins Co., Mt. Royal and Guilford Avenue, Baltimore, (USA), Aug. 1964, Vol. 98, No. 2, pp. 113-117.

848. Kenedy, L.W., "Towards a More Efficient Sprinkler System," Irrigation Engineering and Maintenance (USA), Jan. 1961, pp. 10-11.

Describes how problems of water supply and disposal of overflow were solved to effect a truly efficient irrigation system.

849. Kennedy, J.F., "Mechanics of Dunes and Antidunes in Erodible-Bed Channels," Journal of Fluid Mechanics, Vol. 16, Pt. 4, Aug. 1963, pp. 521-544.

Investigation of stability of fluid-bed interface and characteristics of bed features; model is based on potential flow over 2-dimensional, moving, wavy bed with sinusoidal profile of varying amplitude, and sediment transport relation in which transport rate is proportional to power of fluid velocity at level of bed; dunes, flat bed, and antidunes, are found from model; factors involved in determining maximum heights of bed features and surface waves.

850. Kennedy, J.F., and Brooks, N.H., "Laboratory Study of an Alluvial Stream at Constant Discharge," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 37, pp. 320-330.

A laboratory study in a 60-foot flume was made to determine the hydraulic and sediment transport characters of an alluvial stream when the discharge is constant and the depth varies. These experiments supplement those of Vanoni and Brooks in which the discharge was varied with the depth constant.

851. Kennedy, J.F., and Koh, R.C.Y., "Relation Between Frequency Distributions of Sieve Diameters and Fall Velocities of Sediment Particles," Journal of Geophysical Research, Vol. 66, No. 12, Dec. 1961, pp. 4233-4246.

If sieve diameters of sediment are lognormally distributed, fall velocities will also have distribution, but with different standard deviation which can be calculated; from measurements of fall velocities of 2 different natural sands, distributions of fall velocities are found to be in good agreement with predicted distributions.

852. Kennedy, R.J., and Fulton, J.F., "The Effect of Secondary Currents Upon the Capacity of a Straight Open Channel," American Society of Mechanical Engineers, E.I.C., Hydraulics Conference, Montreal, Paper No. 61-EIC-1, 1961, pp. 1-7.

853. Kent, D.H., "Pressure-Difference Flow-Meter Head Losses," Instrument Engineer, Vol. 8, No. 2, Oct. 1960, pp. 43-47.

854. Keulegan, G.H., "Energy Dissipation in Standing Waves in Rectangular Basins," Journal of Fluid Mechanics, London, Vol. 6, Pt. 1, July 1959, pp. 35-50.

855. Khachatrian, A.G., "Carrying Power of a Flow and the Dynamics of Silt Sedimentation in a Settling Basin," 3rd Congress on Irrigation and Drainage, Report 28, Question 9.

856. Khan, A., "Mianwali Lift Irrigation Scheme," Engineering News, West Pakistan Engineering Congress, Lahore, West Pakistan, Dec. 1964, Vol. 9, No. 4, pp. 6-11.

Gives a brief history of the conditions prevailing in Mianwali district prior to introduction of the Thal canal projects.

857. Khan, K.A., "Irrigation Between the Indus and the Jhelum," Indus, West Pakistan Water and Power Development Authority, Lahore, West Pakistan, Mar. 1964, Vol. 5, No. 2, pp. 29-32.

Describes the various types of land area in this region and the measures that have been adopted for the regular supply of irrigation water by building dams, such as the Khanpur dam, Misriot dam, Chablat Kas and some others in the investigation stages.

858. Khan, S.J., "Pumping Installation for the Warsak Lift Irrigation Scheme," Proceedings of West Pakistan Engineering Congress, Lahore, 1966, Vol. XLIX, Paper No. 374.

859. Khan, M., "Some Recent Trends in Barrage Design on Alluvial Rivers in Pakistan," Proceedings of West Pakistan Engineering Congress, Lahore, 1963, Vol. XLVII, Paper No. 355.

860. Khan, M., "The Present and Future of Silt Excluding Devices," Symposium on Sedimentation Problems as a Result of Indus Basin Works, West Pakistan Engineering Congress, Lahore, Apr. 1962, Vol. VI, No. 46.

861. Khan, M., Malik, S.K., and Mazhar Ali, "Barrage Design," Golden Jubilee Publication, West Pakistan Engineering Congress, Oct. 1963, Part II, pp. 219-272.

Outlines the development of design practices relating to barrages on alluvial rivers in West Pakistan.

862. Khan, S.A.B., "Training of River Loops and Currents on Head Works," Proceedings of West Pakistan Engineering Congress, Lahore, 1958, Vol. XLII, Paper No. 334.

863. Khushalani, K.B., "Irrigation (Practice and Design)," Allies Book-Stall, Poona (India), 1958, 385 pages.

864. Khushalani, K.B., "Possibilities of Sprinkler Irrigation in India," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 15, 1960, pp. 12.231-12.255.

865. Kikkawa, H., Hiroyoshi, S., and Shoji, F., "On the Effects of Suspended Sediments to the Bed Roughness," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A7, Vol. 1, 1967, pp. 49.

To express the roughness of the flow precisely and systematically for the various bed configurations in open channels with movable bed if the logarithmic velocity formula is used for mean velocity and if the effect on roughness affected by suspended sediment concentration is removed by means of Karman's constant variation, the relative (equivalent) roughness is able to be expressed definitely by the hydraulic characteristics, and that this relation may be applicable for very fine sand also.

866. Kilpatrick, F.A., "Flow Measurement by Dye-Dilution Measurement," Civil Engineering, American Society of Civil Engineers, Vol. 38, No. 2, Feb. 1968, pp. 74-76.

867. Kincaid, D.C., Heermann, D.F., and Kruse, E.G., "Application Rates and Runoff in Center Pivot Sprinkler Irrigation," Scientific Series Paper No. 1395, Colorado State University Experiment Station, Department of Agricultural Engineering, Colorado State University, 1968, Paper No. 1395.

868. King, N.J., "An Example of Channel Aggradation Induced by Flood Control," United States Geological Survey, Professional Paper 424-B, No. 15, 1961, pp. 29-32.

Cessation of flow in an ephemeral stream in south-east Wyoming followed the building of a dam and allowed the observation of changes where an ephemeral tributary joins its empty bed. As forecast by Schumum and Hadley, aggradation occurred as the tributary spread over the wider bed.

869. Kingbury, A.E., "Maintenance of Small Earthen Channels; Use of the Buck-Hoe," International Commission on Irrigation and Drainage, Annual Bulletin, 1955.

870. Kinori, B.Z., "Investigation Methods for Subsoil Drainage - Experience with Four Characteristic Sites," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 3, 1960, pp. 11.807-11.825.

871. Kira, H., "Studies on Sediments in Irrigation Channels," 6th Congress of the International Commission on Irrigation and Drainage, No. 3, 1966, pp. 20.435-20.447.

Sediments in irrigation channels cause many troubles. In order to study the effective method of scouring it is a prerequisite to understand the process of sedimentation. Having previously developed the studies on sediment problems, the author conducted experiments on the mechanism of sedimentation due to tractive force.

872. Kirkham, D.,"Steady-State Theories for Drainage," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 92, No. IR1, Proc. Paper 4707, Mar. 1966, pp. 19-39.

872. Continued

Steady-state drainage theories since about 1955 are reviewed for ponded, artesian, and steady rain (or equivalent excess irrigation) water, when the water seeps into drain tiles, ditches, or wells; or through dams. Reviews of work before 1955 are cited. The paper is primarily concerned with the presentation and examination of nine recently developed approximate theories for the seepage of steady rainfall into drain tile or ditches when the soil to be drained is underlain by a barrier at finite depth; in the last third of the paper an exact theory for this problem is presented.

873. Kirmani, S.S., "Design of Silt-Stable Canals," Proceedings of West Pakistan Engineering Congress, Lahore, 1963, Vol. XLVII, Paper No. 355.

874. Kirmani, S.S., "Problems on the Indus Basin Project," Engineering News, West Pakistan Engineering Congress, Lahore, West Pakistan, June 1964, Vol. 9, No. 2, pp. 51-54.

Reviews the progress made and the problems encountered on the Indus Basin Project.

875. Kirmani, S.S., "Sediment Problems in the Indus Basin," Proceedings of West Pakistan Engineering Congress, 1959, Vol. XLIII, Paper No. 336.

876. Kirmani, S.S., "The Design and Construction of Irrigation Structure - Some Important Factors," Proceedings of West Pakistan Engineering Congress, Lahore, 1954, Vol. XXXVIII, Paper No. 304.

877. Kirmani, S.S., "The Phenomena of Losses and Gains in the Indus River System," Proceedings of West Pakistan Engineering Congress, Lahore, 1958, Vol. XLII, Paper No. 329.

878. Kisner, B.T., "Popularity Grows on Texas Plains: Sprinkler Irrigation," Cotton Gin and Oil Mill Press, Dallas, Texas (USA), Sep. 1, 1962, Vol. 63, No. 18, pp. 12.

879. Klawitter, R.A., and Young, C.E., "Forest Drainage Research in the Coastal Plain," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 91, No. IR3, Proc. Paper 4456, Sep. 1965, pp. 1-7.

Tree measurements and soil evaluations indicate that drainage is responsible for nearly doubling the productivity of pine pulpwood in some forest wetlands in the coastal plain. Results from a drainage study on wet, sandy soils on the Apalachicola National Forest in northwest Florida demonstrated that the vigor of 20-yr. old slash pine trees could be improved considerably in only 3 years.

880. Knue, J.E., "Hydraulic Design of Unlined Canals with Particular Reference to Trimmu Sidhnai Link," Engineering News, Lahore, West Pakistan,Vol. 6, No. 2, June 1961, pp. 29-38.

881. Koelzer, V.A., and Bitoun, M., "A Review of Sediment Problems and Possible Solutions," Symposium on Sedimentation Problems as a Result of Indus Basin Works, West Pakistan Engineering Congress, Lahore, Apr. 1962, Vol. VI, No. 45.

882. Koonsman, G.L., and Albertson, M.L., "Design Characteristics of the Vortex Tube Sand Trap," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research, 1951, pp. 317-323.

883. Korchokha, M., "Investigations of Pattern Distribution of Velocities of Flow and of Deformations of Channel at Bend of Polomet River," American Geophysical Union, Soviet Hydrology, Selected Papers No. 4, 1965, pp. 348-369.

On basis of analysis of experimental data on velocity pattern of flow and variation of depths of Polomet River, mechanism of cross circulation is examined; estimate of channel deformation is made, and conclusion is reached that, at bend of Polomet River, stable circulation is absent.

884. Korven, H.C., "Border Ditch and Border Dike Irrigation," Transactions of the American Society of Agricultural Engineers, Vol. 5, No. 2, 1962, pp. 192-196.

"Topographic method" used to study uniformity of water application considers variability across and along strip; results of statistical analysis of relationships in irrigation efficiency; effect of soil moisture before irrigation and head on uniformity of water application efficiency and net depth of water applied for border-ditch and border-dike methods of irrigation.

885. Korven, H.C. and Wilcox, J.C., "Evaluation of Flow and Pressure Regulators for Sprinkling Irrigation," Transactions of the American Society of Agricultural Engineers, Vol. 9, No. 4, 1966, pp. 516-519.

885. Continued

Results of study of four types of individual sprinkler pressure regulators; two flow-control valves and two pressure regulators were evaluated as to their performance in regulating sprinkler pressure in both laboratory and field studies.

886. Kriel, J.P., "Multiple Orifice Canal Offtakes Used on an Irrigation Scheme in South Africa," Proceedings of the 9th General Meeting of the International Association for Hydraulics Research, Seminar A, No. 7, 1961, pp. 1313.

887. Krishnappa, G., and Seetharamiah, K., "Best Angle of Off-Take of Branch Channel," Civil Engineering and Public Works Review," Vol. 59, No. 695, June 1964, pp. 715, 717, 719, and 721.

Investigation is based on concept of constant specific energy along inlet to branch channel and theoretical approach to determine efficient angle of off-take when flow is subcritical in main and supercritical in branch is suggested; it is found that efficient angle of off-take is function of F_1, L/B and μ, where F_1 is Froude number of main channel flow at upstream end of branch, L is inlet width to branch, B is bed width of main channel and μ is experimental coefficient; theoretical approach has given good agreement with experimental results.

888. Krochin, S., "Soil-Cement for Canal Linings," International Commission on Irrigation and Power, Annual Bulletin, 1960, pp. 101-108.

889. Kruse, E.G., "Hydraulics of Small, Rough Irrigation Channels," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 4, 1963, pp. 16.161-16.176.

Resistance to flow in small soil channels, similar to irrigation furrows and borders, was studied in laboratory; each channel was formed with different roughness, and was stabilized with chemical spray to prevent erosion by flow during series of experimental runs; Reynolds numbers were compared with classical relations for laminar and turbulent flow; dye streams injected into flow were observed; experimental data for turbulent flows were analyzed in terms of logarithmic-type resistance equation.

890. Kruse, E.G., "Hydraulics of Subcritical Flow in Small, Rough Channels," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 87-89.

891. Kruse, E.G., "Trapezoidal Flumes for Measuring Discharges in Irrigation Channels," Colorado State University, CER64EGK14, Apr. 1964, 13 pages.

892. Kruse, E.G., "The Constant-Head-Orifice Farm Turnout," Agricultural Research Service, Report No. 41-93.

893. Kruse, E.G., "Weirs for Combination Water Control and Measurement," Colorado State University, CER65-EGK25, May 1965, 16 pages.

894. Kruse, E.G., Huntley, C.W., and Robinson, A.R., "Flow Resistance in Simulated Irrigation Borders and Furrows," United States Department of Agriculture, Soil and Water Research Division, Conservation Research Report No. 3, Nov. 1965, 56 pages.

895. Kruse, E.G., et al., "Sprinkler and Furrow Irrigation Efficiencies," Agricultural Engineering, Vol. 43, No. 11, Nov. 1962, pp. 636-639, 647.

Three-year study of 2 methods, conducted on replicated research plots at University of Nebraska North Platte Experiment Station; comparisons between irrigation methods were made by simultaneously irrigating paired plots by sprinkler and furrow method; all plots were planted to grain sorghum drilled in 24 in. rows; differences in yield of grain sorghum between sprinkler and furrow-irrigated plots were not significantly different at 5% level of probability.

896. Kulkarni, B.M., and Narain, S.N., "Bentonite Lining for Reducing Seepage Losses in Irrigation Canals," Civil Engineering and Public Works Review, Vol. 60, No. 704, Mar. 1965, pp. 337, 339, 341.

Tests using bentonite as sandwich layer in permeable sand irrigation ditches are described; application of bentonite at rate of 1 to 2 psf suitably protected against scour is shown to be effective and inexpensive method of reducing seepage to acceptable values.

897. Kumar, A., "Resistances of Transporting Sand Bed," Proceedings of the Institution of Civil Engineers, Vol. 17, Paper 6445, Dec. 1960, pp. 455-458.

Various functions of bed shear have been used in formulating expressions for bed-load movement; formula for energy gradient of moving water; "tractive" fraction of energy is considered to be difference between total energy and that expended in overcoming resistance of ripple surface; introduction of term of "total roughness" considered as function of grain roughness + ripple roughness + transport roughness.

898. Kumin, D.I., "Effect of Large-Scale Turbulent Mixing on Bed-Load Discharge," Proceedings of the 8th General Meeting of the International Association for Hydraulic Research, Seminar II, 1959, pp. 13-SII-1/3.

899. Lacey, G., "The Problem of Free-Board in Irrigation and Drainage Channels," Transactions of the 2nd Congress on Irrigation and Drainage, Report 1, Question 3, 1954.

Set forth basic principles underlying the provision of free-board on irrigation channels, drainage canals, embankments, etc. Reviews current practices in USA, Pakistan and India. Stresses that the engineer has to use judgement based on available data.

900. Lacey, G., "Flow in Alluvial Channels with Sandy Mobil Beds," The Institution of Civil Engineers, Vol. 9, Paper 6274, Feb. 1958, pp. 145-163.

Description of early development of empirical regime equation derived from canal systems in India; correlations of mean velocity with depth and relations involving width; use of wetted perimeter and hydraulic mean depth as alternative parameters to width and mean depth.

901. Lacey, G., "The Regime Concept and the River Nile," Proceedings of West Pakistan Engineering Congress, Lahore, 1963, Vol. XLVII, Paper No. 357.

902. Lacey, G., "Sediment as a Factor in the Design of Unlined Irrigation Canals," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, No. 3, 1966, pp. 20.1-20.20.

The paper stresses the complexity of the problems to be solved in the design of irrigation canals in alluvial soil. The role of earth banks in restricting the canal width and preventing formation of natural sedimentation embankments is stressed. A primary requirement in canal design is therefore seen to be the selection of a suitable canal width.

903. Lamont, P.A., "A Review of Pipe-Friction Data and Formulae, With a Proposed Set of Exponential Formulae Based on the Theory of Roughness," Proceedings of the Institution of Civil Engineers, Vol. 3, Part III, No. 1, Apr. 1954.

904. Landgren, N.E., and Andersen, J.C., "A Method for Evaluating Erosion Control in Farm Planning," Agricultural Economics Research, Washington, D.C. (USA), Apr. 1962, Vol. 14, No. 2, pp. 57-65.

905. Landgren, N.E., and Putman, J.W., "Water Supplies, Irrigable Soils and Trends in Irrigation Development," Department of Agriculture, Economic Research Service, Great Plains Agricultural Council, Publication No. 3, Nov. 1967, No. 30, pp. 7-19.

Examines the trends in irrigation. Even though there has been rapid expansion of irrigation, physical potentials for further development exist.

906. Lane, E.W., and Carlson, E.J., "Some Factors Affecting the Stability of Canals Constructed in Coarse Granular Materials," Proceedings of the Minnesota International Hydraulics Convention, 1953.

907. Lane, E.W., "Design of Stable Channels in Erodible Material," Indian Journal of Engineering and Technology, Vol. 7, No. 2, Feb. 1954, pp. 30-38.

The purpose of this study is to present some concepts of design which it is hoped will add to an understanding of the phases involved in the hydraulic design of canals.

908. Lane, E.W., and Carlson, E.J., "Some Observations on the Effects of Particle Shape on the Movement of Coarse Sediments," Transactions of the American Geophysical Union, Vol. 35, No. 3, 1954.

909. Lane, E.W., "The Importance of Fluvial Morphology in Hydraulic Engineering," Proceedings of the American Society of Civil Engineers, Separate 745, 1955.

910. Lane, E.W., "Sediment Load Change as a Factor in Stable Irrigation Canals," Journal of the Central Board of Irrigation and Power (India), Vol. 12, No. 2, Apr. 1955, pp. 1-8.

Examples of changes in the silt charge and consequent flow conditions are discussed. Need for more research is stressed.

911. Langa, J.M., and Davis, J.R., "Spray Characteristics of Covering Sprinkler Nozzels," Agricultural Engineering, American Society of Agricultural Engineers, Vol. 40, No. 8, Aug. 1959, pp. 447-449.

912. Langa, J.M., "Land Forming and Level Ditch in Relation to Surface Irrigation at H.C. and S. Co., Hwaoo," Hawaii Sugar Technology Report, No. 19, 1961, pp. 50-53.

913. Langbein, W.B., "Geometry of River Channels," Proceedings of American Society of Civil Engineers, Journal of Hydraulic Division, Vol. 90, No. HY2, Mar. 1964, Paper No. 3846, pp. 301-12.

914. Langbein, W.B., and Leopold, L.B., "Quasi-Equilibrium States in Channel Morphology," American Journal of Science, Vol. 262, No. 6, 1964, pp. 782-794.

The longitudinal river profile, the downstream changes in river channel and tidal estuary geometry and the "at-a-station" channel geometry adjustments are discussed in terms of the most probable distribution of energy. This most probable condition is deduced, by analogy.

915. Langsen. W.B., and Schumm, S.C., "Yield of Sediment in Relation to Mean Annual Precipitation," Transactions of the American Geophysical Union, Vol. 39, No. 5, Dec. 1958, pp. 1076-1084.

916. Larsen, D.C., "How to Irrigate More Efficiently," Transactions of Idaho State Horticulture Society, No. 67, 1961, pp. 37-39.

917. Laurent, J., "Mechanism of the Formation of Sand Bars," Proceedings of the 2nd General Meeting of the International Association for Hydraulic Research, Stockholm, 1948, pp. 477-490.

918. Lauritzen, C.W., "Ways to Control Losses from Seepage," Water, The Yearbook of Agriculture, 1955, pp. 311-320.

919. Lauritzen, C.W., "Soil Stabilizers for Seepage Control in Irrigation Canals and Reservoirs," Industrial and Engineering Chemistry, Vol. 47, Nov. 1955.

920. Lauritzen, C.W., Haws, F.W., and Humphrerys, A.S., "Conveyance Loss and Canal Lining Investigation," Report of the A.R.S. and the Utah State Agriculture College, 1956.

921. Lauritzen, C.W., and Haws, F.W., "Asphalt-Burlap Linings for Canals and Reservoirs," Agricultural Engineering, Vol. 40, No. 6, June 1959, pp. 340-342, 344.

Results from test installations of built-up asphalt burlap laminate structure, during 1955-1957 in Utah and Wyoming to learn influence of weather; 50-60 penetration catalytically blown asphalt with softening point of 190°F. was used; all test lining are in good condition and appear to be controlling seepage satisfactorily.

922. Lauritzen, C.W., "Linings for Irrigation Canals," Irrigation Engineering and Maintenance, Vol. 9, No. 13, Dec. 1959, pp. 10-11.

923. Lauritzen, C.W., "Asphalt-Coated Jute Liner Developed for Canals and Reservoirs," Farm and Home Science, Agricultural Experiment Station, Utah State University, Vol. 21, No. 1, Mar. 1960, pp. 12-13, 28-29.

924. Lauritzen, C.W., "Collapsible Tubing for Head Gate Metering and Turnout Structures," Agricultural Engineering, Vol. 46, No. 9, Sep. 1965, pp. 506-507.

Use of collapsible tubing device, "L-metergate" in canal and ditch turnout applications is illustrated; "L-metergate" consists of length of lay-flat, or semirigid, tubing similar to radiator hose connected to pipe through canal bank; discharge end is raised to close gate and lowered to open it; with semirigid tube, discharge is greater for head differential and measurement is improved; in canal application device can measure as well as regulate.

925. Lauritzen, C.W., "Canal and Reservoir Lining Materials," 3rd Congress on Irrigation and Drainage, Report 16, Question 7.

926. Laursen, E.M., "Total Sediment Load of Streams," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 84, No. HY1, Paper No. 1530, Feb. 1958, pp. 36.

Relationships proposed give both quantity and quality of total, suspended and bed loads as functions of stream and sediment characteristics; in process of empirically defining relationships, encouraging correlation of laboratory and field data was obtained.

927. Laursen, E.M., "Some Aspects of the Problem of Scour at Bridge Crossings," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 34, pp. 304-309.

928. Laverton, S., "Irrigation - Its Profitable Use for Agricultural and Horticultural Crops," Oxford, 1964, pp. 116.

Deals with Irrigation in Great Britain.

929. Law, S.W., and Reynolds, A.J., "Dividing Flow in Open Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY2, Paper 4730, Mar. 1966, pp. 207-231.

Performance of one dividing channel is studied in detail; hydraulic jumps and recirculation regions near junction are described and correlated with overall performance; theoretical models predicting essential features are developed; concentration coefficient characterizing separated flow in branch must be determined experimentally.

930. Lawhon, L.F., "Attempts at Improvement of Design Procedures for Border Irrigation," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 7-10.

931. Lawson, J.D., "Sediment Transport in Alluvial Channels," Proceedings of the Institute of the Australian Conference on Hydraulics and Fluid Mechanics, Pergamon Press, New York, 1964, pp. 453-471.

Presents some of the basic concepts involved in a rational appraoch to flow in alluvial channels.

932. Lean, G.H., and Crickmore, M.J., "Methods for Measuring Sand Transport Using Radioactive Tracers," International Atomic Energy Agency, Radioisotopes in Hydrology, 1963, pp. 111-131.

Experiments were performed in flume with rippled sand bed to compare rate of movement of sand and glass particles of same size and density; two methods of measuring sand transport in flume using radioactive tracers were investigated; first involves measurement of spatial distribution of particles from strip of bed after various times; second requires measurement of passage of tracer in time at station downstream; methods were used to measure velocity of several size fractions in sand mixture.

933. Lee, F.S.V., "Critical Flow in Terms of Hydraulic Equivalents," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 88, No. IR2, Pt. 1, Paper 3155, June 1962, pp. 1-19.

Principle of hydraulic equivalent is presented for study of critical flow in open channels; based on modification of equation of specific energy and introduction of equivalent coefficients, graphs were prepared which, developed originally in metric system and used for many years, will help in analysis of open channels; proposed graphical application is believed to be preferable to usual laborious calculations, particularly when large number of channel solutions are required.

934. Lee, J.K., and Langley, M.N., "Irrigation Pays on Canadian Prairies," Reclamation Era, Washington (USA), Feb. 1963, Vol. 49, No. 1, pp. 23-25.

935. Leffingwell, R.J., "Hawaiian Research on Irrigation," Sugar y Azucar, New York 36, New York (USA), Nov. 1963, Vol. 58, No. 11, pp. 78-80.

936. Leliavsky, S., "Sloping-Sill Sand Screens Exclude Silt from Egyptian Irrigation Canals," Civil Engineering, Vol. 24, No. 3, Mar. 1954, pp. 70-72.

937. Leliavsky, S., "Irrigation and Hydraulic Design,Vols. I, II, and III," Chapman and Hall, Ltd., London, 1955.

Presents fundamentals of design work and deals particularly with percolation in the granular foundation beneath hydraulic structures and in earthen banks. Volume II and III deal with design and operation of irrigation structures and systems.

938. Leliavsky, S., "Concept of Irrigation Diversion Head Works," Engineer (London), Vol. 201, No. 5237, June 8, 1956, pp. 626-629.

The basic object of a diversion work is to raise the water surface in the river to the level required to commend the main diversion canal. Examines the different ways to do this.

939. Leliavsky, S., "Modern Dewatering Methods in Irrigation Problems," Engineer, Vol. 202, No. 5244, July 27, 1956, pp. 114-116, and No. 5245, Aug. 1956, pp. 148-151.

940. Leliavsky, S., "An Introduction to Fluvial Hydraulics," Constable and Co. Ltd, London, 1961, 257 pages.

941. Lembke, W.D., "Hydraulics of Pipe Outlets for Tile Drains," Agricultural Engineering, Vol. 41, No. 6, June 1960, pp. 375-377.

Varied flow equation can be used to compute size of corrugated-metal outlet pipes for gravity flow from tile drainage system; limiting lengths of pipe carrying maximum gravity flow without restriction given in tabular form for 0.1 an 0.2% slope of tile main.

942. Leopold, L.B., and Miller, J.P., "Ephemeral Streams - Hydraulic Factors and Their Relation to the Drainage Net," United States Geological Survey Professional Paper 282-A, 1956, No. 282-A, 36 pages

The hydraulic factors of width, depth, velocity, and suspended-sediment load of ephemeral streams near Santa Fe, New Mexico, were measured during flood flow; later channel slope was measured.

943. Leopold, L.B., and Wolman, M.G., "River Channel Patterns: Braided, Meandering, and Straight," United States Geological Survey Professional Paper 282-B, 1957, No. 282-B, 35 pages .

Channel pattern is used to describe the plan view of a reach of river as seen from an airplane, and includes meandering, braiding, or relatively straight channels.

944. Leopold, L.B., "Flow Resistance in Sinuous or Irregular Channels," United States Geological Survey, Water Supply Paper, No. 282-D, 1960, pp. 111-134.

945. Leopold, L.B., "The Challenge of Water Management (Part B)," United States Geological Survey Circular 414, 1960, No. 414-B, 13 pages .

Water problems do not arise until competition develops. As long as the supply is adequate, problems are minimal.

946. Leopold, L.B., and Langbein, W.B., "A Primer on Water," United States Geological Survey, United States Government Printing Office, 1960, 50 pages.

947. Leopold, L.B., "Rivers," American Scientist, Vol. 50, No. 4, 1962, pp. 511-537.

A general account of recent work on topics such as channel slope, transport of sediment, the relative importance of floods of varying frequency, the slope of meanders, character of drainage nets, and the application of the statistical concept of eutrophy.

948. Leopold, L.B., Wolman, M.G., and Miller, J.P., "Fluvial Processes in Geomorphology," W.H. Freeman and Co., 1964, 522 pages.

The central half of this text book is concerned with an extended discussion on river behavior; partly from a theoretical, but principally from an empirical point of view. In particular, data from observations in the United States is used to establish the mathematical relationships involved in river dynamics.

949. Levine, G., "What is Irrigation Efficiency?," Farm Research, Vol. 26, No. 4, Dec. 1960, pp. 6.

950. Levin, L., "Considerations on the Similitude of Flow in Models with Movable Bed," Proceedings of the 4th General Meeting of the International Association for Hydraulic Research, 1951, pp. 605-615, French.

951. Lewis, J., "Water Conservation on the Farm," Western Australia Department of Agriculture Journal, Vol. 2, No. 1, Jan. 1961, pp. 7-10, 13-17.

952. Lewis, M.R., "Sprinkler or Other Methods of Irrigation," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 30, No. 2, Feb. 1949, pp. 86-87.

The subject implies comparison of the advantages and disadvantages of the use of sprinklers as compared with those of other, that is surface, methods of irrigation. It is important on all areas where conditions will permit surface irrigation with some but not too great difficulty.

953. Lin, K.M., and Priest, M.S., "The Hydraulic Jump Over a Plane Inclined Bottom," Alabama Polythenic Institute Bulletin, No. 30, Apr. 1958, pp. 1-20.

954. Link, A.G., "Textural Classification of Sediments," Sedimentology (Amsterdam), 1966, Vol. 7, No. 3, pp. 249-254.

In the light of present-day requirements and the author's personal experience, the existing systems of nomenclature and classification of sediments on a textural basis need revision. A system is proposed that is based on a three end-member relationship involving sand, silt, and clay-size particles.

955. Linsley, R.K., and Franzini, J.B., "Water Resources Engineering," McGraw-Hill, 1964, 654 pages.

956. Little, W.C., "The Design of Furrow Irrigation Systems," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 103-110.

957. Liu, H.K., "A Note on the Differential Equation of Steady, Gradually Non-uniform Flow in Open Channels," Transactions of the American Geophysical Union, Vol. 39, No. 5, Oct. 1958, pp. 939-940.

958. Liu, H.K., and Hwang, S.Y., "Discharge Formula for Straight Alluvial Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 85, No. HY11, Nov. 1959, pp. 65-97.

959. Liu, H.K., Chang, F.M., and Skinner, M.M., "Effect of Bridge Construction on Scour and Backwater," Civil Engineering Section, Colorado State University, Feb. 1961, 118 pages.

960. Livesley, M.C., "Field Drainage," E. & F.N. Spon Ltd., London, 1960.

961. Livingston, A.C., "Control Gates for Irrigation and Drainage Projects," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 6, 1960, pp. C-33-C-67.

962. Lobb, W.R., and Hall, A.D., "Automatic Irrigation," New Zealand Journal of Agriculture, Wellington, New Zealand, Apr. 15, 1963, Vol. 106, No. 4, pp. 318-319, 321, 323, 325, 327.

963. Loehnberg, A., "Water Supply and Drainage in Semi-Arid Countries," Transactions of the American Geophysical Union, Vol. 38, No. 4, Aug. 1957, pp. 501-510.

964. Long, A.A., and Webster, A., "Surface and Subsurface Drainage Investigations in the Central Gippsland Irrigation District," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 2, Report 7, 1960, pp. 11.97-11.114.

965. Lozano, F.G., "Influence of the Design of a Sprinkler Irrigation Installation on its Efficiency and the Cost of Handling," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 17, 1960, pp. 12.289-12.336.

Describes experiments carried out for the purpose of knowing the influence of the installation design and the shape of the plot on the cost of handling the system, the uniformity of distribution and the efficiency of cultivation.

966. Lutfi, D., "Development of Small Irrigation Projects in Turkey - Hacilar Project," Proceedings Near East and South Asia Region, 5th Irrigation Practices Seminar, New Delhi, Mar. 2-14, 1964, United States Agency for International Development Mission to India (USAID), New Delhi, 1964, pp. 389-397.

Describes general procedure adopted in the development of irrigation projects in Turkey; furnished detail of Hacilar project in terms of technical data and economic analysis.

967. Luthin, J.N.,(Editor), "Drainage of Agricultural Lands," American Society of Agronomy, 1957, 620 pages.

968. Luthin, J.N., "Falling Water Table in Tile Drainage," Transactions of the American Society of Agricultural Engineers, Vol. 2, No. 1, 1959, pp. 44-47, 51.

Development of spacing equation to consider effect of soil-moisture tension on amount of water drained from soil; rate of flow into tile line is function of water table height midpoint between drains; flow into drains is independent of drain spacing for ponded water case; falling water table, essentially flat between drains, extends farther from drain for low hydraulic conductivity soils.

969. Luthin, J.N., and Guitjens, J.C., "Transient Solution for Drainage of Sloping Land," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR2, Proc Paper 5465, Sep. 1967, pp. 43-51.

A Hele-Shaw viscous flow model was used to obtain transient solutions for drainage of sloping land. The laws of similitude between the model and the prototype are shown to hold for the transient case as well as the steady state case. A series of solution are presented for the configuration of the water table for lands with slope varying from 0 to 70%. Capillary flow in the region above the water table is ignored and it is assumed that the drainage ditches penetrate to an impermeable layer.

970. Luthra, S.D.L., Damle, P.M., and Joglekar, D.V., "Remodelling of Canal Head Regulators," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 14, No. 1, Jan. 1957, pp. 53-65.

971. Luthra, S.D.L., and Joglekar, D.V., "Uplift Pressure Below Hydraulic Structures on Stratified, Permeable Foundation," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 2, pp. 279-286.

The paper deals with a detailed study of the distribution of uplift pressures below hydraulic structures, e.g., weirs, barrages, dams and cross drainage works for the conditions when the sub-soil though permeable, is in stratified layers.

972. Lyles, L., Thomas, J.R., and Heilman, M.D., "Land Leveling," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 48, No. 3, Mar. 1967, pp. 146-147.

When land is leveled for irrigation, for drainage, or for water conservation, crops often suffer because of the topsoil removed. In the conventional method of land leveling the design depth of surface soil is merely moved from the cut to the fill area. Most remedial measures are applied only after soil depletion has occurred. To measure the efficacy of these techniques, an experiment was statistically designed as a split-plot randomized block with four replications.

973. Lyle, W.M., and Smerdon, E.T., "Relation of Compaction and Other Soil Properties to the Erosion Resistance of Soils," Transactions of the American Society of Agricultural Engineers, 1965.

Flume data were obtained for critical tractive values from a series of tests where the void ratio of the soil was a controlled variable. Other soil properties considered were plasticity index, percent clay, vane shear strength, dispersion ratio, exchangeable cations associated with the clay and percent organic matter. The best correlation resulted when the critical tractive force values were related to both the plasticity index and the void ratio. A series of empirical equations are presented relating critical tractive force to various soil properties with void ratio as a parameter.

974. Lyon, T., Werenfels, L., and Houston, C., "Filter Envelopes Aid Tile Drainage in Sacremento - San Joaquin Delta Tests," California Agriculture, University of California, Division of Agricultural Science, Berkeley 4, California (USA), Mar. 1964, Vol. 18, No. 3, pp. 14-16.

State that drain failure in the Delta resulted from sealing by much soil, which reduced water movement into the tile.

975. Lytle, W.F., and Wimberly, J.E., "Head Loss in Irrigation Pipe Couplers," Louisiana Agricultural Experiment Station Bulletin, Baton Rouge, (USA), June 1962, Bulletin 553,15 pages.

976. Maasland, D.E.L., and Shery, R.A., "Falling Water Table Between Tile Drains," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR2, Proc. Paper 5258, June 1967, pp. 9-19.

The rate of fall of a water table between drains is determined in a Hele-Shaw model, and the results are compared with those obtained by use of the Glover equation. Considerable differences are found between the two methods. When the ratio between the drain spacing and the depth of the aquifer is decreased, the difference between the model results and the results obtained from the theory is increased.

977. Machmeier, R.E., and Allred, E.R., "Water Distribution with Boom Sprinklers," Irrigation Engineering and Maintenance (USA), June-July 1962, Vol. 7, pp. 13, 16-17, 11-14.

978. Machmeier, R.E., and Allred, E.R., "Operating Performance of Boom Sprinkler - Field Study," Transactions of the American Society of Agricultural Engineers, Vol. 5, No. 2, 1962, pp. 220-225.

Model tests of 200 ft. diam. boom sprinkler using same nozzle arrangement and varying nozzle angle of elevation and nozzle pressure; determination of boom speed throughout one revolution and for each octant of revolution; effect of boom speed and wind speed on variation in speed of rotation; effect of angle of elevation and pressure at various wind speeds; effect of boom speed on wetted diameter; overlap studies.

979. Maddock, T., "The Behavior of Straight Alluvial Channels," Symposium on Hydrology and Water-Resources Development, No. 7-12, Feb. 1966, pp. 243-268.

Streamflow in alluvial channels is characterized by greater solid-lash transport as compared with flow in cohesive soil. Test results show the basic characteristic of alluvial channels; their ability to adjust their width, depth, streamflow velocity and channel depth in a natural interdependence.

980. Maddock, T., "Variation of the Hydrualic Roughness of Alluvial Channels," Symposium on River Morohology, Bern, Publications of the Association Internationale d'Hydrologie Scientifique, No. 75, 1967, pp. 187-200.

The roughness of alluvial channels is controlled by the deformed bed and the hydraulic variables are mutually determined. These variables are width, depth, velocity, slope, and sediment load.

981. Madison, J.H., "Irrigation-Systems and Procedures," California Turfgrass Cult. Jan. 1964, Vol. 14, No. 1, pp. 1-5.

982. Mahajan, I.K., and Handa, C.L., "Control and Distribution of Water in an Irrigation System with Special Reference to the Punjab," 3rd Congress on Irrigation and Drainage, Report 25, Question 9.

983. Mahavir, P., "Beginning of Sprinkler Irrigation in India," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 27, 1960, pp. 12.473-12.479.

Discusses irrigation needs and methods of irrigation practised in India; gives a summary of the observations made and experience gained on sprinkler irrigation on four farms in India.

984. Mahmood, K., and Akhtar, A.B., "Artificial Cut-Off at Islam Headworks," Proceedings, West Pakistan Engineering Congress, Lahore, 1962, Vol. XLVI, Paper No. 352.

Describes the design, operation and consequence of an artificial cut-off used in River Sutlej upstream of Islam Headworks, Compares the rate of development with the cut-offs on the Mississippi River. Also describes the resource cut-offs experienced in the vicinity and the variation of tortuosity with time in alluvial rivers.

985. Mahmood, K., "Design of Channels in Alluvial Soils," Golden Jubilee Publication, West Pakistan Engineering Congress, Oct. 1963, Part II, pp. 3-48.

A historical review of the evolution of stable alluvial channel design, in West Pakistan. Discusses the Regime theory as developed by Kennedy, Lindslev, Lacey and Irrigation Research Institute. Suggests that a synthesis of Regime type equilibrium with tractive force theory and "analytical" methods may contain the solution for problem not covered by conventional Regime theory.

986. Mahmood, K., "Effect of Apron Slope on Hydraulic Jump Performance," M.S. Thesis, University of Washington, Seatle, June 1964.

Studies effect of apron slope on hydraulic jump forming on the apron in Stilling basins typically used in barrages in West Pakistan. The function of the jump is defined as to complete the transformation from supercritical to the downstream subcritical flow and this transition is defined as complete when the bed shear is reduced to that prevailing in the subcritical flow. Experimental data are presented to show that the dimensionless length of channel L/d_2, required to do this, is independent of slope. However, Froude No. limits for various jump classifications seem to depend on apron slope.

987. Mahmood, K., "Hydraulic Research in West Pakistan," Symposium on Role of Engineering Research in Developing Economy of Pakistan, West Pakistan Engineering Congress, Lahore, Oct. 1966, Vol. IX, No. 78.

Summarizes the evolution of hydraulic research in West Pakistan and its importance in the irrigation-agriculture of the province. Discusses some problems facing the growth of research organizations and suggests reorganization measures orientated towards enhancing the role of research in West Pakistan.

988. Mahmood, K., "Adaptation of Equiangular Spiral as an Open Channel Curve," Proceedings of West Pakistan Engineering Congress, Lahore, 1968, Vol. L, Paper No. 389.

Justifies use of logarithmic spiral in open channel bends, when transitions of expansion and bends are to be combined for various reasons. Describes the design of the spiral curve for LCC complex structure, the design of model used in testing and comparision of model-prototype data.

989. Maierhofer, C.R., "Drainage in Relation to Permanent Irrigation Agriculture," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 84, No. IR1, Paper No. 1506, Jan. 1958, pp. 8.

Application of drainage and irrigation technology to arid land discussed; it is concluded that these techniques will largely solve human existence problems.

990. Malaika, J., "Irrigation Conditions and Problems in Iraq," Proceedings Near East and South Asia Region, 5th Irrigation Practices Seminar New Delhi, Mar. 2-14, 1964, pp. 119-125.

991. Malik, B.A., "Tarbela Dam Project," Engineering News, West Pakistan Engineering Congress, Lahore, West Pakistan, June 1963, Vol. 8, No. 2, pp. 5-8.

A multipurpose project comprising a dam 400 feet high and storage capacity 84 million acre-foot, power capacity of 1500 mw.

992. Malik, R.A., "Slurry Trench Method of Cut-Off," Proceedings of West Pakistan Engineering Congress, Lahore, 1965, Vol. XLVIII, Paper No. 363.

993. Malik, S.K., "Design, Construction and Calibration of the Meter Flume at R.D. 1500 Gugera Branch (Pakistan)," Engineering News (Pakistan), Vol. 6, No. 2, June 1961, pp. 43-47.

994. Malik, S.K., "Water Potential of Pakistan - Its Development," Engineering News, West Pakistan Engineering Congress, Lahore, West Pakistan, Mar. 1963, Vol. 8, No. 1, pp. 24-27.

995. Malik, S.K., "Planning the Development of Pakistan's Water Resources," Symposium on Water Resources Development, West Pakistan Engineering Congress, Lahore, 1969, Vol. XI, pp. 1-12.

996. Mandry, J.E., "Design of Pipe Distribution Systems for Sprinkler Projects," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR3, Proc. Paper 5454, Sep. 1967, pp. 243-257.

A project type sprinkler system comprises a central pressure-producing device and high pressure mains radiating to farm delivery locations. The minimum cost distribution system will deliver just enough water to meet peak demands with sprinklers operating almost continuously. An equation is developed to determine cost differential between this minimum capacity system and one using large pipe to allow part-time sprinkling. A method for economic sizing of pipe in a gravity system is developed and its use illustrated.

997. Manson, P.W., "Research has Improved Draintile," Minnessota Farm and Home Science, Vol. 18, No. 1, Fall 1960, pp. 7, 15.

998. Manson, P.W., and Blaisdell, F.W., "Computing Energy Losses at Drain Tile Junctions," Transactions of the American Society of Civil Engineers, Vol. 9, No. 3, 1966, pp. 445-448.

Computations necessary to determine energy losses are dealt with; example shows practical application of equations and curves to design of agricultural drainage systems; theoretical function energy loss is used for computation, for agricultural drainage, where velocities are low, examples indicate that 90-degree function design is as satisfactory as 45 degrees.

999. Mantsur, S., "The Marginal Area in Sprinkler Irrigation," Ministry of Agriculture, Extension Authority, Irrigation Field Service, Jan. 1963, 41 pages.

Deals with the following aspects: Distance of the sprinkler from the border of the field definition of water losses in the marginal area; discusses soil moisture in the marginal area and the reaction of the plant to it.

1000. Mao, S.W., and Rice, L., "Sediment-Transport Capability in Erodible Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY4, Pt. 1, Paper 3569, July 1963, pp. 69-95.

Einstein bed-load function is used as basis for developing procedure for evaluating capacity of erodible channel to transport material originating from sources outside bed and having size distribution different from that of bed-material load; elements of method are described; application of procedure to Upper Chenab Canal in West Pakistan illustrates method of computation and use of procedure to evaluate need for sediment control in design of large alluvial channels.

1001. Marchi, E., "Resistance to Flow in Fixed Bed Channels with the Influence of Cross Sectional Shape and Free Surface," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A-5, Vol. 1, 1967, pp. 32.

1001. Continued

The analytical transfer of the velocity and resistance laws from circular pipes to closed-conduits of general cross-sectional configuration and to open channels, meets the known difficulties which are due to the non-uniform distribution of the wall shear stress and, in the latter case, due also to the free surface influence.

In this paper the study is approached by introducing a new expression of the velocity distribution along normals to the wall. From it, following a classic pattern, the resistance laws are deduced. There is shown the possibility of interpreting the effect of section shape, and also the free surface influence in open channels, with the introduction of only one shape coefficient, which appears as a multiplier of the hydraulic radius.

1002. Markland, E., "Calculation of Flow at Free Overfall by Relaxation Method," Institution of Civil Engineers Proceedings, Vol. 31, May 1965, pp. 71-78.

Details of flow were computed in vicinity of free overfall with Froude number in approach channel equal to 1, 2, 4, and 8 in turn; computations were made by relaxation method in complex-potential plane, using digital computer; possibility of extending technique to other hydraulic problems with free-streamline boundaries is shown.

1003. Marris, A.W., "Radial Distributions of Temporal-Mean Peripheral Velocity and Pressure for Fully Developed Turbulent Flow in Curved Channels," American Society of Mechanical Engineers, Paper No. 59-A-51, 1959, pp. 1-9.

1004. Martin, H.M., and Carlson, E.J., "Model Studies of Sediment Control Structures on Diversion Dams," Proceedings of the 5th General Meeting of the International Association for Hydraulic Research, 1953, pp. 109-122.

1005. Martin, H.M., and Wagner, W.E., "Experience in Turbulence in Hydraulic Structures," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1, pp. 153-172.

This paper identifies the types of turbulent flow experienced in high-head hydraulic structures and appurtenances. Turbulent flow in a complex outlet works structure creating severe vibration was studied in the laboratory.

Also illustrates the importance of obtaining data in study of turbulence and demonstrates limitation of pressure and vibration measurement.

1006. Martinec, J., "The Effect of Sand Ripples on the Increase of River Bed Roughness," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A21, Vol. 1, 1967, pp. 172.

As a contribution to the problem of sand ripples and their effect on the resistance to flow in alluvial channels, experimental data are presented which were obtained by repeated comparative neasurements in a representative river reach. A velocity formula containing the factor of relative roughness was used. The height of ripples increased with the growing discharge and caused a gradual increase of flow resistance expressed as the effective height of roughness. The measured variation of the Manning n from 0.0165 to 0.034 indicates the importance of this problem.

1007. Marzolo, "Hydraulic Structures for Irrigation and Drainage Networks," Transactions of the 3rd Congress on Irrigation and Drainage, Vol. 4, Report 30, 1957, pp. 9.483-9.494.

1008. Masch, F.D., Espey, W.H., and Moore, W.L., "Measurement of the Shear Resistance of Cohesive Sediments," Proceedings of the Federal Inter-Agency Sedimentation Conference, 1963, Agricultural Research Service, Miscellaneous Publication No. 970, Washington, D.C., 1965, pp. 151-155.

A rotating cylinder test apparatus designed to measure low shear stress is described. This apparatus gives a value of the shear stress on a sediment sample which is essentially independent of such uncertainties as roughness changes and boundary layer growth. The apparatus is analyzed in view of the work on rotating cylinders by Taylor and others. A standard test procedure is outlined and results of tests on several boundary samples are presented.

1009. Masch, F.D., and Denny, K.J., "Grain Size Distribution and Its Effect on the Permeability of Unconsolidated Sands," Water Resources Research, 1966, Vol. 2, No. 4, pp. 665-677.

Experimental studies to investigate these relationships consisted of systematic variation of the values of the statistical parameters and evaluation of the corresponding permeabilities of the samples. The parameters investigated included measures of the average size, dispersion, skewness, peakedness, and modality of the sample distributions. Several graphs were developed that related permeability to the various statistical parameters.

1010. Mashkovich, L.A., "Regulation of Transformation Processes of Energy and Forms of Flow by Dissipators of Energy at Zone Where Upper and Down Water Conjugate," International Commission on Irrigation and Drainage, Annual Bulletin 1958, pp. 78-83.

1011. Massey, B.S., "Hydraulic Jump in Trapezoidal Channels," Water Power, Vol. 13, No. 6, June 1961, pp. 232-233.

Presents an improved method of the Diskin's method which is simpler and exact.

1012. Mathur, B.S., and Manohar, S., "Design of a Silt Ejector for the Sanda Canal," Indian Concrete Journal, Vol. 35, No. 1, Jan. 1961, pp. 11-15.

Describes hydraulic features and design of an improved type of ejector built at Sanda Canal after model experiments.

1013. Maxwell, D.C., "Methods of Saving Water," National Reclamation Association Proceedings, Vol. 30, 1961, pp. 92-95.

1014. McAllister, J.S.V., "Irrigation," Agriculture in Northern Ireland, Belfast, Apr. 1962, Vol. 36, No. 12, pp. 358-360.

1015. McBirney, W.B., "Some Experiments with Emergency Siphon Spillways," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 84, No. HY5, Pt.1, Paper 1807, Oct. 1958, pp. 24.

Test of new model design of siphon spillway for use as emergency structure for protection of canals; principal advantage of proposed design is significant reduction in time to prime, and priming can be achieved at lower discharge.

1016. McCavitt, J., "A Comparison of Sprinkler Size and Spacing on the Uniformity of Water Distribution," Golden Anniversary Meeting of the American Society of Agricultural Engineers, Paper No. 57-94, June 1957.

1017. McCulloch, A.W., "The Economics of Sprinkler Irrigation Systems," Irrigation Engineering and Maintenance, Vol. 7, No. 8, Aug. 1957, pp. 18-19, 34-36.

1018. McCutchan, A.J., "The Development of Water Resources for Irrigation," Water Resources, Use and Management, 1964, pp. 359-382.

1019. McDowell, G.E., and Slayter, R.O., "Irrigation and Water Use Under Tropical Condition with Special Reference to Irrigation in Tropical Queensland," United Nations Conference on Applied Science and Technology, Geneva, Oct. 26, 1962, Vol. 18, No. 389, pp. 10.

1020. McLaughlin, R.T., "The Settling Properties of Suspensions," Proceedings of the American Society of Civil Engineers, Hydraulics Division, Vol. 85, Dec. 1959, pp. 9-41.

1021. McQueen, I.S., "Some Factors Influencing Streambank Erodibility," Geological Survey Research, 1961, pp. B-28-B-29.

Prepared sediment samples, in which the moisture content and packing were controlled, were tested in an erosion device. Data obtained indicated that erodibility of a given soil is extremely variable and is influenced by packing and antecedent moisture content.

1022. Meacham, I., "Measuring Irrigation Deliveries, the Dethridge Meter," Aqua, Vol. 12, No. 8, Apr. 1961, pp. 184-189.

Describes the Dethridge meter, a device used to measure discharge in open channels.

1023. Mech, S.J., "Effect of Slope and Length of Run on Erosion Under Irrigation," Agricultural Engineering, Vol. 30, No. 8, Aug. 1949, pp. 379-383, 389.

Three steps were followed in the study of erosion under irrigation: (1) the determination of the amount of silt a number of different rates of flow will pick up and carry under different crop and furrow conditions, (2) the determination of the magnitude of flow rates occurring under the different crop and furrow conditions, (3) the combining of the first two steps. This gives definite erosion values for the entire length of the furrows. Some definite conclusions are indicated. It is possible to have serious erosion on the upper end of irrigated fields even when neither soil nor water are wasted at the tail end. This is because the upper end of irrigating furrows carries a greater amount of water. Increasing the infiltration decreases the percentage of runoff but increases the potential erosion hazard along the furrow.

1024. Mech, S.J., "Influence of Soil Management and Water Intake on Erosion Under Furrow Irrigation," Washington Agricultural Experiment Station, Scientific Paper No. 1715, 1958.

Erosion from furrow irrigation differs from that under rainfall. Practices that increase intake without producing compensating decrease in erodibility, increase the erosion hazard because of the needed increase in furrow flow. The intake of Sagemoor fine loamy sand varied from one-eighth to seven-eighth inch per hour depending on the crop, furrow grade, soil moisture, and stream size. Reditching and furrow distrubance was found to increase erosion. Most erosion was found to occur during the first four hours of flow over the furrow increment.

1025. Mercer, A.G., "Study of Seepage From Earth Canals by Hydraulic and Electric Analog," M.S. Thesis, University of Minnesota, Oct. 1957.

An experimental study of two-dimensional flow of water from a canal section having different depth-width ratios and different side slopes using a Hele-Shaw analog apparatus and a electric field analog apparatus. Results are presented for different water table levels.

1026. Mercer, A.G., "Characteristics of Sand Ripples in Low Froude Number Flow," Ph.D. Thesis, University of Minnesota, June 1964.

An analytical study of the mechanics of sediment movement in association with sand bed ripples emphasizing the three basic relationships, that is the ripple shape and flow pattern relationship, the flow pattern and sediment movement relationship, and the sediment movement and ripple shape relationship.

1027. Mercer, A.G., "Graphical Solution of Problems in Open-Channel Flow," Civil Engineering, American Society of Civil Engineers, Aug. 1966, pp. 75-76.

Many problems in open-channel flow can be solved graphically by using the chart, which contains dimensionless plots of specific energy and specific force.

$$\frac{E}{y_c} = \frac{y}{y_c} + \frac{1}{2}\left(\frac{y_c}{y}\right)^2$$

$$\frac{F}{y_c^2} = \frac{y_c}{y} + \frac{1}{2}\left(\frac{y}{y_c}\right)^2$$

1028. Merriman, J., and Enger, P.F., "Progress Report No. 2 of Canal Erosion and Tractive Force Study: Lower Cost Canal Lining Program," United States Department of the Interior, Bureau of Reclamation, Hydraulic Branch, Report No. HYD-443 (Gen-22), Denver, Colorado, Feb. 1958.

Field and laboratory studies of erosion and tractive force were conducted on 46 test reaches and on soil samples selected from the reaches. Operating discharges in the reaches studied varied from 2 to 3,000 cfs. Channels which were stable, scouring, and where deposition was occurring were studied. Two field trips were made to each site for data collection. One trip was made while the channel was in a dry condition, and the other trip was made when the channel was flowing near maximum discharge. A tractive force apparatus was developed to test earth samples obtained from the channels. Analysis of data representing mostly lean clays is presented in the report.

1029. Meyer, J.L., "Tractor-Tow Sprinkler System for Grapes," Irrigation Engineering and Maintenance, 264 Gravier St., New Orleans 12, Louisiana (USA) June-July 1963, pp. 17-18.

Reviews costs for this type of irrigation of a California vineyard and finds it a profitable practice.

1030. Meyer-Peter, E., and Muller, R., "Formulas for Bed Load Transport," Proceedings of the 2nd General Meeting of the International Association for Hydraulic Research, Stockholm, 1948, pp. 39-64.

1031. Michigan, Water Resources Commission, Hydrology Division, "Water Use for Irrigation; A Survey of Water Use in Agricultural and Municipal Irrigation, Lansing," Michigan, Water Resources Commission, Hydrology Division, 1959, 15 pages.

1032. Mickelson, R.H., "Storing and Utilizing Excess Runoff by Spreading Over Levelled Fields in Dryland Areas," Colorado Agricultural Experiment Station, Progress Report, Fort Collins, Colorado (USA), Aug. 1962, No. 35, pp. 1.

1033. Middleton, J.E., "Irrigation Scheduling," Northwest Science, Vol. 34, No. 3, Aug. 1960, pp. 99-105.

1034. Mikhailov, V.N., "Hydrology and Formation of River Mouth Bars," Scientific Problems of the Humid Tropical Zone Deltas and Their Implications, UNESCO (Paris), 1966, pp. 59-64.

As a result of analysis and extrapolation of field observations and specially planned laboratory experiments one may reach the conclusion that the formation of bars and river-mouth islands is characteristics of the majority of river mouths, located in various physiographic environments.

1035. Miller, C.R., and Borland, W.M., "Stabilization of Fivemile and Muddy Creeks," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 89, No. HY1, Proc. Paper 3392, Jan. 1961, pp. 67-98.

Steady waste flows from the Riverton Projects in central Wyoming increased the annual discharge of two ephemeral streams. Accelerated erosion resulted with Fivemile Creek losing its natural meander pattern, becoming wide and braided. Muddy Creek still retained its meander pattern because it has only recently carried waste water. As a result of investigations, comprehensive plans were made for control of both creeks. Both creeks were stabilized with jacks, groins, and jetties. Willow and Russian olive seedlings were planted behind the control works. Both channels are now essentially stabilized.

1036. Miller, C.R., "Recent Developments in Sedimentation Research and Installations," United States Pacific Southwest Interagency Committee, Minutes of the Meeting, San Francisco, California (USA), 1962, pp. 28-37.

1037. Miller, R.L., and Byrne, R.J., "The Angle of Repose for a Single Grain on a Fixed Rough Bed," Sedimentology, Vol. 6, No. 4, 1966, pp. 303-314.

The angle of repose under water is experimentally determined for a single particle on a fixed rough bed. The effect of grain shape, size and sorting of the bed and ratio of particle diameter to average bed grain diameter are taken into account.

1038. Miloslav, P., "Some Water Management Problems in Projecting Spray Irrigation," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 23, 1960, pp. 12.423-12.436.

1039. Mirajgaoker, A.G., "Economic Utilization of Irrigation Water," Indian Journal of Power and River Valley Development, Vol. 9, No. 12, Dec. 1959, pp. 21-23.

1040. Mirajgaoker, A.G., "Drag on Cubical Roughness in Open Channel Flow," Irrigation and Power, Vol. 19, No. 6, June 1962, pp. 399-408.

Factors affecting drag on large geometrical roughness object in open channel flow have been determined by dimensional analysis; for cube roughness relations in Froude number, Reynold's number, relative submergence and drag coefficient have been studied; concept of modified Froude number combining Froude number and relative submergence gives good correlation in drag coefficient, modified Froude number and Reynold's number for cubical roughness in open channel flow.

1041. Mirajgaoker, A.G., and Charlu, K.L.N., "Natural Roughness Effects in Rigid Open Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY5, Pt. 1, Paper 3630, Sep. 1963, pp. 29-44.

Effect of large natural roughness elements in open channels on Chezy's resistance function is studied in 3 ft. wide rigid bed flume; natural stones in size range of 2 1/2 in. and 3 in. were used in flume bed in 6 different placement patterns; it was observed that resistance function and roughness are related by certain logarithmic formula, and that general resistance diagram, relating resistance function and Reynolds number, is also applicable for large natural roughness.

1042. Mirajgaoker, A.G., and Gupta, R.S., "Effect of Angle on Sediment Distribution in Canal Off-Takes," Irrigation and Power (India), Vol. 20, No. 4, Oct. 1963, pp. 507-519.

Experimental studies on effect of angle of off-take sediment distribution in channels; main channel flume was 3 ft. wide and 20 ft. long and off-take channel was 15 in. wide; 5 different off-take angles were studied with fixed quantity of sediment fed at head of parent channel for 3 channel discharges.

1043. Mirajgaokar, A.G., "Drag on Hemispherical Element in Open Channel Flow," Institution of Engineers (India), Vol. 43, No. 5, Pt. CI3, Jan. 1963, pp. 177-186.

1043. Continued

In open channel flow, drag on large elemental roughness is function of Froude number, Reynold's number, and relative submergence of object; discussion of relationship of these variables for hemispherical roughness element, fixed to channel bed of laboratory flume; statistical formula relating drag coefficient and Reynold's number is presented.

1044. Miranda, C.X.C.F., "Nomograms for Design of Trapezoidal Canal Section," Institution of Engineers (India), Vol. 45, No. 3, Pt. CI2, Nov. 1964, pp. 275-288.

Construction of nomograms to handle various types of design situations is based on Manning's formula, using fps system of units; nomogram spreads over four quadrants, but there are no negative quantities involved; side slope of 2 to 1 and coefficient of roughness 0.0225 were used; examples of nomogram use are shown.

1045. Mirchandani, T.J., "Design and Layout of Farm Irrigation Systems," 2nd Regional Irrigation Practices Leadership Seminar, Teheran, 1959, pp. 120-146.

1046. Mirchandani, T.J., "Promoting Better Farm Irrigation Practices in India," 2nd Regional Irrigation Practices Leadership Seminar, Teheran, 1959, pp. 137-150.

1047. Mirtskhulava, T.E., "Erosional Stability of Cohesive Soils," Journal of Hydraulics Research, International Association for Hydraulic Research, Vol. 4, No. 1, 1966, pp. 37-50.

Evaluation of resistance of cohesive soils to erosion and deterioration of non-eroding velocities as effected by mechanical composition, density and kind of soil has been carried out.

1048. Mirtskhulava, T.E., Dolidze, I.V., and Magomedova, A.V., "Mechanism and Computation of Local and General Scour in Noncohesive and Cohesive Soils and Rock Beds," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Vol. 3, No. C20, 1967, pp. 160-176.

The existing methods for predicting scour depth, often yield results considerably departing from data of actual observation, because of the failure of such methods to take into account the flow distribution in the scour hole and the soil resistance to erosion.

1049. Mirza, A.L., "Lessons from the Failure of Tando Masti Khan Fall," Proceedings of West Pakistan Engineering Congress, Lahore, 1958, Vol. XLII, Paper No. 331.

1050. Mitchell, P.K., "Irrigation in Sierra Leona; Possibilities and Prospects," United Nations Conference on Applied Science and Technology, Geneva, Sep. 21, 1962, Vol. 1, No. 6, pp. 6.

1051. Moccool, D.K., Beasley, R.P., and Berry, I.L., "Terrace Channel Design Using Spatially Varied Flow and Tractive Force Theories," Transactions of the American Society of Agricultural Engineers, 1962, Vol. 5, No. 2, pp. 190-196.

1052. Modgal, S.C., "Sprinkler is Sparing with Irrigation Water," Indian Farming, Delhi, India, Dec. 1963, Vol. 13, No. 9, pp. 20-32.

1053. Modi, P.N., and Seth, S.M., "Design of Most Economical Trapezoidal Section of Open Channels," Irrigation and Power, Journal of the Central Board of Irrigation and Power, July 1968, Vol. 25, No. 3, pp. 271-280.

1054. Mohanrao, B., "Review of Flow in Pipes," Journal of the Institution of Engineers (India), May 1962, Vol. 42, No. 5, Pt. CI5, pp. 389-420.

Describes the analytical investigations of Prandtl and Karman and the experimental work of Nikuradse which have led to the universal laws or resistance for turbulent flow in smooth and rough pipes.

1055. Mohi-Ud-Din-Khan, "Design Office Practice," West Pakistan Engineering Congress Symposium, 1961, pp. 11-16.

1056. Molenaar, A., "Irrigation by Sprinkling," Food and Agriculture Organization of the United Nations FAO, Agricultural Development Paper No. 65, 1960, pp. 93.

1057. Montagu, A.M.R., "Irrigation Projects for Arid Areas," Proceedings of the Institution of Civil Engineers, Vol. 19, Aug. 1961, pp. 433-448.

Describes planning of irrigation projects. Volume of water needed in relation to the area irrigated.

1058. Moody, G.B., "Bonanza - Literature for Civil Engineers," Civil Engineering, Jan. 1968, pp. 46-47.

1058. Continued

Items such as catalogs, periodicals, transactions, specifications, codes and costs are available to engineers from sources the author lists. Many are free.

1059. Mookerjea, D., and Aich, B.N., "Sedimentation in the Kosi - A Unique Problem," Irrigation and Power (New Delhi), 1963, Vol. 20, No. 3, pp. 265-290.

The bed of the Kosi, third largest river in India, is subject to a peculiar pattern of shifting; fluctuations recur at long-term intervals, the westward movement being slow and stepwise, and the eastward movement rapid and accompanied by heavy losses in life and property.

1060. Moolani, M.K., and Behl, N.K., "Investigations on the Irrigation Requirements of Hybrid Maize Crop in Arid Region of Punjab," Punjab Agricultural University, Hissar (India), Department of Agronomy, Annals of Arid Zone, Mar. 1968, Vol. 7, No. 1, pp. 105-115.

A field experiment was conducted to determine the effects of different levels of irrigation, nitrogen and plant density on the yield of hybrid maize. Consumptive use, seasonal water requirements and irrigation requirements of maize were found.

1061. Moore, C.V., and Hedges, T.R., "Some Characteristics of Farm Irrigation Water Supplies in the San Joaquin Valley," Giannini Foundation of Agricultural Economics, 207 Giannini Hall, Berkeley 4, California (USA), Sep. 1962, No. 258, 42 pages.

1062. Moore, D., "Deltaic Sedimentation," Earth Science Review (Amsterdam), 1966, Vol. 1, No. 2 and 3, pp. 87-104.

Rivers entering standing water behave as jets, either axial jets where river and standing water are equally dense or as plane jets where the river is lighter than the standing water.

1063. More, R.J.M., "Irrigation and Conservation in the Great Ouse River Valley," Journal of the Chartered Land Agents' Society, London, Apr. 1963, Vol. 62, No. 4, pp. 140-147.

1064. Moore, S.D., "Contour Banks Protect Crop Land," South Australian Department of Agriculture Journal, Adelaide (Australia), Mar. 1962, Vol. 65, No. 8, pp. 318-324.

1065. Moore, S.D., "Flood Irrigation Design," Journal of the Department of Agriculture of South Australia, Adelaide, Australia, Apr. 1964, Vol. 67, No. 9, pp. 280-287.

1066. Moore, S.D., "Flood Irrigation Design II," Journal of the Department of Agriculture of South Australia, Adelaide, Australia, May 1964, Vol. 67, No. 10, pp. 316-321.

1067. Moore, W.L., and Morgan, C.W., "Hydraulice Jump at Abrupt Drop," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 83, No. HY6, Paper 1449, Dec. 1957, pp. 21.

Hydraulic jump may form at various locations relative to low abrupt drop in determing form of jump and in stabilizing its position is clarified by analysis and experiment; example illustrates application of results to analysis of stilling basin.

1068. Moore, W.L., and Masch, F.D., "Experiments on the Scour Resistance of Cohesive Sediments," Journal of Geophysical Research, Vol. 67, No. 4, Apr. 1962, pp. 1437-1449.

Exploratory tests for measuring scour resistance are described and some correlated results are presented for a test involving scour by a vertical submerged jet. The characteristics of the scour surface were observed for a remolded and a natural sediment, and the rates of scour were measured by the weight loss of the sample. Results are presented in terms of dimensional parameters. An apparatus designed to permit a direct measurement of a uniform shear stress developed at the surface of a cylindrical sample of a cohesive sediment is described.

1069. Moore, W.L., and Masch, F.D., "Influence of Secondary Flow on Local Scour at Obstruction in a Channel," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 36, pp. 314-320.

In this paper an attempt is made to develop a better understanding of some of the characteristics of the three-dimensional flow patterns occurring at such obstructions, which may lead to a better basis for devising methods to control the local scour.

1070. Morel-Seytoux, H.J., "Domain Variations in Channel Seepage Flow," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 90, No. HY2, Pt. 1, Paper 3822, Mar. 1964, pp. 55-79.

General method to calculate seepage discharge from channel of complex shape is based on use of Hedmaard's formula for variation of Green's function when shape of region for which Green's function is known has changed; method is applied to calculate seepage from channels that may be considered almost trapezoidal or triangular; simple geometrical construction yield equivalent channel from which same quantity of water is lost; graphs of seepage discharge in dimensionless form are given for trapezoidal triangular channels.

1071. Morrice, H.A., "The Design of Headworks for Irrigation Canals in the Delta of a Torrential River," 3rd Congress on Irrigation and Drainage, Report 26, Question 9, 1957.

Describes the design of headworks for irrigation canal in delta of a torrential river Gash in Sudan. Permanent headworks in such rivers is not economical as river changes its course frequently. Simple and economic structures are thus required, which have been used in the entire delta.

1072. Mosonyi, E., "Hydraulic Roughness Determined by Measuring the Distance of the Hydraulic Jump," Proceedings of the 6th General Meeting of the International Association for Hydraulic Research, D24, 1955, pp. 1-6.

1073. Moulton, L.K., Belcher, C., and Butler, B.E., "Report of an Investigation of Scour at Bridges Caused by Floods," Civil Engineering and Public Works Review, Vol. 53, No. 624, June 1958, pp. 669-672.

1074. Mounis, H., "Sediment Load," Flood Control Journal, ECAFE, Sep. 1959, pp. 26-29.

1075. Mukhtar, S., and Gandhi, R.T., "Fertilizers in Relation to Efficient Use of Irrigation Water," Proceedings Near East and South Asia Region, 5th Irrigation Practices Seminar New Delhi, Mar. 2-14, 1964, United States Agency for International Development Mission to India (USAID), New Delhi, 1964, pp. 486-497.

Review literature on fertilizer-irrigation relationship with particular reference to Indian work.

1076. Munson, W.C., "Method for Estimating Consumptive Use of Water for Agriculture," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 86, No. IR4, Pt. 1, Paper 2672, Dec. 1960, pp. 45-57.

Monthly and annual estimates in planning of irrigation projects; data on measured rate of consumptive use of water and on estimated consumptive use determined by various formulas; proceedure for determining monthly and annual water requirements on project basis from climatological data for areas when measurements of consumptive use are not available.

1077. Muramoto, Y., "Secondary Flows in Curved Open Channels," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A53, Vol. 1, 1967, pp. 429.

It is intended in this paper to analyze the internal structure of the curved flow on the basis of the measurement of three velocity components and the calculation of vorticity components of the flow in a curved open channel. According to the observed results of the peculiar properties of the distribution of velocity and vorticity, the flow in a curved section is divided into the following three regions as a mathematical model - a generating region, a developing region and a fully developed region of the secondary flow -, and the several analytical results to show the characteristics of the flow in the first and the final region are presented on the basis of the forementioned proposed model.

1078. Muszkalay, L., "Effect of Pumping Plant on the Flow Conditions of the River," Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 4, pp. 1043-1050.

In the surroundings of the floating pumping plant placed on the concave side of one of the right meanders of Tizsa River, large-sized bank erosion appears. In order to determine the hydraulic causes of the erosion, use is made of the new Muszkalay Kranicz type direction finder.

1079. Muzurak, A.P., and Mosher, P.N., "Detachment of Soil Particles in Simulated Rainfall," Soil Science Society of American Proceedings, Sep.-Oct. 1968, Vol. 32, No.5, pp. 716-719, (4 pages, 3 figures, 1 table, 8 references).

1079. Continued

Discussed is the relation between falling raindrops and detachment of soil particles from a soil mass, which is the first stage of erosion. Information is presented that relates particles are exposed to simulated rainfall. Experimental procedure involved subjecting separates of soil materials of various particle sizes to variable simulated rainfall intensities.

1080. Myers, L.E., "Flow Regime in Surface Irrigation," Journal of Agricultural Engineering, Vol. 40, No. 11, Nov. 1959, pp. 676-677, 682-683.

Review of existing information shows that hydraulic radius is not satisfactory dimension for calculating Reynold's number. Critical Reynolds number for shallow flow has not been satisfactorily determined, equation for turbulent flow at low Reynolds numbers must contain viscosity factor, and equations should consider relative roughness rather than absolute roughness.

1081. Myers, L.E., and Haise, H.R., "Water Application Efficiency of Surface and Sprinkler Methods of Irrigation," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 1, 1960, pp. 12.1-12.14.

Points out that it is rarely possible to make valid comparison of efficiency tests made by different workers at different locations because there is no standarization of methods or agreement on procedures.

1082. Myers, V.I., and Tovey, R., "Accurate, Rapid Evaluation of Erosion from Irrigation Furrows," Transactions of the American Society of Agricultural Engineers, Vol. 9, No. 3, 1966, pp. 404-405.

Simple procedure for sampling combination of suspended canal bed loads in irrigation furrows and for computing erosion rate from weight and volumetric measurements; procedure applies equally well to sediment samples taken in runoff plot or watershed studies.

1083. Mylvaganam, T., "Design of a Control Structure Below a Head Sluice," Civil Engineering and Public Works Review, Vol. 51, No. 605, Nov. 1956, pp. 1225-1228.

1084. Nace, R.L., West, S.W., and Mower, R.W., "Feasibility of Ground-Water Features of Alternate Plan for Mountain Home Project, Idaho," United States Geological Survey, Water Supply Paper, No. 1376, 1957, pp. 121.

1085. Nagarajan, R., "Silt Factor, Its Determination and Significance in the Computation of Scours in Alluvial River Beds," Irrigation and Power (New Delhi), 1959, Vol. 16, No. 2, pp. 232-244.

Several methods for computing the silt factor (introduced by Lacey as $f=1.76\sqrt{dm}$, where d_m - mean silt diameter in mm.) are outlined, and their relative merits compared. The following method is presented for determining a "mean silt factor". Silts from different depths at each point can be combined to form a single sample.

1086. Nagle, A., "Modified Contour Ditch Irrigation," The Australian Irrigator (and Pasture Improver), Vol. 6, No. 12, Nov. 1961, pp. 19-22.

Suggests modification of contour ditch method by way of erecting small check banks approximately 33 ft. apart and at right angles to the contour lines.

1087. Nagy, I.V., "The Applicability of Frankl's Equations for the Investigation of Suspended Sediments," Proceedings of the 11th General Meeting of the International Association for Hydraulics Research, Seminar 3.7, 1965, 166 pages.

1088. Nakaya, T., "Method of Diverting Irrigation Water Into Headgate on a Rapid Stream," 3rd Congress on Irrigation and Drainage, Report 17, Question 9, 1957.

Describes a movable rectifying lattice which, if built at the entrance of the sand basin of a headregulator of canal taking off from a rapid stream carrying large quantities of sediment, will reduce the length of the sand basin and help in making sand deposits in it smooth.

1089. Nalson, J.S., and Parker, M.L., "Irrigation on the Gascoyne," Farm Policy, Ames, Louisiana (USA), Dec. 1963, Vol. 3, No. 3, pp. 72-80.

1090. Narahara, W., "Sequamatic Overhead Irrigation System," Hawaii Sugar Technologist Report, No. 19, 1960 (1961), pp. 186-188.

1091. Nathan, K., "Check Water Loss in Sprinkler Use," New Jersey Agriculture, New Brunswick, New Jersey (USA), Nov.-Dec. 1962, Vol. 44, No. 6, pp. 13-14.

1092. Nathan, K., "Performance of Turf Irrigation Sprinklers," Journal of Soil and Water Conservation, Soil Conservation Society of America, 338 Fifth Ave. Des Moines 14, Iowa (USA), Nov.-Dec. 1963, Vol. 18, No. 6, pp. 236-238.

1093. Nazir, A., "Stabilization of Side Slopes of Kalari Feeder," Irrigation Research Institute, Lahore, Report No. 154, Ph/L.C.25, 1957.

1094. Nazir, A., "Location of Previous Sites Along Lower Chenab Canal," Irrigation Research Institute, Lahore, Report No. 171 Ph/Seep-34/59, 1959, 4 pages.

1095. Nazir, A., and Zia-Ul-Haq, "Reclamation of 0.5 Million Waterlogged Acres of Rechna Doab," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 3, Report 24, 1960, pp. 11.471-11.491.

1096. Nebraska Agricultural Experiment Station, "Cost of Distributing Irrigation Water by the Sprinkler Method," Nebraska Agricultural Experiment Station, Mar. 1960, 34 pages.

1097. Neill, C.R., "Mean-Velocity Criterion for Scour of Coarse Uniform Bed Material," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Vol. 3, No. C6, 1967, pp. 46-54.

In view of the lack of design data for determination of incipient motion of solid bed load in open channels, extensive experimental research was conducted, the results of which are summarized and systematized. The experiments were conducted in a 0.9 m. laboratory flume with bed-load material ranging from 6 to 30 mm. in grainsize.

1098. Nelson, K.D., "Waterlosses in Irrigation Channel Systems," International Commission on Irrigation and Drainage, Annual Bulletin, 48 Nyaya Marg, Chanakyapuri, New Delhi 11, India, 1964, pp. 52-53.

Presents investigations made on a 60 cfs channel having 152 outlets, 75% of the outlets fitted with dethridge water meters to account for various losses.

1099. Nelson, K.D., and Robinson, E.P., "Distribution Losses in Irrigation Channels," Institution of Engineers (Australia), Vol. CE8, No. 2, Oct. 1966, pp. 179-182.

Results of study of water losses from three unlined distributary channels in Northern Victoria, Australia.

1100. Nelson, R.W., "Fiberglass as Filter for Closed Tile Drains," Agricultural Engineering, Vol. 41, No. 10, Oct. 1960, pp. 690-693, 700.

Experiments show improved fiberglass with random reinforcing functions well in most unstable soils and is more economical than sand and gravel materials; 2 to 4 in. of soil must be placed over sheet manually to prevent its tearing and breaking; test procedures described.

1101. Nemenyi, P.F., "Annotated and Illustrated Bibliographic Material on the Morphology of Rivers," Bulletin of the Geological Society of America, Vol. 63, June, 1952.

Selected books and articles on fluvial morphology are abstracted and some of them are critically analyzed. The selections emphasized typical recurrent forms and the attempts to find physical laws governing their occurrence. Additional references are given. The bibliographic material is supplemented by an introduction which extends the survey to problems beyond those treated in this material and attempts a unification of the whole.

1102. Neogy, B.N., "Submergence Tests on Critical Depth Meter," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 18, No. 9, Sep. 1961, pp. 821-826.

Effect of submergence on a critical depth meter and equations to compute discharge under submergence conditions.

1103. Nichols, M.L., and Smith, D.D., "Progress in Erosion Control over the Past 50 Years," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 38, No. 6, June 1957, pp. 422-425, 460.

Accelerated erosion has generally been associated with tillage of steep or rolling land. The opening of extensive new areas for cultivation, as in the prairies and high plains, and the increase of row-crop land per operator with the decrease of soil conserving feed crops for horses and mules, has tended to increase soil erosion.

1104. Nieuwoudt, A.D., "Surface Irrigation," Farming in South Africa, Pretoria, South Africa, Jan. 1964, Vol. 39, No. 10, pp. 42-43.

1105. Nizery, A., and Braudeau, G., "Variation in Grain Size Distribution of Bed-Load in a River Section," Proceedings of the 5th General Meeting of the International Association for Hydraulic Research, 1953, pp. 49-60.

1106. Nohre, C.O., and Raup, P.M., "The Regulation of Water Use in Minnesota Agriculture," Minnesota Farm and Home Science, St. Paul (USA), Winter 1962, Vol. 19, No. 2, pp. 7 and 21.

1107. Nolte, B.H., and Beasley, R.P., "Investigation of Farm Draintile Terrace Outlets," Transactions of the American Society of Agricultural Engineers, Vol. 7, No. 1, 1964, pp. 94-96.

Tests were made to determine effect of velocity, tile-joint spacing and misalignment on difference between head in tile line and head against soil surrounding tile line; 14 test joints were constructed for range of spacings and misalignments; test joints were each constructed from two 1-ft. sections of 8-in. diam commercially manufactured concrete draintile with 3/4-in. wall thickness.

1108. Nordin, C.F., "Aspects of Flow Resistance and Sediment Transport, Rio Grande Near Bernalillo, New Mexico," United States Geological Survey, Water-Supply Paper 1498-H, 1964, 41 pages.

Observations of hydraulic variables at a partially confined section and a wider section on a reach of the Rio Grande near Bernalillo, New Mexico, form the basis for this study. Averages of the hydraulic properties of cross-section are used to determine bar resistance and bed-material transport.

1109. Nordin, C.F., and Beverage, J.P., "Sediment Transport in the Rio Grande, New Mexico," United States Geological Survey, Prof. Paper, 1965, No. 462-F, pp. 35.

This report describes hydraulic data, observed and computed sediment concentrations, and size distributions of bed-material samples for 293 observations and presents the results of a series of investigations at six sediment stations on the Rio Grande in New Mexico.

1110. Nordin, C.F., and Richardson, E.V., "The Use of Stochastic Models in Studies of Alluvial-Channel Processes," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Vol. 2, No. B11, 1967, pp. 96-102.

The results of model experiments on processes in alluvial channels are presented and the utility of stochastic models in describing sediment-transport processes and river-channel morphology is stressed.

1111. North, J.J., "Irrigation," World Crops, Leonard Hill Ltd. Stratford House 9, Eden St., London, N.W.1, Sep. 1962, Vol. 14, No. 9, pp. 302-305, 307.

Discusses the use of systems of pipe irrigation for crop production in the United Kingdom and economic benefits which may be expected when conditions are suitable for their economic use.

1112. Norum, E.M., "A Method of Evaluating the Adequacy and Efficiency of Overhead Irrigation Systems," Hawaii Sugar Technologist Report, No. 19, 1960 (1961), pp. 192-195.

1113. Nourse, E.F., et al., "Supplemental Irrigation by Sprinkling Increases Delta Sugar Beat Yields," California Agriculture, University of California, Berkeley 4, California (USA), July 1963, Vol. 17, No. 7, pp. 2-3.

Describes that the use of sprinklers to supplement the usual subbing method of irrigation increased Oct. harvested sugar beet production.

1114. Novâk, P., "Bed-Load Meters, Development of a New Type and Determination of Their Efficiency with the Aid of Scale Models," Proceedings of the 7th General Meeting of the International Association for Hydraulics Research, No. A-9, 1957, pp. 1-11.

Bed load transport constitutes a very complicated problem. The functioning and efficiency of the transportmeter can be determined only by laboratory research supplemented by experiments in nature. Research on the efficiency of samplers of several other types with or without wire mesh, has been carried out in three flumes of different width with smooth concrete floors as well as gravel or sand beds and by using several methods for the determination of the bed load transport across the flumes. A summary of all experimental results is given as well as a description of a new sampler, values of efficiencies, and conclusions to the problem of similarity and scale effect for research of this type.

1115. Novâk, P., "Report on Sediment Transport," Proceedings of the International Association for Hydraulic Research, Seminar II, 1959, pp. R4-SII-1/8.

1116. Novak, P., "Influence of Bed Load Passage on Scour and Turbulence Downstream of a Stilling Basin," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1, pp. 66-75.

The purpose of this study is to ascertain how the passage of bed load from the reservoir influences, under various conditions, the formation and the final size of scour downstream of the weir stilling basin. On the basis of this it is possible to judge the factor of safety which is introduced by usually working with clean water.

1117. Nyazi, A., "Farm Drainage," 3rd Regional Irrigation Practices Leadership Seminar NESA Region, Lahore, Feb. 15-26, 1960, 101 pages.

Presents some notes on the subject relating to West Pakistan, India, Afghanistan and Iran.

1118. O'Byrne, T.N., "A Correlation of Rock Types with Soils, Topography, and Erosion in the Gisborne, East Cape Region," New Zealand Journal of Geology and Geophysics, 1967, Vol. 10, No. 1, pp. 217-231.

The rock types of the Gisborne, East Cape Region (New Zealand) have been arranged in groups in order of increased severity of erosion. The recent alluvium of flats and terraces are stable; slip and sheet erosion occurs on limestone, sandstones, massive siltstones, and basalt; gullying and soil erosion occur on banded mudstone and greywacke; moderate slumping and gullying occurs on unconsolidated sandstone and close-jointed mudstone.

1119. Ofomata, G.E.K., "Factors of Soil Erosion in the Enugu area of Nigeria," Nigerian Geographical Journal, 1965, Vol. 8, No. 1, pp. 45-59.

The average annual precipitation in the above area reaches 1.646 mm. of which 85% fall between April and October, mostly as intensive storm rains. The soils are of the tropical red-earth type mainly with a particle size of 0.2-0.5 mm.

1120. Oliver, A.R., "Nomograms for Backwater Curves in Trapezoidal Channels," Commonwealth Engineer, Vol. 45, No. 3, Oct. 1957, pp. 53-56.

1121. Olivier, H., "Irrigation and Climate," Edward Arnold (Publishers) Limited, London, 1961, 250 pages.

Simple methods for estimating the quantities and times of crop water requirements for different localities.

1122. Olivier, H., "Efficiency of Water Distribution and Use on Land," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 4, 1963, pp. 16.35-16.58.

System of water accountancy is discussed in terms of forecasting and periodic adjustments of requirements against ideal characteristic requirement curves developed from climatological and soil factors; improvement in application and conveyance efficiences, with special reference to canal linings and methods of field application; reference is made to advantages of introducing balancing reservoirs into long canal systems and use of tubewells for providing peak supplies.

1123. Ostromecki, J., "Some Specific Problems Concerning Irrigation in Poland," International Commission on Irrigation and Drainage, Annual Bulletin, 1957, pp. 26-30.

1124. Ostromecki, J., "Method of Computing the Border Flow Irrigation System," International Commission on Irrigation and Drainage, Annual Bulletin, 1960, pp. 73-77.

1125. Oxley, R., "It Pays to go Round in Circles," Irrigation Engineering and Maintenance (USA), Vol. 11, No. 2, Feb.-Mar. 1961, pp. 11-25.

1126. Ozal, K., "A Review of Irrigation Development in Turkey," United Nations Conference on Applied Science and Technology, Geneva, Oct. 11, 1962, Vol. 6, No. 261.

1127. Padoan, G., Terenzio, U., and Todaro, U., "Some Aspects of the Problem of the Lining of Irrigation Canal Lining in Italy," Transactions of the 3rd Congress on Irrigation and Drainage, Vol. 2, Report 31, 1957, pp. 7.369-7.406.

1128. Pair, C.H., "Sprinkler Irrigation," United States Department of Agriculture, Leaflet No. 476, July 1960, 8 pages.

1129. Pair, C.H., "Effects of Irrigation Methods and System Management on Water Application Efficiency," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 4, 1963, pp. 16.145-16.159.

1129. Continued

Factors affecting field-water application efficiency in irrigation are studied; paper summarizes study conducted near Boise, Idaho, to compare field-water application efficiencies of furrow, border, contour border, and sprinkler methods of irrigation of crops in grain-legume rotation on 3 to 5% slopes.

1130. Pair, C.H., "Making Use of Sprinkler Pattern Data," Irrigation Engineering and Maintenance, Oct.-Dec. 1963, pp. 10-11.

Observes that presently sprinkler irrigation design selection is based on an erroneous assumption; describes a new procedure which would greatly improve design and performance.

1131. Palmer, D.B., and Johnson, H.P., "Field Evaluation of Flow Through Blind Inlets," Transactions of the American Society of Agricultural Engineers, 1962, Vol. 5, No. 1, pp. 58-61.

1132. Palmer, R.E., "Solid-Set Irrigation for Strawberries in Michigan," Proceedings of Open Technical Conference, Sprinkler Irrigation Association, California (USA), 1964, pp. 51-53.

1133. Palmer, R.S., "Waterjet Break-Up from Stainless Steel Tubes," Agricultural Engineering, St. Joseph, Michigan, Aug. 1962, Vol. 43, No. 8, pp. 456-457.

Describes design of apparatus to count, collect and to record time collecting period during which water drops are discharged through small stainless steel tubes and to facilitate study of drop forming devices for simulation of rain.

1134. Palmer, W.I., "Water Resources: Development and Uses," American Association for Advancement of Science, Land and Water Use, Washington, D.C. (USA), 1963, pp. 59-72.

1135. Pandey, M.P., and Raghavarao, K.V., "Minor Irrigation Systems by India Part II - Groundwater Development in India Through Irrigation Tubewells," Proceeding Near East and South Asia Region, 5th Irrigation Practices Seminar, New Delhi, Mar. 2-14, 1964, pp. 367-375.

1136. Pantelopulos, J., "Model Study on Bed-Load Transport of Mixture of Solids," Proceedings of the 7th General Meeting of the International Association for Hydraulic Research, D30, 1957, pp. 1-24, French.

1137. Pantelopulos, J., "Influence of Turbulence on the Distribution of the Tractive Power Among the Materials of a Movable Bottom," Proceedings of the 9th General Meeting of the International Association for Hydraulics Research, Paper I, No. 14, 1961, pp. 98-109.

1138. Parthasarthy, C.S., "Thoughts on Irrigation and Valley Developments in the U.S.A.," Indian Journal of Power and River Valley Development, Vol. 7, No. 2, Feb. 1957, pp. 13-17.

1139. Partheniades, E., "A Summary of the Present Knowledge of the Behavior of Fine Sediments in Estuaries," Technical Note 8, Hydromechanics Laboratory, Massachusetts Institute of Technology, Cambridge, Massachusetts, June 1964.

This report reviews current research activities pertinent to the behavior of cohesive soils in estuaries and open channels. The work discussed is divided into three categories: (1) Results of field investigation, (2) Basic research work on the transportation and deposition of clays, and (3) Basic research work on the erosion of cohesive soils. Certain conclusions reached by various investigators are compared and discussed and some necessary future research work is outlined.

1140. Partheniades, E., "Erosion and Deposition of Cohesive Soils," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY1, Pt. 1, Paper 4204, Jan. 1965, pp. 105-139.

Effects of shear stress, suspended sediment concentration, and shear strength of bed on erosion rates of cohesive bed in open channel with salt water was investigated; deposition rates of suspended cohesive sediment and patterns of bed erosion were studied; erosion rates were found to be independent of shear strength of bed and concentration of suspended sediment; they depend strongly on bed shear stress; there exists "critical" velocity for clay part of suspended sediment, above which all such sediment remains in suspension, whereas even for velocities slightly below this critical limit, suspended clay deposits rapidly.

1141. Partheniades, E., and Paaswell, R.E., "Erosion of Cohesive Soil and Channel Stabilization, Part I: State of Knowledge, Part II: Behavior of Cohesive Soils," Civil Engineering Report No. 19, Department of Civil Engineers, State University of New York at Buffalo, Oct. 1968.

Results of several laboratory investigations on the erodibility of cohesive soils by water are critically reviewed and information is obtained on significant flow and soil parameters. Theories on erosion of cohesive soil are developed. Part I: 34 references; Part II: 38 references.

1142. Pattabiramiah, K.R., and Lakshmana Rao, N.S., "A Suggested Method to Estimate Flow in Open Circular Channels," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 17, No. 1, Jan. 1960, pp. 56-62.

An attempt to correlate flow in a circular channel with pipe flow in terms of dimensionless parameters.

1143. Pattabiramiah, K.R., and Rajaratnam, N., "A New Method to Predict Flow in a Branch Channel," Irrigation and Power, Journal of the Central Board on Irrigation and Power, Vol. 17, No. 1, Jan. 1960, pp. 48-51.

An analytical solution to calculate the discharge in a channel taking off from a main channel.

1144. Pattabhiramaiah, K.R., and Rajaratnam, N., "Branch Channel Flow," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 18, No. 3, Mar. 1961, pp. 198-200.

Presents further work on "A New Method to Predict Flow in a Branch Channel" by the authors.

1145. Pauls, D.E., and Parrish, B.D., "Comparison of Sprinkler and Surface Irrigation Methods, 1956 and 1957," Washington Agricultural Experiment Station, C.369, Feb. 1960, pp. 6.

1146. Pavlov, M., "New Irrigation Techniques in the U.S.S.R.," Indian Farm Mechanization, Vol. 10, No. 11, Nov. 1959, pp. 38-42.

1147. Peikert, F.W., "The Role of the State University in Advancing Sprinkler Irrigation," Proceedings of the Open Technical Conference, Sprinkler Irrigation Association, California, (USA), 1964, pp. 15-20.

1148. Penman, F., "Irrigation and Drainage," James Hardie and Coy. Pty. Ltd., Australia, 1962, 2 pages.

1149. Penman, H.L., "General Principles of Irrigation," Scottish Journal of Agriculture, Vol. 42, No. 3, Winter 1960-1961, pp. 140-142.

1150. Penman, H.L., "Irrigation in Britain," Journal of the Royal Society of Arts, London, England, Mar. 1963, Vol. III, No. 5080, pp. 272-289.

1151. Peter, Y., "Influence of Traction Force on Design of Earth Channels," Civil Engineering and Public Works Review, Vol. 53, No. 628, Oct. 1958, pp. 1152-1154.

Relationship between specific soil quality, expressed as traction force, knowledge of ground slope, and choice of geometric shape of cross section determines other values of hydraulic design; permissible value of traction force changes with depth of water and distribution of velocity over cross section. Calculations and equations for evaluation of factors in design of earth channels for flood protection, irrigation, and power development are given.

1152. Peter, Y., "Cross Sections and Drops in Design of Earth Channels," Civil Engineering and Public Works Review, Vol. 55, No. 649, Aug. 1960, pp. 1023-1024.

Conclusions of author's 1958 article are referred to; present paper enlarges on properties of hydraulically best cross-section, and investigates problem of trapezoidal drop which has advantage over rectangular one.

1153. Peter, Y., "Two Aspects of Design of Water Courses and Earth Channels," Civil Engineering and Public Works Review, Vol. 58, No. 684, July 1963, pp. 879-881.

Problem of connecting tributary to main channel is discussed and example procedure for design of confluence of trapezoidal cross sections described; rational approach to flexible design of erosion resistant trapezoidal earthen channels is presented.

1154. Peter, Y., "Channels and Drops - Some Peculiarities," Civil Engineering and Public Works Review, Vol. 59, No. 698, Sep. 1964, pp. 1095, 1097, 1099.

Relation between permissible traction force on bottom of erodible channel and flow and soil conditions are investigated and design rules established; influence of channel side slope on permissible traction force; comparison between rectangular and trapezoidal drops.

1155. Petersen, M.S., "Laboratory Contributions to Channel Stabilization," Journal of the Waterways and Harbors Division, American Society of Civil Engineers, Vol. 92, No. W.W. 1, Proc. Paper 4673, Feb. 1966, pp. 87-108.

1155. Continued

Hydraulic model studies for investigation of channel stabilization problems on the Mississippi, Ohio, Middle Rio Grande, and Arkansas Rivers are summarized. Most of the studies were conducted with models of the movable-bed type for the purpose of predicting changes in channel regime, for determining causes of failure of channel stabilization works, and for the design of systems of channel stabilization works. There has been a steady trend toward the use of models of larger scale and with smaller distortion, and movable-bed model techniques have been improved and refined.

1156. Pharr, P.M., "The Design, Construction and Operation of a Project-Type Sprinkler Irrigation System," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 8, 1960, pp. 12.129-12.152.

1157. Phelan, J.T., "Bench Leveling for Surface Irrigation and Erosion Control," Transactions of the American Society of Agricultural Engineers, Vol. 3, No. 1, 1960, pp. 14-17.

1158. Phelan, J.T., "Design Procedures and Research Needs for the Furrow Method of Irrigation," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 45-54.

1159. Philip, A.W., "Efficient Tile Drainage," Farm Mechanics, Vol. 12, No. 134, Oct. 1960, pp. 349-351.

1160. Philip, J.R., and Farrel, D.A., "General Solution of Infiltration-Advance Problem in Irrigation Hydraulics," Journal of Geophysical Research, Vol. 69, No. 4, Feb. 15, 1964, pp. 621-631.

General solution of Lewis-Milne equation is found by means of Faltung theorem of Laplace transformation; new solutions are found for Kostiakov-Lewis equation; equation for cumulative infiltration $y=St^{1}/2 +At$ is solved; power series and asymptotic expansion forms give insight into behavior at small and large times.

1161. Phillips, R.L., "Land Leveling for Drainage and Irrigation," Agricultural Engineering, Vol. 39, No. 8, Aug. 1958, pp. 463-465.

Method of land leveling to provide, in one system, both surface drainage and surface irrigation of Missouri River bottom land; system gives farmer insurance against hazards of either wet or dry year; arrangement diagrams.

1162. Piccoli, A., et al., "Sediment in Irrigation and Drainage Channels," 6th Congress of the International Commission on Irrigation and Drainage, Vol. 3, 1966, pp. 20.165-20.211.

1163. Pillsbury, F., "Water Table Control in Arid and Semiarid Regions," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 2, Report 5, 1960, pp. 11.65-11.84.

1164. Pillsbury, A.F., Pelishek, R.E., and Buras, N., "Wetting Expansion of Draintile and Its Effect on Water Entry," Transactions of the American Society of Agricultural Engineers, 1960, pp. 88-89.

1165. Pillsbury, A.F., et al., "Tile Drainage Performance, Coachella Valley, California," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 91, No. IR2, Proc. Paper 4344, June 1965, pp. 1-10.

The performance of tile drainage systems in a low desert area of high evapotranspiration is evaluated. Factors for use in empirical design equations are developed on the basis of quantity of tile installed and area drained. Irrigation efficiencies have been found to be rather poor, but probably beneficial for maintaining good water quality in the groundwater basin.

1166. Pillsbury, A.F., et al., "Salinity of Tile Drainage Effluent," Water Resources Research, Vol. 1, No. 4, 4th Quarter 1965, pp. 531-535.

Four year studies of drainage effluent obtained from 15 tile drainage systems located in arid San Joaquin Valley of California showed that concentration of salts and various ions discharged in tile effluent decreased, logarithmically, from time that tile systems were installed; regression equations and correlation coefficients are presented for total salts, boron, sodium, calcium plus magnesium, chloride and sulfate ions, vs. time.

1167. Pillsbury, A.F., "Observation on Tile Drainage Performance," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR3, Proc. Paper 5447, Sep. 1967, pp. 233-241.

1167. Continued

In arid and semi-arid climates, tile must maintain the plant rootzone as a low-salt environment. Through evapotranspiration, the rootzone serves to concentrate salts in the soil water, and the tile system provides egress for the saline water below that rootzone. Filters with D_{50}=1.0 mm and σ>1.0 mm are desirable. A technique to protect tile lines during "subbing-in" and to lessen envelope requirements is discussed.

1168. Pohjakas, K., "Measuring Irrigation Water Losses Through Border Dikes," Canadian Agricultural Engineering, Vol. 7, No. 1, Jan. 1965, pp. 28-29.

Sampling program was designed and conducted to provide data which made it possible to calculate border losses from gravimetric soil moisture determinations.

1169. Portland Cement Association, "Lining Irrigation Canals," Portland Cement Association, 1957, 32 pages.

1170. Posey, C.J., and Sybert, J.H., "Erosion Protection of Production Structures," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 4, pp. 1157-1162.

Platforms for drilling of oil wells were built off the shore of Padre Island, Texas, founded on tubular piles driven into sand. Observation made thirty months after the first platform was installed showed that the sand was being scoured away to such a depth that the stability of the platforms, by then converted to production structures, was endangered.

1171. Posey, C.J., "Protection of Soil from Erosion by Swiftly Flowing Water," Proceedings of the Iowa Academy of Sciences, Des Moines, 1962, No. 69, pp. 307-309.

1172. Posey, C.J., "Some Basic Requirements for Protection Against Erosion," Proceedings of the 5th General Meeting of the International Association for Hydraulic Research, 1953, pp. 85-88.

1173. Pourtauborde, J., "Report to the Government of Chile on Irrigation in Chile, with a Special Study of the North," F.A.O., Reprint No. 1622, 1963, pp. 75.

1174. Prasad, M., "Problems of Irrigation and Water Use in India," United Nations Conference on Applied Science and Technology, Geneva, Sep. 28, 1962, Vol. 3, No. 106, 8 pages.

1175. Price, G.A., "Sediment Diversions Through Distributary Channels Normal to a Major River," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, pp. 185-192, Paper No. 26.

Discusses sediment diversions in three normally oriented distributary channels of the Lower Mississippi River.

1176. Prickett, C.N., "Use of Water in Agriculture," Proceedings of the Symposium on Conservation of Water Resources in the United Kingdom Institution of Civil Engineers, London, 1963, pp. 15-19.

1177. Prochazka, J., "The Effect of Turbulence on Current Meter," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1, pp. 222-226.

The velocity pulsation influences the water velocity accuracy measured by means of current meters during a certain time 't' at a point of stationary flow. With the increase of time 't', the effect of pulsation decreases. The purposes of investigation are: to determine a) magnitude of turbulence, (b) the effect of turbulent pulsations on current meters.

1178. Prus-Chacinski, T.M., "Patterns of Motion in Open-Channel Bends," Journal of the Institution of Water Engineers, Vol. 10, No. 5, Aug. 1956, pp. 420-426.

1179. Pugh, W.J., "Portable Irrigation Check Dam," Colorado Agricultural Experiment Station, Oct. 1963, No. 110, pp. 2.

1180. Pugh, W.J., "Inexpensive Land Preparation for Leaching," Journal of Soil Conservation, Vol. 18, No. 6, Nov.-Dec. 1963.

1181. Pugh, W.J., and Evans, N.A., "Weed Seed and Trash Screens for Irrigation Water," Bulletin, Colorado Agricultural Experimental Station, Fort Collins (USA), Nov. 1964, No. 522-S, 18 pages.

1182. Qasi, A.R., "Design Criteria for Tile Drain Filters," M.S. Thesis at Colorado State University, Mar. 1961.

1183. Quackenbush, T.H., and Thorne, M.D., "Irrigation in the East," United States Department of Agriculture, Year Book, 1957, pp. 368-377.

1184. Quackenbush, T.H., "The Management of Irrigation Water," Irrigation Engineering and Maintenance, H.D. Peace Publications, 264 Gravier Street, New Orleans 12, Louisiana (USA), May 1963, pp. 16-17, 25.

1185. Quackenbush, T.H., and Phelan, J.T., "Irrigation Water Requirements of Lawns," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 91, No. IR2, Proc. Paper 4350, June 1965, pp. 11-19.

Irrigation water requirements for lawn grasses can be estimated by an empirical formula when adequate climatological data are available. The modified Blaney-Criddle formula can be used for this purpose. This procedure is explained and recommendations are made for the use of the results in accordance with the lawn condition desired.

1186. Quackenbush, T.H., "Land Modification for Efficient Use of Water," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 93, No. IR1, Paper 5124, Mar. 1967, pp. 7-14.

Following methods are considered - land grading for surface drainage in higher rainfall areas, land leveling for irrigation in western United States, contour benching to control erosion from rainfall and give efficient irrigation in Midwest, soil exchange in western alluvial valleys, deep plowing, etc.

1187. Quackenbush, T.H., "How to Install Flexible Membrane Canal Linings," Agricultural Engineering, Journal of the American Society of Agricultural Engineers, Vol. 48, No. 9, Sep. 1967, pp. 500-501.

1188. Quashu, H.K., and Bual, S.W., "Hydraulic and Micromorphological Properties of Stream Channel Sediments," Water Resources Research, Richmond, Virginia, 1967, Vol. 3, No. 2, pp. 465-469.

In the arid and semiarid regions of the southwestern United States, a large portion of the natural water recharge is through channel beds and alluvial deposits in river basins. Water transmission in these beds varies with time, location, depth and extent of alluvium, and hydraulic characteristics of flows, sediment loads, and morphology of the channels.

1189. Qureshi, P.M.I., "A Controlled Fall - A New Device," Engineering News (Pakistan), Vol. 6, No. 1, Mar. 1961, pp. 17-20.

1190. Qureshi, P.M.I., "Prevention of Undermining of Structures on Pervious Foundation," Engineering News, West Pakistan Engineering Congress, Lahore, West Pakistan, Mar. 1964, Vol. 9, No. 1, pp. 22-25.

States that structures on pervious foundations are subject to a head of water and their stability is worked out on the understanding of the exit gradient.

1191. Rafay, T., "Analysis of Change in Size of Bed Material Along Alluvial Channels," M.S. Thesis at Colorado State University, Nov. 1964.

1192. Ragip, B., and Savaskan, C., "Farm Layout and Distribution System - Cumra-Karkin Irrigation Development Project," Proceeding Near East and South Asia Region 5th Irrigation Practices Seminar, New Delhi, Mar. 2-14, 1964, pp. 316-330.

Describes briefly climate, topography, soils and other problems of the 320 hectares project; gives economic analysis of the project and reports resulting ratio of benefit to costs as 3:4.4.

1193. Rahman, M.A., "Minor Irrigation Systems by India, Part III-Small Storage and Diversion Scheme in South India," Proceeding Near East and South Asia Region 5th Irrigation Practices Seminar, New Delhi, 1964, pp. 376-388.

Describes the main design and construction features adopted generally in the southern states (particularly in the state of Andhra Pradesh) for execution of small storage and diversion schemes; furnishes information in regard to the land resources, water resources, rainfall pattern, type of soils and cropping pattern.

1194. Rahman, M.V., "Irrigation and Field Patterns in the Indus Delta," Abstracts of Dissertations and Titles of Theses, Louisiana State University, Vol. 21, No. 3, Sep. 1960, pp. 588-589.

1195. Raichlen, F., and Kennedy, J.F., "The Growth of Sediment Bed Forms From an Initially Flattened Bed," Proceedings of the 11th General Meeting of the International Association for Hydraulics Research, Vol. 3, No. 7, 1965, pp. 1-8.

1196. Rajaratnam, N., "Direct Solution for Depth of Stilling Basin," International Commission on Irrigation and Drainage, Annual Bulletin, 1959, pp. 43-51.

1197. Rajaratnam, N., "Distribution System to Serve Small Holdings (Ceylon)," 3rd Regional Irrigation Practices Leadership Seminar, NESA Region, Lahore, Feb. 15-26, 1960, pp. 151-160.

1198. Rajaratnam, N., "Direct Solution for Diameter of Pipe in Rough Turbulent Flow," La Houille Blanche, No. 6, Nov. 1960, pp. 714-719, French.

A Direct Analytical solution is presented in this paper for the diameter of the pipe in fully developed rough turbulent flow.

1199. Rajaratnam, N., "Pre-Entrained Jump," Civil Engineering and Public Works Review, Vol. 56, No. 663, Oct. 1961, Nov. 1961, pp. 1349-1351 and 1469-1471.

Pre-entrained jump is defined as jump in which supercritical stream is self-aerated and is distinguished from normal hydraulic jump, in which supercritical jump is not aerated; rational theory for pre-entrained jumps is presented; experimental verification of theory is given for values of air entrained Froude numbers up to 3.59.

1200. Rajaratnam, N., "Constant Velocity Concept for Supercritical Branch Channel Flow," Irrigation and Power, Vol. 19, No. 1, Jan. 1962, pp. 17-21.

Based on experimental finding that mean velocity in main channel across branch remains practically constant for supercritical flow in main and free flow into branch, it has been established that discharge distribution is function of only branch channel parameter lamda; equation developed can be used for predicting branch channel discharge for values of lambda in range 0.1 to 0.8.

1201. Rajaratnam, N., "Experimental Study of Air Entrainment Characteristics of Hydraulic Jump," Institution of Engineers (India), Vol. 42, No. 7, Pt. CI4, Mar. 1962, pp. 247-273.

Results for Froude numbers from 2.42 to 8.72 are presented; study includes development of air concentration probe suitable for measurements in hydraulic jump; analysis of variations in mean air concentration, ratio of air discharge to water discharge, and air concentration distribution along length of jump is given; new rational criterion is proposed for length of hydraulic jump, based on certain percentage of mean air concentration.

1202. Rajarathan, N., "Effect of Air-Entainment on Stilling Basin Performance," Irrigation and Power, Journal of the Central Board of Irrigation and Power, New Delhi, India, May 1962, Vol. 19, No. 5, pp. 334-343.

Presents a rational solution for analyzing the effect of air-entrainment on stilling basin performance.

1203. Rajaratnam, N., "Profile Equation for Hydraulic Jump," Water Power, Vol. 14, No. 8, Aug. 1962, pp. 324-327.

Based on results of systematic experimental investigation, generalized equation for mean flow profile of hydraulic jump for Froude numbers from 5 to 12 is presented.

1204. Rajaratnam, N., "Critical-Flow Diagram for Trapezoidal Channels," Water Power, London, England, Oct. 1962, Vol. 14, No. 10, pp. 413-414.

1205. Rajaratnam, N., and Muralidhar, D., "Unconfined Free Over-Fall," Irrigation and Power, Vol. 21, No. 1, Jan. 1964, pp. 73-90.

Experimental investigation on unconfined free over-falls below channels of rectangular, triangular, trapezoidal and parabolic forms with horizontal bed; lateral variation and trajectory characteristics of nappe have been studied; brink depth for rectangular channel with unconfined nappe is 1.4% less than that with confined nappe.

1206. Rajaratnam, N., "Forced Hydraulic Jump," Water Power, Vol. 16, No. 1, and No. 2, Jan. 1964 and Feb. 1964, pp. 14-19, and 61-65.

General theory for forced hydraulic jump from drag momentum equations is developed; analysis of experimental results on which preliminary design curves are based; 7 devices by means of which forced jump is formed are considered; jump is classified under 6 major types which may be predicted either by drag coefficient or by relative location; examples of design of stilling basins.

1207. Rajaratnam, N., and Muralidhar, D., "End Depth for Exponential Channels," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 90, No. IR1, Proc. Paper 3819, Mar. 1964, pp. 17-39.

1207. Continued

For a fully developed free overfall, the ratio of the end depth to the corresponding critical depth for parallel flow has been found to be 0.795 for triangular shpaed channels and 0.772 for the parabolic shaped channels. For sloping channels, this ration varies with the relative slope. Direct solutions for the problem of predicting the discharge from a known value of the end depth are given for the triangular, parabolic, and rectangular channels. A simple method of uniform flow calculation in parabolic channels uses

$$\frac{Q_n}{S_o^{1/2} a^{8/3}} = 3.96\ f_{(\alpha_o)}$$

1208. Rajaratnam, N., "Hydraulic Jump in Horizontal Conduits," Water Power Vol. 17, No. 2, Feb. 1965, pp. 80-83.

Design charts for hydraulic jump problems of horizontal conduits of exponential and circular cross sections are presented.

1209. Rajaratnam, N., "Experiments on Submerged Jump in Triangular Channel," Civil Engineering and Public Works Review, Vol. 60, No. 708, July 1965, pp. 1039-1040.

Results of eight experiments on submerged jump in triangular channel of semi-apex angle of 30° for supercritical Froude Number of 4.84 with submergence factor varying up to about 1.50 are presented.

1210. Rajaratnam, N., "Submerged Hydraulic Jump," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY4, Pt. 1, Paper 4403, July 1965, pp. 71-96.

Study of submerged hydraulic jump as case of plane turbulent wall jet under adverse pressure gradient with backward flow on top is presented; using experimental results of author for forward flow and those of Liu and Henry for backward flow, method has been devised to predict surface profile, and fall of pressure plus momentum and energy in submerged hydraulic jump; study was also made of boundary shear stress that was measured with Preston tube; 27 references.

1211. Rajaratnam, N., "Hydraulic Jump as Wall Jet," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY5, Pt. 1, Paper 4482, Sep. 1965, pp. 107-132.

Study of mechanics of hydraulic jump, treating it as plane turbulent wall jet under adverse pressure gradient; extensive measurements were made regarding pressure field, velocity distribution, and boundary shear stress in jump for nine supercritical Froude numbers from 2.68 to 9.78; it was found that pressure distribution is hydrostatic only in narrow region near bed; accurate form of momentum equation for jump was developed; method is devised to predict surface and energy profile in jump.

1212. Raju, R.L., "Irrigation in Mysore," Indian Journal of Power and River Valley Development, July 1962, Vol. 12, No. 7, pp. 23-24.

1213. Rakoczi, C., "Experimental Study of Flume-Bed Roughness," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A22, Vol. 1, 1967, pp. 181.

Laboratory experiments were carried out using four different sand and sand-gravel mixtures as bed material to determine the share of the total energy of flow required for sediment transport. The total head loss of flow could be separated into three parts due to (i) bed forms, (ii) grain size roughness, (iii) transport of sediment. The results show the primary importance of the slopes, in comparison to depths or hydraulic radii in determining the sediment-transporting capacity.

1214. Ram, M., "Surface Irrigation," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 4, 1963, pp. 16.465-16.483.

Importance of changing irrigation methods periodically, particularly in connection with crop rotation and with cumulative effects of imperfect practices, when one and same method is used continuously is discussed; analysis of hydraulics of surface irrigation is presented; provision of uniform water distribution by means of regulation of slope, and attainment of high application efficiency in furrow irrigation by means of stream regulation.

1215. Rand, W., "Flow Over Vertical Sill in Open Channel," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY4, Pt. 1, Paper 4408, July 1965, pp. 97-121.

1215. Continued

Investigation of particular case of flow over vertical sill is reported; flow consists of definite nonuniform reach between two flow sections, entrance section upstream of sill at which supercritical flow exists and surface roller of forced hydraulic jump begins, and exit section downstream of sill at which uniform subcritical flow is reached; flow is described by five dimensionless variables, Froude number, and four similarity criteria for flow geometry; boundary values and similarity concepts for flow are defined; results are applicable to design of hydraulic jump stilling basins.

1216. Ranga Raju, K.G., and Garde, R.J., "Form Resistance in Alluvial Channels," Institution of Engineers (India) Journal, Vol. 47, No. 5, Pt. CI3, Jan. 1967, pp. 245-259.

Empirical methods of separating total resistance in alluvial channels into grain resistance are reviewed; results of attempts made at finding form resistance of bed undulations by actual pressure measurements; form resistance obtained is compared with values predicted by conventional methods of separation of total resistance.

1217. Rangeley, W.R., "Factors in Calculation of Benefit-Cost Ratio for Irrigation Projects," 5th Congress of the International Commission on Irrigation and Drainage, Transactions, Vol. 2, 1963, pp. 15.231-15.246.

Principles of benefit-cost ratio method for general application to irrigation are discussed, and examination made of various components of analysis and their evaluation in irrigation practice; examples are given of application of benefit-cost procedures to irrigation schemes in Middle East and East Africa.

1218. Rantz, S.E., "Surges in Natural Stream Channels," United States Geological Survey, Water Supply Paper 1369-C, 1961, 90 pages.

Investigation of travel of surges in natural stream channel of irregular cross section, slope and alignment; time of travel of initial element of surge or initial disturbance to steady flow, can be computed reliably in accordance with Seddon's principle.

1219. Rao, B.V., "Effect of Secondary Flows on the Sediment Suspension in Trapezoidal Channels," Irrigation and Power, Vol. 24, No. 2, 1967, pp. 197-200.

The effect of secondary currents developing in open channels is briefly described in the case of trapezoidal channels.

1220. Rao, B.V., and Seetharamiah, K., "Development and Role of Secondary Currents in Alluvial Streams," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A58, Vol. 1, 1967, pp. 472.

Secondary Currents and their cause are described briefly. The effect of secondary currents on sediment suspension is discussed. The possible existence and pattern of a type of secondary currents developed in alluvial streams and the effect of the same on sediment suspension is discussed. It is tried to estimate the amount of secondary component of velocity using the empirical equations obtained from alluvial streams.

1221. Rao, K.L., "Some Advances in Water Resources Development," Bhagirath, Vol. VIII, No. 5, Nov. 1961, pp. 185-189.

Describes the use of mathematical models in making projects along with the features of the project.

1222. Rao, N.S.G., Seetharamalah, K., and Swamy, N.V.C., "Dissipation of Energy of a Circular Jet Submerged in Water," La Houille Blanche, No. 6, Nov. 1960, pp. 704-713, French.

Dissipation of energy of a high velocity jet flowing into a standing mass of water. It reports some studies undertaken with a view to studying the mechanism by which the energy of the jet gets decreased to a minimum.

1223. Rathbun, R.E., and Guy, H.P., "Effect of Nonequilibrium Flow Conditions on Sediment Transport and Bed Roughness in a Laboratory Alluvial Channel," Proceedings of the 12th General Congress of the International Association for Hydraulics Research, Paper A23, Vol. 1, 1967, pp. 187-193.

Non-equilibrium flow conditions were examined in a laboratory alluvial channel to determine responses of the recirculation and sand-feed systems of flume operation to changes in load, tailwater depth, and sand-bed slope. It was found that the simple proportionality suggested by Lane (1955) for relating sediment transport rate, sand size, water discharge and slope predicted qualitatively the results. Experiments were limited to one water discharge and one sand.

1224. Rathbun, R.E., and Guy, H.P., "Measurement of Hydraulic and Sediment Transport Variables in a Small Recirculating Flume," Water Resources Research, 1967, Vol. 3, No. 1, pp. 107-122.

An evaluation of techniques for measuring the hydraulic and sediment transport variables in a small recirculating flume showed that (1) the average depth of flow over a ripple bed could be determined adequately by measuring the difference between the water-surface elevation and the sand-bed elevation at a large number of positions and averaging the results; (2) the water surface slope could be determined easily and accurately from a series of piezometers.

1225. Raudkivi, A.J., "Study of Sediment Ripple Formation," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY6, Pt. 1, Paper 3692, Nov. 1963, pp. 15-33.

Laboratory results show variation of bed friction factor with formation of ripples and dunes under flowing water; flow pattern in lee of ripple is compared with wake at abrupt expansion; velocity, pressure, and shear stress measurements on fixed ripple form are examined and explanation is proposed for mechanism of formation of regular ripple pattern.

1226. Raudkivi, A.J., "On the Problem of Sediment Transport," Hydraulics and Fluid Mechanics; Proceedings of the 1st Australian Conference held at the University of West Australia, 1962,Pergamon Press, London, New York, 1964, pp. 369-384.

Presents the study for a particular case of water flow over a cohesionless sand bed, its velocity, pressure and shear stress measurements.

1227. Raudkivi, A.J., "Loose Boundary Hydraulics," Pergamon Press, New York, London, 1967, 331 pages.

Designed as a text book on alluvial channel hydraulics. Summarizes and correlates publications in this field. Topics covered include sediment properties, incipient movement, sand transport by air and by water, sediment transportation, stable channel design, bed forms, resistance to flow, etc.

1228. Raup, P.M., "Supplemental Irrigation in Minnesota Agriculture," Minnesota Farm and Home Science, St. Paul, Minnesota (USA), Spring 1964, Vol. 21, No. 3, pp. 31-32.

1229. Reclamation Era, "Plastic Canal Lining," Reclamation Era, Feb. 1959, pp. 3-4 and 16.

1230. Rees, D.M., "Progress Report for 1962 on Cooperative Research Program in Utah Pertaining to Multipurpose Use and Management of Reusable Water," Proceedings of the Utah Mosquito Abatement Association, Ogden (USA), 16th Annual Meeting, 1963, pp. 27-28.

1231. Reid, G.C., "Automatic Watering Pays Its Own Way," American City, Vol. 80, No. 3, Mar. 1965, pp. 106-107.

Experiments with automatic water sprinkling systems, intended to replace manual watering completely on golf courses, parks and traffic islands at Tucson, Arizonia, are described.

1232. Reinecke, E., "The Mechanics of Fertilizing Through a Sprinkler Irrigation System," Irrigation Engineering and Maintenance, H.D. Peace Publications, 264 Gravier Street, New Orleans 12, Louisiana (USA), Jan.-Feb. 1964, Vol. 14, No. 1, pp. 10-11.

1233. Replogle, J.A., Huggines, L.F., and Black, R.D., "Discharge Ratings of a Drop Inlet for a Small Farm Pond," Transactions of the American Society of Agricultural Engineers, Saint Joseph, Michigan (USA), 1962, Vol. 5, No. 2, pp. 210-211, 217.

1234. Replogle, J.A., and Chow, V.T., "Tractive-Force Distribution in Open Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY2, Paper 4727, Mar. 1966, pp. 169-191.

Tractive-force distribution in open channels is derived with aid of simplifying assumptions that reduce turbulent flow problem to computer solution of laminar flow equations; boundary drag and other effects, caused by restraint of turbulent flunctuations at wall and free surface, are considered to originate two superimposed laminar velocity distributions on same flow; two laminar flow cases are solved; usual laminar open channel case, and closed channel, or pipe, having same cross sectional shape as open channel; two solutions are superimposed to obtain final velocity distribution from which tractive-force distribution is derived.

1235. Replogle, J.A., Myers, L.E., and Brust, K.J., "Evaluation of Pipe Elbows as Flow Meters," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 92, No. IR3, Proc. Paper 4888, Sep. 1966, pp. 17-34.

A number of flanged, 90° commercial elbows of several sizes, ranging from 3 in. to 12 in. in diameter are calibrated as elbow flow meters. The accuracy to which a calibration equation can be predicted using only the nominal elbow size and the average calibration results of several similar elbows is determined. A relatively simple and inexpensive method for accurately determining the radius of bend with casting plaster is presented. The effects of installing the elbow flow meters in the proximity of other piping components are investigated and a modification of the classical vortex velocity profile analysis for elbow flow meters is presented.

1236. Revner, A.S., "Water Conservation Projects in the Republic of South Africa," Geographical Review, New York, (USA), May 1963, Vol. 62, No. 5, pp. 197-202.

1237. Reynolds, A.J., "Waves on Erodible Bed of Open Channel," Journal of Fluid Mechanics, Vol. 22, Pt. 1, May 1965, pp. 113-133.

Stability of erodible bed of stream with free surface is studied within framework of classical hydraulics, in which velocity variation with depth is reduced to single mean velocity and bed friction is related in general way to local depth and mean velocity; only two dimensional motions can be studied in this way; two dimensional potential flow over wavy stream bed is also examined.

1238. Richardson, E.V., "Sediment Transport in Alluvial Channels, (Examination of Bagnold's 1956 Hypothesis), " M.S. Thesis, Colorado State University, Ft. Collins, Colorado, 1960.

1239. Richardson, E.V., "Resistance to Flow in Alluvial Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 86, No. HY5, Paper No. 2485, May 1960, pp. 73-99.

Paper presents initial results of flume study of alluvial channels; detailed classification of regions of flow, forms of bed roughness, and basic concepts pertaining to resistance to flow; description of experimental equipment and procedure; criteria for washout of dunes and for decrease of resistance to flow, hysteresis observed at changes in dune bed.

1240. Richardson, E.V., Simons, D.B., and Posakony, G.J., "Sonic Depth Sounder for Laboratory and Field Use," United States Geological Survey, Circular No. 450, 1961, 7 pages.

The laboratory investigation of roughness in alluvial channels has led to the development of a special electronic device capable of mapping the stream bed configuration under dynamic conditions. This electronic device employs an ultrasonic pulse-echo principle, similar to that of a fathometer, that utilizes microsecond techniques to give high accuracy in shallow depths.

1241. Richardson, E.V., Simons, D.B., and Haushild, W.L., "Boundary Form and Resistance to Flow in Alluvial Channels," Bulletin de l'Association Internationale d'Hydrologie Scientifique (Louvain), 1962, Vol. 7, No. 1, pp. 48-52.

The form of the boundary in an alluvial channel may be ripples, dunes plane bed, standing waves, antidunes or some combination of these, depending upon the flow, fluid, bed material, and channel characteristics. The changes in boundary form cause correspondingly large changes in resistance to flow and sediment transport.

1242. Richardson, E.V., and Harris, D.D., "A Control Structure for Measuring Water and Sediment," United States Geological Survey Professional Paper 450-D, 1962.

A control structure was designed for the Rio Grande conveyance channel near Bernardo, New Mexico, to stabilize the stage-discharge relation and to facilitate the measurement of the total sediment load. With modification for various site conditions the control should be suitable for installation on other sand-channel streams to improve their water and sediment-discharge records.

1243. Richardson, E.V., and Simons, D.B., "Resistance to Flow in Alluvial Channels," United States Geological Survey, Colorado State University, CER64EVR-DBS8, 1964.

1244. Richardson, E.V., "Resistance to Flow in Sand Channels," Ph.D. Dissertation at Colorado State University, June 1965.

1245. Richardson, E.V., and Simon, D.B., "Resistance to Flow in Sand Channels," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A18, Vol. 1, 1967, pp. 141-150.

1245. Continued

A single unique equation or relation does not exist for prediction of resistance to flow and average velocity of flow in sand channels. The reasons that a single unique relation does not exist are: (1) the configuration of the bed, (2) the properties of the fluid, (3) the drastic changes in turbulence characteristics with changes in flow, fluid, sand and channel geometry. However, if the bed configuration is known, it is possible to estimate flow resistance and average velocity. A relation between stream power and sand size is presented for determining the bed configuration and equations are presented for estimating resistance to flow and average velocity.

1246. Richardson, E.V., and Sayre, W.W., "Macroturbulence and Stochastic Processes in Hydraulics," General Report, Proceeding XII Congress of the International Association for Hydraulic Research, Vol. 5, 1967.

1247. Richardson, E.V., and McQuivey, R.S., "Measurement of Turbulence in Water," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulic Division, Vol. 94, No. HY2, 1968, pp. 411-430.

1248. Robillard, L., and Kennedy, J.F., "Some Experimental Observations on Free Surface Shear Flow Over a Wavy Boundary," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A6, Vol. 1, 1967, pp. 41-48.

Laboratory experiments on supercritical flow over rigid beds of sinusoidal form in a rectangular cross-section channel revealed the existence of oblique, stationary surface waves, one wave emanating from each bed wave. Measurements of velocity distributions traced the origin of these waves to periodic variations in the displacement thickness of the boundary layers of the vertical walls of the test section. Predictions of the inclination of these waves from kinematical considerations are found to be in good agreement with measured values.

1249. Robinson, A.R., and Chamberlain, A.R., "Trapezoidal Flumes for Open Channel Flow Measurement," Transactions of the American Society of Agricultural Engineers, Vol. 3, No. 2, 1960, pp. 120-124, 128.

1250. Robinson, A.R., "Vortex Tube Sand Trap," Transactions of the American Society of Civil Engineers, Vol. 127, 1962, pp. 391-422.

Laboratory studies and field experiences were made with device for removal of large sediments from canals; review of formerly used such devices and tunnel ejectors; author calls new device vortex tube sand trap; test results with various forms and with various flow and sediment conditions; design requirements and design calculations are given.

1251. Robinson, A.R., "Water Measurement in Small Irrigation Channels Using Trapezoidal Flumes," Transactions of the American Society of Agricultural Engineers, Vol. 9, No. 3, 1966, pp. 382-385, 388.

Results of research on small trapezoidal flumes are presented; it is shown how flumes can be constructed of metal, precast using plastic or cement, or poured and formed in place as integral parts of lined channel.

1252. Robinson, E.P., "Watertight Seal for Flow Control Structures," Annual Bulletin of the International Commission on Irrigation and Drainage, 1962, pp. 64-70.

Describes the design and fitting of synthetic rubber strips which enable a completely watertight seal to be obtained with gates in channel outlets and in other water control concrete structures.

1253. Robinson, E.P., "Irrigation Channel Structures - The Problem of Leakage," Aqua, July 1962.

1254. Robinson, F.E., et al., "Sprinkler and Surface Irrigation of Vegetable and Field Crops in an Arid Environment, Agronomy Journal (USA),. Nov.-Dec. 1968, Vol. 60, No. 6, pp. 696-700.

Four experiments were conducted in the Imperial Valley of California to investigate the effects of sprinkler irrigation on a number of different crops, and to obtain comparision of emergence, growth, and soil characteristics under surface and sprinkler irrigation.

1255. Rochester, E.W., and Kriz, G.J., "Model Study of Boundary Effects on Ditch Drainage," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 94, No. IR4, Proc. Paper 6313, Dec. 1968, pp. 493-504.

A Hele-Shaw model was used to evaluate the influence of the depth to an

impermeable layer on transient subsurface drainage into equally spaced open drains. The results indicate that a horizontal impermeable layer affects drainage significantly only if the layer is closer to the ditch bottom than one-twelfth the ditch spacing. The initial depth of water above the ditch bottom does not affect this criteria.

1256. Rogers, E.M., and Pitzer, R.L., "The Adoption of Irrigation by Ohio Farmers," Ohio Agricultural Experiment Station, Research Bulletin, 851, June 1960, 46 pages.

1257. Rolleston, F., "The Advantages of Spray Irrigation," Cane Grower's Quarterly Bulletin, Vol. 25, No. 1, July 1, 1961, pp. 7-10.

1258. Rollins, M.B., and Dylla, A.S., "Field Experiments on Sealing Permeable Fine Sand with Bentonite," Proceedings of the Soil Science Society of America, Ann Arbor, Mar. Apr. 1964, Vol. 28, No. 2, pp. 268-271.

1259. Rollins, M.B., "Sealing Sands with Waterborne Bentonite, "Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR4, Proc. Paper 5640, Dec. 1967, pp. 25-44.

A model, designed to resemble field conditions as nearly as possible, was used to study the sealing of sand with waterbourne bentonite. Four sizes of sand were sealed with a Wyoming bentonite using suspensions having 0.1 to 6% concentration. Time of sealing varied directly with the sand particle size. Drying damaged the original seal but a second sealing treatment proved very effective. Estimated cost figures showed this method of sealing to be feasible if proper bentonite concentrations are used and if the bentonite source is within an economical shipping distance of the sealing site.

1260. Rossinskiy, K.I., "Specific Discharge of Entrained Sediments," Soviet Hydrology: Selected Papers 1967, No. 2, pp. 152-158.

A formula is proposed for computing the discharge of bed load sediments under the influence of velocity pulsations. Discharge is a function of compactness of particle motion, defined as the ratio of instantaneous volume of moving particles to total volume of the layer in which motion occurs.

1261. Rottner, J., "Formula for Bed Load Transportation," La Houille Blanche, Vol. 14, No. 3, May-June 1959, pp. 301-307.

New bed load formula for natural waterways, based on previous laboratory flume tests, and giving bed load discharges as function of flow parameters; variation of mean velocity of flow of water accompanying bed load transportation is examined and results graphed on chart; using this chart, solid flow and mean water velocity can be found from slope, flow depth and grain size.

1262. Rouse, H., "Critical Analysis of Open-Channel Resistance," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91, No. HY4, Pt. 1, Paper 4387, July 1965, pp. 1-25.

General resistance function is examined under effects of viscosity, roughness, and shape of cross section, effects of boundary nonuniformity, and effects of unsteadiness, particularly free-surface instability; special attention is given to integration of logarithmic velocity law, variation of roughness form and concentration, channel choking in critical region, and resistance augmentation by both standing and traveling waves.

1263. Rozovskii, I.L., "Flow of Water in Bends of Open Channels," Translated from Russian by the Israel Program for Scientific Translations, 1961, 233 pages.

Theoretical and laboratory investigation of flow dynamics in channel bends.

1264. Ruhela, J.S., "Two Dimensional Flows in Rivers," Indian Journal of Power and River Valley Development, Vol. 16, No. 1, Jan. 1966, pp. 30-32,39.

Methods and formulas for calculation of regimes of flow in rivers as affected by construction of new structure on river, such as bridge, weir, dam or revetment; uniform flow, accelerated flow, variation of discharge in rising and falling stages, back water curve, and flow at bends are dealt with.

1265. Russell, J.A., "Overhead Irrigation Layout at Lihue and Its Effect on All Field Operations," 22nd Annual Conference, Hawaii, Sugar Technologist Report, 1964, pp. 1-4.

1266. Sadiq, M.M., "Sampling and Analysis Technique of Suspended Sediment," Symposium on Sedimentation Problems as a Result of Indus Basin Works, West Pakistan Engineering Congress, Lahore, Apr. 1962, Vol. VI, No. 47.

1267. Saha, H.L., "Soil Studies in Designing the Irrigation Canals with Special Reference to the Mayurakshi Canals," Indian National Society of Soil Mechanics and Foundation Engineering, Central Board of Irrigation and Power, No. 6, Jan. 1960, pp. 9-19.

1268. Sakkas, J.G., and Hart, W.E., "Irrigation with Cut-Back Furrow Streams," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 94, No. IR1, Paper No. 5852, Mar. 1968, 91 pages.

1269. Sakurai, S., et al., "Efficiency of Sprinkler Irrigation at the Sloping Field," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 25, 1960, pp. 12.449-12.461.

Presents the results of a study on measurement method of allowable sprinkling intensity, irrigation efficiency, length of lateral in a sloping field.

1270. Sandover, J.A., and Holmes, P., "Hydraulic Jump in Trapezoidal Channels," Water Power, Nov. 1962, Vol. 14, No. 11, pp. 445-449.

Experiments were carried out in 60-ft. open channel and results compared with theoretical analyses; there appears to be little agreement between theory and practice; experiments will have to be extended and effort to solve conjugate-depth problem will have to be made on similar lines to those employed by Flores.

1271. Sanford, H., "Linings for Irrigation Canals," Indian Journal of Power and River Valley Development, Vol. 10, No. 12, Dec. 1960, pp. 145-148.

Make comments on different types of linings from the operation and maintenance point of view, bringing out problems that have been encountered and questions that remain to be answered.

1272. Santini, C., "Agricultural Mechanization; Irrigation by Canals and Sprinklers," United Nations Economic Commission for Europe, Palais des Nations, Geneve, Committee on Agruicultural Problems, Agri., Mech., 21, 1962, pp. 59.

1273. Sardar, A.B., "Irrigation Practices," Engineering News, Lahore, West Pakistan, Mar. 1963, Vol. 8, No. 1, pp. 39-40.

Dwells upon the functions of outlets, watercourses and the canal revenue system.

1274. Sarkar, S.N., "Representation of Soil Grains and Their Size Analysis Results," Indian Journal of Power and River Valley Development, Vol. VIII, No. 4, Apr. 1958, pp. 21-23.

1275. Sarkar, S.N., "A Modified Bottle Sampler and Its Comparative Study with an Ordinary Bottle Sampler," Irrigation and Power (New Delhi), 1959, Vol. 16, No. 3, pp. 348-355.

An improved type of bottle sampler was tested in comparison with the ordinary bottle sampler. The new type has an air exhaust separate from the water intake, and pressure equalization inside and outside the container.

1276. Sarma, K.V.N., "Simple Empirical Formula for Scour Under Vertical Jets," Irrigation and Power, Vol. 22, No. 1, Jan. 1965, pp. 27-33.

Simple formula was developed for scour phenomenon under vertical jets of clear water in which scour is proportional to logarithm of time.

1277. Sayre, W.W., and Hubbell, D.W., "Transport and Dispersion of Labeled Bed Material; North Loup River, Nebraska," United States Geological Survey, Professional Paper No. 433-C, 1965, 48 pages.

Sand particles labeled with radioactive nuclide were released on river bed; as tracer particles moved and dispersed downstream with natural bed-material load, their distribution along the channel was determined with radiation-detective equipment; derivation of theoretical concentration-distribution function is based on probability theory.

1278. Sayre, W.W., and Conover, W.J., "General Two-Dimensional Stochastic Model for the Transport of Bed Material Sediment Particles," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Vol. 2, No. 810, 1967, pp. 88-95.

1279. Sbraccia, A., "Concrete Canal Units for Irrigation Structures," Journal of the Prestressed Concrete Institute, Vol. 8, No. 5, Oct. 1963, pp. 38-41.

Standard series of precast prestressed concrete units being used for Italian irrigation projects described; design of canal units and method of fabrication explained.

1280. Schade, R.O., "Return-Flow Systems Aid Irrigation," California Citrograph, Los Angeles (USA), Jan. 1963, Vol. 48, No. 3, pp. 92-94.

1281. Schiller, R.E., "A Study of Sand Transport in the Indus Basin Canals," Ph.D. Dissertation, Colorado State University, Ft. Collins, Colorado, CED68-69VRS16, 1958.

1282. Schlee, J., and Webster, J., "A Computer Program for Grain-Size Data," Sedimentology (Amsterdam), 1967, Vol. 8, No. 1, pp. 45-53.

Statistical summation of data from grain-size analysis is used for the numerical description of sediment and its parameters, permitting conclusions on the origin of sediments. The main objective of the present paper has been to describe a computer program which approximates a continuous distribution and yields sediment parameters by the method of moments.

1283. Schleusener, P.E., and Kruse, E.G., "Empirical Formula for Computing Water Needs of Row Crops," Transactions of the American Society of Agricultural Engineers, Vol. 6, No. 2, 1963, pp. 140-141, 144.

Equation was developed for computing daily evapotranspiration rates of row crop on field basis and tested with hydrologic data obtained from irrigated fields in western Nebraska; equation was then used to determine number of irrigations and amount of irrigation water required for corn on sandy loam soil with low water-holding capacity.

1284. Schleusener, P.E., "USAD's Help with Irrigation Research in the States," Sprinkler Irrigation Association, California, Proceedings of the Open Technological Conference, 1964, pp. 7-14.

Includes a brief outline of the activities of USDA's Cooperative State REsearch Service as they relate to research in the States and extent of irrigation research of the State Agricultural Experiments Station.

1285. Schmer, F., "Operating and Maintaining Irrigation Wells," South Dakota State College Agricultural Extension F.S., Apr. 1964, pp. 5.

1286. Schmidt, B.L., Shrader, W.D., and Moldenhauer, W.C., "Relative Erodibility of Three Loess-Derived Soils in Southwestern Iowa," Proceedings of the Soil Science Society of America, 1964, Vol. 28, No. 4, pp. 570-574.

Measurements of original and present surface soil depth, as indicated by slope and erosion field data and organic carbon contents, were used to determine the relative erodibility of the loess-derived Monona, Marshall, and Sharpsburg soils in Southwestern Iowa.

1287. Schneider, V.R., "Mechanics of Local Scour," Ph.D. Dissertation, CED68-69VRS16, Fort Collins, Colorado, Colorado State University, 1968.

1288. Schraufnagel, F.H., "Ridge-and-Furrow Irrigation for Industrial Waste Disposal," Journal of the Water Pollution Control Federation, Washington (USA), Nov. 1962, Vol. 34, No. 11, pp. 1117-1132.

1289. Schroeder, K.B., and Hembree, C.H., "Application of the Modified Einstein Procedure for Computation of Total Sediment Load," Transactions of the American Geophysical Union, Vol. 37, No. 2, Apr. 1956.

1290. Schultz, H.B., "Ground Sprinkler Limitations for Frost Protection in Deciduous Orchards," California Agriculture, University of California, Division of Agricultural Science, Berkeley 4, California (USA), Apr. 1964, Vol. 18, No. 4, pp. 14-15.

Reports experiments carried out which show that under-tree sprinkling for frost protection in deciduous orchards involves a great amount of risk with only partial protection possible as compared with no risk involved in the overhead sprinkling method, under practically all California spring frost weather conditions.

1291. Schulze, F.E., "Uniformity of Water Distribution and Lateral Spacing in Sprinkler Irrigation," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 3, 1963, pp. 15.473-15.486.

Response curve of crop to irrigation being usually in nature of declining additional yield is studied; it is shown that in sprinkler irrigation it is possible to obtain more uniform distribution of water by reducing spacing of laterals, but this is accompanied by increase in labor required per unit of area; attempt is made to elaborate this line of thought quantitatively according to theoretical principles.

1292. Schumn, S.A.,"The Shape of Alluvial Channels in Relation to Sediment Type," United States Geological Survey, Professional Paper 352-B, Washington, D.C., 1960, pp. 30.

The percent silt-clay of alluvial stream channels is used as a descriptive parameter of channel material. As the percentage of silt-clay changes, the shape of the channel varies. Changes in width, depth, and width-depth ratio along the Smoky-Hill-Kansas River system is used as an example of the importance of sediment type to stream regimen. In general, aggrading channels have a higher width-depth ratio than indicated by the silt-clay percent, and degrading channels have a lower width-depth ratio.

1293. Schumn, S.A., "The Effect of Sediment Characteristics on Erosion and Deposition in Ephemeral Stream Channels," United States Geological Survey, Profession Paper 352-C, Washington, D.C., 1961, pp. 70.

Study of five semi-arid valleys with changing percent silt-clay emphasizes the importance of sediment type in determining channel shape and differences in the mechanics of erosion and deposition. The shape of stable cross sections is dependent on percent silt-clay such that width-depth ratio increases with decreased silt-clay. It is suggested that the relation between channel shape and silt-clay can be used as a criterion of channel stability. The study suggests that preventive conservation may be the most practical solution to some erosion problems, and that only certain critical reaches of a channel need be controlled to prevent erosion over large areas.

1294. Schumn, S.A., "Dimensions of Some Stable Alluvial Channel," United States Geological Survey, Professional Paper 424-B, 1962, pp. B26-B27.

1295. Schumn, S.A., "A Tentative Classification of Alluvial River Channels," United States Geological Survey, Circular No. 477, 1963,

1296. Schumn, S.A., "River Metamorphosis," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulic Division, Vol. 95, No. HYl, Jan. 1969, Paper No. 6352, pp. 255-273.

Data collected from stable alluvial rivers are used to demonstrate the channel width, depth, shape, meander wavelength, sinuosity, and gradient are significantly relative to quantity of water and to the type of sediment load. Metamorphosis can take place by change in the pressure. Geologic and historic examples are used to support the empirical relations for deductions of long range changes.

1297. Schwab, G.O., Fouss, J.L., and Leech, A.P., "Rate, Duration and Frequency of the Flow," Agricultural Engineering, Vol. 42, No. 10, Oct. 1961, pp. 546-549, 555.

1298. Schwab, G.O., "Spacing Tile Drains," Ohio Farm and Home Research, Wooster (USA), Jan.-Feb. 1964, Vol. 49, No. 1, pp. 6-7, 11.

1299. Schwab, G.O., et al., "Crop Response from Tile and Surface Drainage," Proceedings of the Soil Science Society of America, Vol. 30, No. 5, Sep. -Oct. 1966, pp. 634-637.

Effects of various drainage systems and different levels of treatments on corn yields were evaluated for fine-textured lakebed soil during period of 3 years; drainage treatments consisted of undrained plots, surface drained, tile drained, and surface and tile drained combinations; excess wetness was provided each year.

1300. Schwalen, H.C., and Frost, K.R., "Sprinkler Irrigation," Bulletin, Arizonia University, Agricultural Extension and Service, Tucson, Jan. 1963, No. A-24, 39 pages.

1301. Scott, D.F., and Mayo, K.L., "Farm Drainage," Bulletin, New Zealand Department of Agriculture, Wellington, New Zealand, 1962, Bulletin No. 286, 48 pages.

1302. Scott, V.H., "Prefabricated Linings for Irrigation Ditches," Agricultural Eningeering, Vol. 37, No. 2, Feb. 1956, pp. 113-116.

Results of two years testing and experimentation on various types of prefabricated linings for small irrigation on installation, performance, maintenance and vegetative growth control for both buried and surface linings.

1303. Seetharamiah, K., and Rama Murthy, A.S., "Hydraulic Jump Stabilization," Institution of Engineers (India), Vol. 42, No. 7, Pt. CI4, Mar. 1962, pp. 306-318.

Investigations conducted to determine extent to which jump stabilization can be effected by use of friction blocks; data presented in dimensionless form serve as guide to feasibility of using blocks as stabilizing accessories in basin.

1304. Seginer, I., "Water Distribution for Medium Pressure Sprinklers," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 89, No. IR2, Pt. 1, Paper 3545, June 1963, pp. 13-29.

Experiments enabling quantitative analysis of effect of various factors on interrelationships between sprinkler drop size distribution, drop velocity, and distribution pattern of water on ground, indicate that operating pressure is most important factor; higher pressures yield longer ranges, finer drops and more even distribution; advantages of single nozzle may be realized by having it act alternately as range-nozzle and distribution nozzle through insertion and extraction of pin from jet.

1305. Seginer, I., "Gully Development and Sediment Yield," Journal of Hydrology (Amsterdam), 1966, No. 4, pp. 236-253.

The purpose of the paper has been to study the rate of gully erosion and ensuing sediment transport in order to determine the economic aspects of soil-conservation methods intended to eliminate the damages of gully erosion.

1306. Selim, M.A., and Nicola, F., "Sprinkler Irrigation and Comparison with Other Methods in Egypt," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 10, 1960, pp. 12.167-12.186.

Describes the semi-portable sprinkler system introduced in Liberation Province of United Arab Republic. Make economic studies with other methods of irrigation used in the areas.

1307. Sell, W.J., "Sprinklers Pipes and Hoses," Australasian Irrigator and Pasture Improver, Sydney, Australia, Sep. 1964, Vol. 9, No. 10, pp. 11-12.

Discusses disadvantages of sprinklers; describes very briefly trickle system of irrigation wherein aluminun pipes and plastic hoses are used.

1308. Senturk, F., "Graphical Method for the Prediction of Riverbed Changes Due to Change of the Regime," Proceedings of the 11th General Meeting of the International Association for Hydraulic Research, Vol. 3, No. 20, 1965, pp. 1-17.

1309. Senturk, F., "Bed Resistance Due to Sand Roughness and Wave Roughness of Stream," Symposium on Hydrology and Water Resources Development, Feb. 7-12, 1966, pp. 157-172.

The behavior of sediment particles moving in a streamflow is investigated and bed resistance is established.

1310. Sesha Pillai, C.R., "Composite Rugosity Coefficient in Open Channel Flow," Irrigation and Power, Vol. 19, No. 3, Mar. 1962, pp. 174-187.

States 3 solutions available for finding combined rugosity coefficient; Horton's equation is most suitable; assumption underlying Horton's approach agreed very closely with observed results; combined rugosity coefficient depends on not only lengths and rugosity coefficients of component parts of wetted border but also on angle which sides make with horizontal.

1311. Sethna, T.R., "Uniform Flow of Water in Alluvial Channels," Proceedings of the Institution of Civil Engineers, Great George Street, Westminster, London, Jan. 1962, Vol. 21, pp. 115-138.

Analysis has shown that flow of water in alluvial channels is of 2 types - where bed material is not in movement and where bed material is in movement; discussion of friction conditions based on Chezy and Froude formulas; new formula for silt transportation is derived.

1312. Shachori, A., and Seginer, I., "Sprinkling Assembly for Simulation of Design Storms as a Means for Erosion and Runoff Studies," Bulletin de l"Association Internationale d'Hydrologie Scientifique (Louvain), 1962, Vol. 7, No. 4, pp. 57-72.

Various patterns of sprinkling assemblies simulating natural design storms in the field are described. The simulated rain is applied with the aid of overlapping patterns of two-arm rotating sprinklers positioned 2 m. above the ground.

1313. Shafei, A., "Problems of Irrigation in Arid Zones," Bulletin of the Egyptian Geographical Society, Vol. 32, 1959, pp. 143-163.

1314. Shah, C.H., Shukla, T., and Meti, T.K., "Problems of Irrigation," Indian Journal of Agricultural Economics, Vol. 16, No. 4, Oct.-Dec. 1961, pp. 23-47.

1315. Shakir, B.A., "Design of Canal Falls," Golden Jubilee Publication, West Pakistan Engineering Congress, Oct. 1963, Part II, pp. 49-84.

1316. Sharma, H.D., "Hydraulic Jump in Design of Barrages," Indian Journal of Power and River Valley Development, Vol. VIII, No. 4, Apr. 1958, pp. 13-15, 12.

1317. Sharp, B.B., "Flow Measurement with a Suspension Wire," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 90, No. HY2, Proc. Paper 3821, Mar. 1964, pp. 37-53.

A flow measuring device based on the drag developed on a wire suspend transverse to the flow of water has been developed. The wire is suspended between a fixed support and an elastic support, with the wire deflection registered by a semi-conductor strain gage incorporated at the elastic end. The gage formed part of a Wheatstone bridge circuit with a sensitive galvanometer and d-c amplifier recorder. A probe with a wire length of the order of 1 in. extended the work for open-channel flows. Velocity distributions have been determined within a wire diameter of the channel floor.

1318. Shaumyan, V.A., "Soviet Experience in Sprinkling," International Commission on Irrigation and Drainage, Annual Bulletin, 1957, pp. 70-72,59.

1319. Shearer, M.N., "Ways of Evaluating Your Sprinkler System," Oregon State Horticultural Society, Annual Report No. 53, 1961, pp. 151-153.

1320. Shearer, M.N., and Humphrys, C.R., "Stretching Water for Irrigation," Michigan State University Extension Folder, F310, Jan. 1962, 10 pages.

1321. Shen, H.W., "A Study on Meandering and Other Bed Patterns in Straight Alluvial Channels," California University, Water Resources Center, Contract No. 33, 1960, 68 pages.

The purpose of this dissertation is to investigate the meandering and other bed patterns in straight alluvial channels with unerodible banks.

1322. Shen, H.W., and Horikawa, K., "Sand Movement by Wind Action," United States Beach Erosion Board Technical Memorandum No. 119, Aug. 1960, 51 pages.

The movement of sand by wind action along the coast has long been a problem of importance to the coastal engineer engaged in the design and maintenance of shore protection works. In this report the main effort is devoted to the study of available sand traps and to development of a suitable type if needed.

1323. Shen, H.W., "Development of Bed Roughness in Alluvial Channels," Proceedings of the American Society of Civil Engineers, Vol. 88, No. HY3, Paper 3113, May 1962, pp. 45-58.

Experimental data collected at many research laboratories are analyzed together with some river data; it is found that with uniform size materials, variation of resistance due to sediment bed irregularities is function of both sediment transport rate and Reynold's number based on fall velocity of sediment particle.

1324. Shen, H.W., and Einstein, H.A., "A Study on Meandering in Straight Alluvial Channels," Journal of the American Geophysical Union, Dec. 1964.

1325. Shen, H.W., Ogawa, Y., and Karaki, S., "Time Variation of Bed Deformation Near Bridge Piers," Proceedings 11th Congress of International Association for Hydraulic Research, Leningrad, (USSR), 1965, Vol. 3, No. 3.14, pp. 9.

Time variation of scour depth at a circular pier is described in the paper. Adequate design of bridge pier foundation requires proper assessment of this phenomena. Experiments indicated that Froude number was the most important factor in determining scour depth. With known or assumed values of velocity and flow depth, scour depth can be determined for any time.

1326. Shen, H.W., Schneider, V.R., and Karaki, S., "Mechanics of Local Scour," Engineering Research Center, Colorado State University Report No. CER66HWS22, 1966, Vol. I-II-III.

The purpose of this research is to study the basic mechanism of local scour, i.e., scour due to the pier alone. It has been shown that the mechanism of scour at a blunt nosed pier is the strong horseshoe vortex system upstream of a blunt nosed pier. The mechanism which forms the horseshoe vortex is the pressure field induced by the pier. The analysis shows that the strength of the vortex initially is a function of the pier Reynolds number. This study has demonstrated the existence of a basic function between scour depth and the pier Reynolds number.

1327. Shen, H.W., Schneider, V.R., and Karaki, S., "Mechanics of Local Scour Supplement: Methods of Reducing Scour," Engineering Research Center, Colorado State University Report No: CER66HWS36, June 1966.

The purpose of this report is to summarize the results of tests conducted at Colorado State University on the hydraulic feasibility of reducing scour by modifying pier shapes. The various models were investigated. Although limited and qualitative in nature, experimental results definitely demonstrate the feasibility of using certain pier configurations to reduce the depth of scour to a significant amount. An analytical study is presented which shows that maximum scour is a function of the Reynolds number based on the projected width of the pier and approach velocity.

1328. Shen, H.W., Roper, A.T., Schneider, V.R., "Analytical Approach to Local Scour," Proceedings of the 12th International Association of Hydraulic Research Congress, Fort Collins, Colorado, 1967, Vol. 3, Paper No. 18, pp. 151-162.

The local scour phenomena is described in terms of the large-scale eddy structure near the pier. The horseshoe vortex system which occurs at the upstream side of blunt-nosed piers is analyzed for subcritical flow conditions.

1329. Shen, H.W., and Schneider, V.R., "Strength and Transport Capacity of Horseshoe Vortex System Upstream from Bridge Piers," CER68-69HWS-VRS24, 1968.

1330. Shen, H.W., and Komura, S., "Meandering Tendencies in Straight Alluvial Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 94, No. HY4, Paper No. 6042, July 1968, pp. 997.

1331. Shen, H.W., Schneider, V.R., and Karaki, S., "Local Scour Around Bridge Piers," To be published in the Journal of the Hydraulic Division, American Society of Civil Engineers, Nov. 1969.

This paper considers local scour at bridge piers caused by the horseshoe vortex system which forms at the base of the piers. Piers which induce a pressure field strong enough to cause the formation of the horseshoe vortex system are termed "blunt nosed"; all others being classed as sharp nosed piers.

1332. Sheppard, J.R., "Methods and Their Suitability for Determining Total Sediment Quantities," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 32, pp. 272-287.

The methods of determining total sediment quantities and a discussion of the suitability of each include: (1) the use of yield rates, (2) the use of suspended sediment sampling data with estimated bedload, (3) suspended data with bedload equations, (4) suspended data with the Modified Einstein procedure, and (5) suspended data with Colby curves of unmeasured load and velocity.

1333. Shih, C., and Grigg, N.S., "A Reconsideration of the Hydraulics Radius as a Geometric Quantity in Open Channel Hydraulics," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A36, Vol. 1, 1967, pp. 288.

This study is concerned with the validity of applying the hydraulic radius as a sole geometric quantity for various channel shapes in the computation of turbulent uniform flow. Results of the study show that for a given hydraulic radius, channel slope, and roughness, the increase in mean velocity of turbulent flow or the decrease in flow resistance is attributed to the lowering aspect ratio. This trend toward less flow resistance appears to be more evident for the mild slope than the steep. The application of the hydraulic radius in the uniform flow analysis is valid within the limit of engineering accuracy if the aspect ratio is high, say greater than about two; the use of the hydraulic radius should be coupled with the consideration of the effect of channel shape if the aspect ratio is less than about two.

1334. Shockley, D.G., "Evaluating Furrow and Corrugation Irrigation," Journal of the Irrigation and Drainage Division, Proceedings of American Society of Civil Engineers, Vol. 85, No. IR4, Dec. 1959, Paper 2284.

There are now nearly 37 million acres of irrigated land in the United States. The greatest single use of fresh water in our country is for irrigation. Increases are expected to meet the food, feed, and fiber requirements of expanding population. The conservation use of our irrigation water supplies, therefore, is imperative.

1335. Sockley, D.G., "Present Procedures and Major Problems in Border Irrigation Design," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 1-6.

1336. Shockley, D.G., Woodward, H.J., and Phelan, J.T., "Quasi-Rational Method of Border Irrigation Design," Transactions of the American Society of Agricultural Engineers, Vol. 7, No. 4, 1964, pp. 420-423, 426.

Procedure for design of graded type border irrigation is proposed; empirical limits of site adaptation and guide information on efficiency levels are presented; examples of layouts are shown for proposed procedure.

1337. Shull, H., "Furrow Hydraulics Study at the Southwestern Irrigation Field Station," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 55-62.

1338. Shull, H., "Hydraulic Characteristics of Glass-Fiber Filter Materials," Transactions of the American Society of Agricultural Engineers, Madison, Wisconsin (USA), 1964, Vol. 7, No. 2, pp. 120-122.

Describes results of tests conducted to determine hydraulic characteristics of glass-fiber mat materials from drainage filter standpoint.

1339. Shull, H., "An Inflow-Advance-Storage Method for Determining Infiltration in Irrigated Furrows," Soil Science, Baltimore 2, Maryland (USA), Sep. 1964, Vol. 98, No. 3, pp. 192-196.

1340. Siddiqui, F.A., "Sediment Control with Reference to Intake Channel for Ganges, Kobadak Pumping Station, Bhermana," Paper presented to the Water Resources Conference, Dacca, Institution of Engineers, Oct. 1961.

1341. Sijbesma, R.P., and Vries, M., "Computations of Boundary Condition of a River Model with Movable Bed," Proceedings of the 9th General Meeting of the International Association for Hydraulic Research, Paper III, No. 27, 1961, pp. 870-875.

1342. Silvester, R., "Specific-Energy and Force Equations in Open-Channel Flow," Water Power, Vol. 13, Mar. 1961, pp. 99-103.

1343. Silvester, R., "Hydraulic Jump in all Shapes of Horizontal Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 90, No. HY1, Pt. 1, Paper 3754, Jan. 1964, pp. 23-55.

Simple analytical solution of ratios of conjugate depth and energy loss in terms of upstream Froude number for hydraulic jump in horizontal rectangular, triangular, parabolic, circular and trapezoidal channels; semiempirical solution is provided for jump length in same sections; comparison of prototype jumps with model reproduction is necessary to determine effect of vorticity, turbulence and aeration on characteristics.

1344. Simmons, W.P., "Hydraulic Design of Transitions for Small Canals," United States Bureau of Reclamation, Engineering Monograph No. 33, Apr. 1964, 39 pages.

United States Bureau of Reclamation's first progress report on methods used and results obtained in determining energy losses and flow characteristics of transitions for moderate and small size canals; transitions are used to connect pipe lines to canals and canals to pipe lines; testing techniques and conclusions reached in evaluating variables affecting erosion, or scour, in canals adjacent to transitions are also described.

1345. Simmons, W.P., "Transitions for Canal and Culverts," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 90, No. HY3, Pt. 1, Paper 3918, May 1964, pp. 115-153.

Results of large scale model studies of variations in open-type and closed-conduit-type inlet and outlet transitions for small canals and culverts; resonable changes in slope of inverts, slope of pipe lines, or changes in divergence of sidewall have little effect on losses or scour; scour in earth canals is less with closed conduit transition than with conventional open ones.

1346. Simons, D.B., "Theory and Design of Stable Channels in Alluvial Channels," Colorado State University, Department of Civil Engineering, Ph.D. Dissertation, 1957.

1347. Simons, D.B., Richardson, E.V., and Albertson, M.L., "Flume Studies Using Medium Sand (0.45 mm)," United States Geological Survey, Water-Supply Paper 1498-A, 1961, 76 pages.

1347. Continued

Results of study of fluvial hydraulics, specifically roughness in alluvial channels; data were collected by using recirculating rectangular flume of adjustable slope, 8 ft. wide, 2 ft. deep, and 150 ft. long with alluvial bed or sand approximately 0.7 ft. deep; 45 runs have been completed over range of bed roughness forms extending from plane bed with no movement to antidunes.

1348. Simons, D.B., Haushild, W.L., and Richardson, E.V., "The Significance of the Fall Velocity and Effective Fall Diameter of Bed Materials," United States Geological Survey Professional Paper 424-D, Art 300, 1961.

Particle-size distribution of bed materials based upon the fall velocity of the particles will vary with the characteristics of fluid. The distribution in distilled water is in terms of fall velocity; fall diameters obtained directly from the standard fall velocity; fall diameter and standard fall velocity are defined in a report of United States Inter-Agency Committee on Water Resources (1957).

1349. Simons, D.B., and Richardson, E.V., "Forms of Bed Roughness in Alluvial Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 87, No. HY3, Pt. 1, Paper 2816, May 1961, pp. 87-105.

Field studies and laboratory experiments in large recirculating flume have established that resistance to flow and sediment transport in alluvial channels are related to form of bed roughness; form of roughness can be divided into lower and upper regimes of flow on basis of their shape, resistance to flow and sediment transport.

1350. Simons, D.B., Richardson, E.V., and Haushild, W.L., "Some Properties of Clay-Water Dispersions and Their Effects on Flow," Geological Survey, United States Department of the Interior, CER61DBS50, Colorado State University, Fort Collins, Colorado, Aug. 1961.

Fine material (bentonite and kaolin clays) dispersed in water affect the viscosity and specific weight of the fluid. Flume experiments demonstrated that when changes in fall velocity, caused by the changes in fluid properties, occurred the form of bed roughness was altered. Resistance to flow and sediment transport, because they are dependent on the form of bed roughness, were appreciably affected.

1351. Simons, D.B., Richardson, E.V., "Effect of Bed Roughness on Depth-Discharge Relations in Alluvial Channels," United States Geological Survey, Water Supply Paper 1498-E, 1962, 26 pages.

Alluvial channel stage-discharge and depth-discharge relations were studied in large sand bed recirculating flume; from this study, it was found that form of these relations are intimately related to-regime of flow, form of bed roughness which included characteristics of bed material, concentration of fine sediment, temperature and rate of change of discharge with time.

1352. Simons, D.B., Richardson, E.V., and Haushild, W.L., "Depth-Discharge Relation in Alluvial Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Sep. 1962, Vol. 88, No. HY5, Pt. 1, Paper 3263, pp. 57-72.

Studies regimes of flow and forms of bed roughness in laboratory alluvial channel and field streams; examines significant changes that occur in depth discharge relations as the result of changes in bed roughness.

1353. Simons, D.B., Richardson, E.V., and Haushild, W.L., "Some Effects of Fine Sediment on Flow Phenomena," United States Geological Survey, Water Supply Paper 1498-G, 1963, 46 pages.

Effect of fine material on fall velocity of bed material can be determined, as first approximation, with visual accumulation tube by using aqueous dispersions of clay as sedimentation liquid; experiments conducted in flumes at Colorado State University demonstrated that when changes in fall velocity caused by changes in fluid properties occurred, form of bed roughness was altered.

1354. Simons, D.B., and Richardson, E.V., "A Study of Variables Affecting Flow Characteristics and Sediment Transport in Alluvial Channels," Proceedings of the Federal Inter-Agency Sedimentation Conference, Miscellaneous Publication No. 970, Agricultural Research Service, United States Department of Agriculture, 1963, Paper No. 27, pp. 193-207.

The United States Geologic Survey has been studying sediment transport and resistance to flow at Colorado State University, Fort Collins, since 1956. The study has largely been done in laboratory flumes with only limited collection of field data.

1355. Simons, D.B., and Albertson, M.L., "Uniform Water Conveyance Channels in Alluvial Material," Transactions of the American Society of Civil Engineers, Vol. 128, 1963.

Methods of designing uniform alluvial channels are developed and illustrated. Design theories which are recommended include; (1) a modification of the regime theory, and (2) a modification of the tractive force theory. Special emphasis is given to the modified regime theory. The results of this investigation are based on a field study of stable alluvial irrigation channels and other existing alluvial channel data which are applicable.

1356. Simons, D.B., "Report on Stable Channels," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 90, No. IR4, Dec. 1964.

1357. Simons, D.B., "Channel Stabilization of Alluvial Rivers," Proceedings of the American Society of Civil Engineers, Journal of Waterways and Harbors Division, WW1, Feb. 1965.

1358. Simons, D.B., Richardson, E.V., and Nordin, C.F., "Bedload Equation for Ripples and Dunes," United States Geological Survey, Professional Paper 462-H, 1965, 9 pages.

Simple bedload transport equation based on mean forward velocity and mean height of ripples and dunes is applied to 101 observations from flume studies by using recirculating flume and four different sands; where average dune velocities and heights are determined accurately with sonic equipment, and where suspension of bed material is negligible, computed and observed transport rates of bed material agree reasonably well; general guidelines for adapting procedure to field application.

1359. Simons, D.B., Richardson, E.W., and Nordin, C.F., "Unsteady Movement of Ripples and Dunes Related to Bed-Load Transport," 11th Congress of the International Association for Hydraulic Research, Vol. 3, Paper 3.29, 1965, pp. 9.

Methods for computing bed-load transport from dune movement are considered; equation based on mean forward velocity and mean height of ripples and dunes is applied to flume data, and yields satisfactory results where average dune shapes, velocities and heights can be determined accurately.

1360. Simons, D.B., and Miller, C.R., "Sediment Discharge in Irrigation Canals," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, No. 20, 1966, pp. 20.75-20.82.

1361. Simons, D.B., and Richardson, E.V., "Resistance to Flow in Alluvial Channels," United States Geological Survey, Professional Paper 422-J, 1966, 61 pages.

Relation between stream power, median diameter of bed material, and bed configuration was developed, from field and laboratory data, for estimating bed configuration.

1362. Simpson, E.S., "Transverse Dispersion in Liquid Flow Through Porous Media," Professional Paper, United States Geological Survey, 1962, No. 411-C, 29 pages.

1363. Singer, J., "Square-Edges Broad-Crested Weir as a Flow Measurement Device," Water and Water Engineering, London, England, June 1964, Vol. 68, No. 820, pp. 229-235.

Presents a new analysis of the coefficient data for broad-crested weirs, supported by experimental results.

1364. Singh, B., "Bed Load Transport in Channels," Irrigation and Power (New Delhi), 1961, Vol. 18, No. 2, pp. 110-126, No. 5, pp. 411-430.

The development of ripple patterns in a channel bed is described and the influence of velocity and depth discussed. It is shown that neither the ripple configuration nor the roughness of movable-bed channels are in accordance with the existing theory of Einstein. A new empirical correlation for determining Chezy's 'C' for channels with sand beds.

1365. Singh, B., and Agrawal, S.R., "Utilization of Drag for Velocity Measurements in Channels," Irrigation and Power, Vol. 22, No. 1, Jan. 1965, pp. 9-26.

Two new instruments designed and tested for velocity measurements in channels and hydraulic models are based on direct or indirect measurement of drag experienced by body in stream; they are inexpensive and robust, and require less time, labor and skill than other commonly used instruments without loss of accuracy.

1366. Singh, B., "Some Implications of Regime Design of Channels," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, No. 3, 1966, pp. 20.96-20.111.

1367. Singh, M., Gandhi, R.T., and Dastane, N.G., "Methods of Irrigation in India and Suggestion for Their Improvement and Evaluation," Indian Journal of Agronomy, Vol. 6, No. 2, Dec. 1961, pp. 155-166.

1368. Singleton, J.T., "Automatic Irrigation in the East," Golf Course Reporter, St. Charles, Illinois (USA), June 1963, Vol. 31, No. 6, pp. 31-33,36.

1369. Sinker, R.F., "New Methods of Checking Sprinkler Irrigation Pressures," Journal of the Department of Agriculture of South Australia, Adelaide, Australia, Nov. 1963, Vol. 67, No. 4, pp. 116-121.

1370. Sisson, D.R., "Better Farm Drainage Needed," Crops and Soils, Vol. 13, No. 1, Oct. 1960, pp. 12-14.

1371. Sisson, D.R., and Jones, B.A., "Filter Materials for Tile Drains in a Medium Sand - A Laboratory Comparison," Transactions of the American Society of Agricultural Eningeers, Saint Joseph, Michigan (USA), 1962, Vol. 5, No. 1, pp. 54-58.

1372. Skogerboe, G.V., and Hyatt, M.L., "Rectangular Cutthroat Flow Measuring Flumes," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR4, Proc. Paper 5628, Dec. 1967, pp. 1-13.

The dimensions and criteria for constructing rectangular cutthroat flumes, their role in water measurement, and the advantages of their use are examined. The general free flow equation and the curves which are used when submerged flow exists in the flumes are presented. Proper installation and maintenance procedures for cutthroat flumes and techniques for measuring flow depths which yield satisfactory results are described.

1373. Smerdon, E.T., and Beasley, R.P., "Critical Tractive Force in Cohesive Soils," Agricultural Engineering, Vol. 42, No. 1, Jan. 1961, pp. 26-29.

Presents a brief resume of the tractive force theory and its method of application to the problem of stable open channel design.

1374. Smerdon, E.T., "Effect of Rainfall on Critical Tractive Forces in Channels With Shallow Flow," Transactions, American Society of Agricultural Engineers, Vol. 7, No. 3, 1964, pp. 287-290.

The effect of simulated rainfall on the erosion of the bed of a channel with shallow flow (less than 0.4 ft. deep) was determined in a research flume. Critical tractive force values for five soils were determined both for flow with and without superimposed rainfall. In general, the values of critical tractive force increased slightly when rainfall was present indicating that rainfall reduced the tendency for the flow to erode the channel bed.

1375. Smerdon, E.T., and Glass, L.J., "Surface Irrigation Water-Distribution Efficiency Related to Soil Infiltration," Transactions of the American Society of Agricultural Eningeers, Vol. 8, No. 1, 1965, pp. 76-78, 82.

Rational equation is developed which relates water distribution along surface irrigation runs to three dimensionless ratios, representing time factors, distance along run, and water application amounts; curves relating water-distribution efficiency to infiltration function and dimensionless time factor are also developed.

1376. Smith, C.D., "Open Channel Water Measurement with the Broad Crested Weir," International Commission on Irrigation and Drainage, Annual Bulletin, 1958, pp. 46-51.

Reviews the problem of open channel water measurement structures for irrigation projects. Selects broad crested weirs for detailed analysis.

1377. Smith, C.D., and Yu, J.N.G., "Use of Baffles in Open Channel Expansions," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY2, Paper 4703, Mar. 1966, pp. 1-17.

Laboratory tests were conducted to determine efficacy of using baffle piers in open channel outlet transition with flow at sub-critical velocity throughout; it was found that use of such baffles will substantially reduce structure length required to achieve given velocity reduction.

1378. Smith, C.N., "Installing Plastic Lining in McCaskey Lateral," Reclamation Era, United States Bureau of Reclamation, Washington 25, D.C., Nov. 1962, Vol. 48, No. 4, pp. 95-97.

Describes methods of placing vinyl membrane; gives economics of this type of lining; states that it effectively checked seepage from the lateral.

1379. Smith, D.I., and Bridges, E.M., "Rates of Erosion and Weathering in the British Isles," Transactions of the Institute of British Geographers, 1965, No. 36, pp. xiii-xiv.

Report of a symposium held at Bristol, January 1965. The main topics discussed were the solutional erosion of limestone and the measurement and description of other forms of erosion - especially the erosional and depositional aspects of soil erosion.

1380. Smith, K.J., "Bitumen Sealing for Flumes and Waterways," Journal of the Soil Conservation Service of New South Wales, Vol. 16, No. 1, Jan. 1960, pp. 31-40.

1381. Smith, K.V.H., "Alluvial Channal Resistance to Bed Form," Proceedings of the American Society of Civil Engineers, Journal of the Hydrauliçs Division, Vol. 94, No. HYl, Paper No. 5720, Jan. 1968, pp. 59.

1382. Smith, L.A., "Aluminum Irrigation Pipe in the Ground," Irrigation Engineering and Maintenance, June-July 1962, pp. 18-19.

Experience has shown that with certain minimum wall thicknesses aluminum tubing can safely be buried unprotected in most soils.

1383. Smith, R.E., and Matz, R.J., "A Theoretical Method of Determining Discharge Coefficients for Venturis Operating at Critical Flow Condition," American Society of Mechanical Engineers, Paper No. 61-WA-211, 1961, pp. 1-12.

1384. Sochon, Z., "Water Management in Surface Flood Irrigation with Utilization of Outflowing Water," International Commission on Irrigation and Drainage, Annual Bulletin, 1958, pp. 60-77, 83.

1385. Sochon, Z., "Possibilities of Considerable Reduction of Total Water Requirements for Flood Irrigation by Means of Utilization of Outflowing Water Within System," Transactions of the 5th Congress of the International Commission on Irrigation and Drainage, Vol. 4, 1963, pp. 16.337-16.352.

Method of water management in overhead flooding with flow-off utilization within system is presented; formulas to determine unit inflows, total water requirements for flodding, volume of flow-off conducted from system to receiving ditch, and duration of flooding of single plot with water conducted to system, bringing water to system, flow-off draining from system to receiving ditch, and overhead flooding within system.

1386. Society of Instrument Technology, "Symposium on Flow Measurement," Transactions of the Society of Instrument Technology, London, June 1959.

1387. Soderberg, A.D., "Irrigation Development in Subhumid Area," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, 33 West 39th Street, New York 18, New York (USA), June 1964, Vol. 90, No. 2, IR2, Pt. 1, Paper No. 3922, pp. 1-19.

Points out that complete investigations and proper planning criteria are necessary in order to achieve successful irrigation development, especially in subhumid area; states that system capability for water delivery is greater in subhumid area because needs are intensified for shorter irrigation period.

1388. Soil Conservation Service, "Standards for Buried Aluminum," Sprinkler Irrigation Association, 1964, pp. 78-83.

1389. Somerhalder, B.R., "Comparing Efficiencies in Irrigation Water Application," Agricultural Engineering, Vol. 39, No. 3, Mar. 1958, pp. 156-159.

Compares water application efficiences for sprinkler and surface irrigation of alfalfa.

1390. Spencer, E.A., and Tudhope, J.S., "Literature Survey of Salt-Dilution Method of Flow Measurement," Journal of the Institution of Water Engineers, Vol. 12, No. 2, Mar. 1958, pp. 127-138.

1391. Spencer, E.A., "Flow Measurement by the Salt-Dilution Method," Journal of the Institution of Water Engineers, Vol. 14, No. 3, May 1960, pp. 215-235.

Describes volumetric and colorimetric methods of analysis to measure the concentrations of sodium dichromate used in the salt-dilution method of water measurement.

1392. Sprinkler Irrigation Association, "1964 Open Technical Conference Proceedings," Santa Monica, California, 1964, 89 pages.

1393. Squire, R.T., "Spray Irrigation," The Australasian Irrigator and Pasture Improver, Vol. 6, No. 2, Jan. 1961, pp. 11-14.

1394. Sridharan, K., and Lakshmana Rao, N.S., "Division and Combination of Flow in Open Channels," Institution of Engineers (India), Vol. 46, No. 7, Pt. CI4, Mar. 1966, pp. 337-356.

Division of flow in open channels has been solved using concept of constant specific energy, and that of side weir. Effect of angle of offtake on discharge distribution is discussed; equations for ratio of discharge distribution for right angled offtakes were obtained for conditions when flow in main channel is subcritical and that in branch is supercritical.

1395. Staff, C.E., "Storing and Conveying Water with Plastics," Agricultural Engineering, Vol. 46, No. 2, Feb. 1965, pp. 88-90.

Applications of plastic materials for liners for control of seepage and conveyance of irrigation water are described; examples of use of vinyl linings in farm ponds and irrigation canals.

1396. Starosolszky, O., "Measuring Irrigation Water for Investigating the Efficiency of Irrigation System," International Commission on Irrigation and Drainage, Annual Bulletin, 1962, pp. 36-44.

Emphasizes the importance of measurement of irrigation supplies; describes measuring structures, devices and instruments with special regards to the experience gained in Hungary.

1397. State of California, "Bank and Shore Protection in California Highway Practice," Department of Public Works, Division of Highways, Sacramento, 1960.

1398. Stebbings, J., "Shapes of Self Formed Model Alluvial Channels," Proceedings of the Institution of Civil Engineers, Vol. 25, Aug. 1963, pp. 485-510.

Experiments carried out in tilting flume demonstrated full range of cross-sectional shapes taken up by self formed regime channel in noncoherent material.

1399. Stelczer, K., "Problems Relating to Bed-Morphology with Special Regard to Permissible Velocities," Proceedings of the 11th General Meeting of the International Association for Hydraulics Research, Vol. 3, No. 32, 1965, pp. 1-9.

1400. Stepanich, F.C., Simons, D.B., and Richardson, E.V., "Control Structures for Sand-Bed Channels," Proceedings of the American Society of Civil Engineers, Journal of the Waterways and Harbors Division, May 1964, Vol. 90, No. WW2, pp. 1-18.

A laboratory study demonstrated the feasibility of constructing a relatively short channel to serve as a control structure in alluvial sand channel. Variations and discontinuities present in depth-discharge relations for alluvial sand channels resulting from changes in bed configuration are eliminated by this control; structure creates sufficient turbulence to suspend the bed material of the channel so that conventional suspended sediment samplers can be used to measure the total sediment discharge. The rock channel control should be more economical to construct than concrete controls.

1401. Stephens, J.C., Blackburn, R.C., Seaman, D.E., and Weldon, L.W., "Flow Retardance by Channel Weeds and Their Control," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 89, No. IR2, Pt. 1, Paper 3550, June 1963, pp. 31-53.

Maintenance of canals infested with aquatic weeds, when attempting to achieve design flow in waterways, is discussed; weeds raise Manning's n value in proportion to density of growth according to weed type as controlled by channel geometry, area and flow; physical factors affecting aquatic vegetation and associated retardance values are considered.

1402. Sternberg, Y.M., "Analysis of Sprinkler Irrigation Losses," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR4, Proc. Paper 5672, Dec. 1967, pp. 111-124.

An analysis of spray and evapotranspiration losses from day and night sprinkler irrigation is presented. Determination of the combined losses of spray evaporation and drift was based on the average depth of the water applied and the average depth of the water caught in catch cans. These tests suggest that the total losses are probably the same for day and night sprinkling, although the individual components which make up this total loss are not necessarily equal.

1403. Stevens, D.M., "Sprinkler and Gravity Irrigation - Investment and Water Requirements, Operating Costs and Labour Imputs," Wyoming Agricultural Experiment Station, Bulletin No. 378, May 1961, 32 pages.

1404. Stevens, P.R., "Effect of Irrigation on Ground Water in Southern Canyon Country, Idaho," United States Government Printing Office, Washington, 1962, 74 pages.

1405. Stewart, J.D., and Haslam, A.R., "Profitability of Irrigation in Mid Canterbury," Lincoln, College of Agricultural Economic Research Publication, May 1964, No. 6, 33 pages.

1406. Story, C.G., "Supplementary Irrigation in the Central District," Cane Growers, Quarterly Bulletin, Brisbane, Australia, July 1, 1964, Vol. 28, No. 1, pp. 21-25.

1407. Straub, L.G., "Effect of Water Temperature on Suspended Sediment Load in an Alluvial River," Proceedings of the 6th General Meeting of the International Association for Hydraulic Research, D25, 1955, pp. 1-5.

Although the turbulence pattern of a river may not be strongly influenced by the temperature of the water, the ability of the stream to transport fine sediments in suspension may be greatly increased with decreasing water temperature. This is due to the lower sedimentation rates of alluvial bed materials in water of low temperature as compared to water of higher temperature. Attention is called to field observations showing the high concentration of fine sands in suspension in a river during the winter months as compared to that in the summer months, and the tendency to channel degradation by cold-water flow as compared to conditions for warmer water flow.

1408. Strauss, V., "The Kinetic Energy Correction Factor and the Momentum Correction Factor in Open Channels," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A39, Vol. 1, 1967, pp. 314.

Deals with the effect of the velocity distribution and section shape of open channels on the value of the kinetic energy correction factor and of the momentum correction factor Equations for correction factors are derived, for the most used simple and combined channel sections. Theoretical results and direct measurements in open flows confirm that the values of the correction factor are often much higher than the generally used values in the range 1.0-1.1.

1409. Strong, D.C., "Which Method of Irrigation?," Farm and Home Science, Vol. 22, No. 2, June 1961, pp. 26-27, 48-50.

1410. Strong, D.C., "Economic Evaluation of Alternative Facilities for Surface and Sprinkler Irrigation in Utah," Utah Agricultural Experiment Station Bulletin, Utah State University, Logan, Utah, 1962, 47 pages.

Studies relative feasibility of surface versus sprinkler methods of irrigation under different physical and economic conditions.

1411. Strong, D.C., "Input Requirement and Costs of Surface and Sprinkler Methods of Irrigation Under Actual Operating Conditions in Utah," Utah Agricultural Experiment Station, Utah State University, Logan, Utah, Feb. 1962, 38 pages.

A statistical supplement to an economic evaluation of alternative methods of irrigation for various land situations.

1412. Strong, W., "Irrigation; Principles and Practice," Spanish Shell Public Health and Agricultural News, London, England, 1964, Vol. 7, No. 2, pp. 77-80.

Summary of the report on the activity of the Department of Hydraulic Resources.

1413. Strong, W.C., "Criteria for Operation of Sprinklers," Irrigation Engineering and Maintenance, 264 Gravier Street, New Orleans 12, Louisiana (USA), Apr. 1963, pp. 11.

Discusses the importance of adequate water pressure, speed of sprinkler rotation and rate of precipitation in preventing crop damage.

1414. Suga, K., "The Stable Profiles of the Curved Open Channel Beds," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A60, Vol. 1, 1967, pp. 487.

The stable lateral bed profiles of the continuous curved open channel, both in the dynamic and in the static equilibrium, are analyzed theoretically by some assumptions on the velocity and bed material load distributions in the bends, and verified experimentally.

1415. Suryanarayana, B., "Natural Roughness Effect in Rigid Open Channels," Institution of Engineers (India), Vol. 46, No. 9, Pt. CI5, May 1966, pp. 435-448.

Series of experiments carried out to determine effect of roughness spacing in open channel flow; conditions of dunes and ripples on streambed were created by fixing corrugations of asbestos cement sheet, at various spacings.

1416. Sutherland, A.J., "Proposed Mechanism for Sediment Entrainment by Turbulent Flows," Journal of Geophysical Research, Vol. 72, No. 24, Dec. 15, 1967, pp. 6183.

Entrainment was considered to include both the initiation of sediment motion and the suspension of grains by the flow. Observations of grain motion induced by turbulent flows and by a pulsating jet led to the formulation of an entrainment hypothesis based on the concept of turbulent eddies disrupting the viscous sublayer and impinging directly onto the grain surface.

1417. Sutton, J.G., "Installation of Drain Tile for Subsurface Drainage," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 86, No. IR3, Pt. 1, Paper 2591. Sep. 1960, pp. 27-49.

Soil Conservation Service provided technical assistance on installation of 24059 miles of tile drains during 1959 fiscal year; tile used in surface drainage and current proceedures in making drainage investigation; recent changes in ASTM specifications for clay and concrete drain tile are discussed; use of concrete tile under acid and alkali conditions is discussed.

1418. Swarner, L.R., and Hagood, M.A., "Irrigation Trends in the Pacific Northwest," Agricultural Engineering, June 1963, Vol. 44, No. 6, pp. 304-307.

1419. Swarner, L.R., and Pair, C.H., "Community-Type Sprinkler Irrigation Systems," Agricultural Engineering, Vol. 45, No. 10, Oct. 1964, pp. 548-550, 565.

Design and development of community type sprinkler irrigation systems that consist of open and closed pipe conveyors are discussed for determining most efficient method.

1420. Swartzendruber, D., "Approximate Water Flow Rates for Tube Drains in Stratified Soils," Journal of Geophysical Research, June 1962, Vol. 67, No. 6, pp. 2395-2402.

1421. Swenson, H.A., "Sediment in Streams," Journal of Soil and Water Conservation, Vol. 19, No. 6, 1964.

1422. Sylvester, R.D., Seabloom, R.W., "Quality and Significance of Water Return Flow," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 89, No. IR3, Pt. 1, Paper 3624, Sep. 1963, pp. 1-27.

Water quality changes in Yakima River Basin occurring during irrigation are examined together with techniques and objectives for return flow quality studies.

1423. Symposium on Erosion and Sedimentation, Journal of Geophysical Research, Vol. 67, No. 4, 1962, pp. 1427-1527.

1424. Szalay, M., "Effect of Incomplete Sheet Pilings and Impermeable Aprons on Filtration Flow Under Pressure," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 2, pp. 360-363.

According to boundary conditions, sheet piles penetrating into an equifer situated between two impervious layers, cause either the diminishing of flow discharge, or the increase of the difference of pressure heads characterizing the entering and leaving sections of water.

1425. Szigyarto, Z., "Effect of Turbulence on the Calibration Accuracy of Hydraulic Structures," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 1, pp. 227-238.

1425. Continued

Many hydraulic structures are used also for discharge measurement and for this purpose the magnitude of flow passing under various conditions is determined by means of calibration. Calibration is usually carried out by using revolving current meters. The accuracy of calibration depends thus on the errors of discharge measurement with revolving current meters.

1426. Talsma, T., and Haskew, H.C., "Investigation of Water-Table Response to Tile Drains in Comparison with Theory," Journal of Geophysical Research, Vol. 64, No. 11, Nov. 1959, pp. 1933-1944.

Performance of tile laterals, selected from farm drainage systems; useful theories of water-table reponse to tile lines; field procedure used for investigation.

1427. Tamers, M.A., "Surface-Water Infiltration and Ground-Water Movement in Arid Zones of Venezuela," Proceedings of the Symposium on Isotopes in Hydrology, International Atomic Energy Agency and IUGG, Vienna, Nov. 14-18, 1966, Vienna, 1967, pp. 339-351.

Radiocarbon dating of the carbonate species present in groundwater is capable of furnishing information on the recharge of underground deposits as well as directions and rates of movement, The origins of the dissolved carbonates fall under two classifications.

1428. Tarig, A., and Sarfraz, K.M., "Working the Right Bays of Balloki Barrage," Proceedings of West Pakistan Engineering Congress, Lahore, 1958, Vol. XLII, Paper No. 330.

1429. Tarrant, J., "Design of Large Flows in Open Channels," Water and Sewage Works, Vol. 107, Nov. 1960, pp. 422-424.

On parshall flumes of large size.

1430. Task Committee on Channel Stabilization Works, "Channel Stabilization of Alluvial Rivers," Proceedings of the American Society of Civil Engineers, Journal of the Waterways and Harbors Division, Paper No. 4236, Vol. 91, No. WW1, Feb. 1965, pp. 7-37.

A study of channel stabilization and bank protection works on fourteen alluvial streams in the continental United States. The report is based on a series of papers that have been presented at American Society of Civil Engineers Conventions and Conferences or published in the Waterways and Harbors Journal, or both; study of available literature listed in the bibliography; and inspections of existing works on the rivers under study. Data on current (1964) practices of channel stabilization and bank protection work were collected and analyzed. Conclusions are presented and explained in the report.

1431. Task Committee on Erosion of Cohesive Materials, "Abstracted Bibliography on Erosion of Cohesive Materials," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulic Division, Mar. 1966, Vol. 92, No. HY2, Paper No. 4746, pp. 243-290.

An abstracted bibliography has been compiled as an aid in assessing the current status of research on erosion of cohesive materials. All items in the bibliography are listed alphabetically by the author. An attempt has been made to include only those papers and reports that have a direct and significant relationship to the problem of erosion of cohesive materials.

1432. Task Committee on Erosion of Cohesive Materials, Committee on Sedimentation, "Erosion of Cohesive Sediments," Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, July 1968, Vol. 94, No. HY4, Paper No. 6044, pp. 1017-1049.

Final report prepared by the Task Committee on Erosion of Cohesive Materials, describes laboratory research, field observations, design criteria, and agricultural land and channel problems as related to cohesive sediments. Much of the literature currently available is reviewed and recommendations are made for practical application to design and for further research An extensive bibliography, a compliation of design equations and charts, and some design information are included.

1433. Task Committee on Preparation of Sedimentation Manual, Committee on Sedimentation, "Sediment Transportation Mechanics: Introduction and Properties of Sediment," Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, July 1962, Vol. 88, No. HY4, Part 1, Paper No. 3194, pp. 77-109.

1434. Task Committee on Preparation of Sedimentation Manual, Committee on Sedimentation, "Sediment Transportation Mechanics: Erosion of Sediment," Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, July 1962, Vol. 88, No. HY4, Part 1, Paper No. 3195, pp. 109-127.

Erosion is the removal of soil particles from their environment by water or wind. It constitutes the beginning of motion of particles that were previously at rest and their removal from the region under consideration. Soil materials, from the point or view of erosivity, may be loosely classified as (1) non-cohesive sediments and (2) cohesive sediments.

1435. Task Committee on Preparation of Sedimentation Manual, "Density Currents," Journal of the Hydraulics Division, American Society of Civil Engineers, Sep. 1963, Vol. 89, No. HY5, Proc. Paper 3639, pp. 77-87.

This report deals with density currents, defined as the movement under gravity of a stream of fluid under, through, or over another fluid, the density of which differs by a small amount from that of primary current.

1436. Task Committee on Preparation of Sedimentation Manual, "Sediment Transportation Mechanics: Suspension of Sediment," Journal of the Hydraulics Division, American Society of Civil Engineers, Sep. 1963, Vol. 89, No. HY5, Paper No. 3636.

Turbulence, the most important factor in the suspension of sediment, is defined and examined. The diffusion mechanism is examined. The differential equation for the suspension of sediment is derived, as well as the classical equations for the distribution of suspended sediment in a turbulent flow.

1437. Task Committee on Preparation of Sedimentation Manual, "Sediment Transportation Mechanics: Nature of Sedimentation Problems," Journal of the Hydraulic Division, Proceedings of the American Society of Civil Engineers, Mar. 1965, Vol. 91, No. HY2, Paper No. 4260, pp. 251-266.

Sedimentation embodies the processes of erosion, entrainment, transportation, deposition, and the compaction of sediment. These are natural and complex processes that have been active throughout geological times and have shaped the landscape. The principle external dynamic agents of sedimentation are water, wind, gravity, and ice.

1438. Task Committee on Preparation of Sedimentation Manual, "Sediment Transportation Mechanics: Wind Erosion and Transportation," Journal of the Hydraulics Division, American Society of Civil Engineers, Mar. 1965, Vol. 91, No. HY2, Proc. Paper 4261, pp. 267-287.

The mechanics of wind erosion is a broad, complex subject. The transport of soil material by wind is a special case of the broader field of the transport of solids by fluids. Certain fundamental and relatively great differences exist, however, between the transport of material by wind as compared to its transport by water.

1439. Task Committee on Preparation of Sedimentation Manual, "Sediment Transportation Mechanics: Initiation of Motion," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY2, Paper No. 4738, Mar. 1966, pp. 291-314.

Progress report of Task Committee on Preparation of Sedimentation Manual; report discusses investigations dealing with problem of determining critical conditions for entrainment of sediments; bibliography on initiation of motion is included.

1440. Task Committee on Preparation of Sedimentation Manual, "Nomenclature for Bed Forms in Alluvial Channels," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 92, No. HY3, Paper 4823, May 1966, pp. 51-64.

Collection of definitions developed by Task Force is presented to describe principal types of bed form that occur in alluvial channels; illustrative photographs and observation on occurrence of various bed geometrics are also presented, along with summary of other terms in common use for bed forms that are distinguished; some guidelines are given to aid in collection of meaningful data on bed forms.

1441. Task Committee on Preparation of Sedimentation Manual, "Economic Aspects of Sedimentation," Journal of the Hydraulics Division, American Society of Civil Engineers, Jan. 1969, Vol. 95, No. HY1, Paper No. 6334, pp. 191-207.

Problems associated with the movement of sediment either as erosion or deposition, are discussed in relation to their economic consequences. The cost of erosion and sedimentation in various civil engineering projects are presented.

1442. Task Committee on Preparation of Sedimentation Manual, "Sediment Control Methods: Intoduction and Watershed Area," Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Mar. 1969, Vol. 95, No. HY2, Paper No. 6438, pp. 649-675.

The subject is considered in two general areas, the land surface and the fluvial channels and associated water bodies. Sediment control on land is discussed in terms of watershed areas. Larger channels are discussed separately in terms of natural and artificial channels. The prevention of the erosion of sediment particles from the land or from fluvial channels and the controls applicable in fluvial channels or in the lakes, reservoirs, estuaries, or bays into which they flow are also explored.

1443. Termier, H., and Termier, G., "Erosion and Sedimentation," Van Nostrand, London, 1963, pp. 433.

French text revised for this English translation. It is primarily concerned with sedimentation, on the basis of the various sedimentary environments and with erosion, and its climatic and tutonic environment.

1444.. Terrell, P.W., and Borland, W.M., "Design of Stable Canals and Channels in Erodible Material," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 82, No. HYl, Proc. Paper 880, Feb. 1956.

The development and present method of design of canals are outlined. Factors causing a change in stream regimen are numerated and several methods by which the proper size and shape of channel can be computed are suggested and one example is presented. An outline of basic data needed for adequate design of a channel is given. Bed and bank material are considered.

1445. Thames, J.L., and Evans, D.D., "An Analysis of the Vertical Infiltration of Water into Soil Columns," Water Resources Research, Aug. 1968, Vol. 4, No. 4, pp. 817-828.

To investigate the behavior of soil water movement during infiltration and thereby determine the applicability of flux equations involving soil water content gradients as the apparent driving force.

1446. Thiel, T.J., and Bornstein, J., "Tile Drainage of Sloping Fragipan Soil," Transactions of the American Society of Agricultural Engineers, Vol. 8, No. 4, 1965, pp. 555-557.

Report of analog study of placement of equally spaced tile drains in silt loam, poorly to somewhat poorly drained phase; electrical resistance network analog was used to determine relationship between rain depth and depth outflow rate, to examine physical properties of flow regime, and effect of backfill treatment on drain system.

1447. Thiruvengadam, A., "Direct Solution of Pipe-Friction Problems from the Colebrook-White Formula," Water Power, Vol. 12, No. 7, July 1960, pp. 262-264.

1448. Thiruvengadam, A., "Hydraulic Jump in Circular Channels," Water Power, Vol. 13, Dec. 1961, pp. 496-497.

1449. Thiruvengadam, A., "Flow in Branch Channel," Water Power, Feb. 1962, Vol. 14, No. 2, pp. 76-77.

Proposes a simple method for evaluating discharge in a branch channel at right angles to the main one; gives results of initial experiments to determine appropriate coefficient of discharge.

1450. Thomas, A.R., "Some Experiments on the Control of the Hydraulic Jump," 3rd Congress on Irrigation and Drainage, 1957, Report 6, Question 9.

1451. Thomas, C.W., "Structures and Methods for Measuring Irrigation Water," 3rd Congress on Irrigation and Drainage, 1957, Report 9, Question 9.

1452. Thomas, C.W., "Errors in Measurement of Irrigation Water," Transactions of the American Society of Civil Engineers, 1959, pp. 319-340.

Deals with magnitude of errors resulting from changes in some dimensions, incorrect settings, changes in flow pattern, and other deviations.

1453. Thomas, C.W., "World Practices in Water Measurements at Turnouts," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 86, No. IR2, Pt. 1, Paper 2530, June 1960, pp. 29-52.

1454. Thomas, C.W., and Enger, P.F., "Use of an Electronic Computer to Analyze Data From Studies of Critical Tractive Forces for Cohesive Soils," 9th Convention, International Association for Hydraulic Research, Dubrovnik, Yugoslavia, 1961.

1454. Continued

To help improve design criteria for earthlined and unlined canals an established program for an IBM 650 electronic digital computer was used to develop multiple linear empirical correlations of critical tractive forces versus standard soil properties. Data were collected by testing in a tractive force apparatus hand cut, undisturbed 8 in. (0.203 m) cohesive soil samples, taken from operating irrigation canals in the western United States. The tractive force apparatus was developed and calibrated in the laboratories of the Bureau of Reclamation.

1455. Thomas, W., "Something New in Sprinkler Irrigation," The Australian Irrigator (and Pasture Improver), Vol. 6, No. 11, Oct. 1961, pp. 15-16.

Describes a mechanical device known as "Re-Closing Take Off Elbow" which is added to the normal take off elbow or hydrant bend which fits on top of the hydrant and carries out the operation of opening the hydrant. It can be operated manually or automatically.

1456. Thompson, C.B., "Study of Municipal and Irrigation Water Shortage," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Dec. 1963, Vol. 89, No. IR4, Pt. 1, Paper 3714, pp. 7-13.

Presents an analysis of water shortages for municipal and industrial and irrigation uses.

1457. Thompson, C.B., "Irrigation Water Requirements in Texas," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Sep. 1964, Vol. 90, No. IR3, Pt. 1, Paper 4040, pp. 13-40.

Presents derivation of irrigation water requirements and explanation of their use in Texas taking into account effective precipitation, consumptive use, farm waste and deep percolation losses, canal and lateral losses, return flows and diversion requirements.

1458. Thoms, Z., "Velocity of Motion of Sand Banks," Proceedings of the 12th Congress of the Internation Association for Hydraulic Research, Paper A49, Vol. 1, 1967, pp. 398-407.

The research of macro-turbulence and energy losses caused by friction of the water course, the bottom of which is formed by various types of sand banks, is connected with the investigation of their velocities of motion. A new general type of an equation for the velocity of the motion of sand banks, has been proposed.

1459. Thorfinnson, T.S., Swanson, N.P., and Epp, A.M., "Cost of Distributing Irrigation Water by the Sprinkler Method," Nebraska Agricultural Experiment Station, S.B. 455, Mar. 1960, 34 pages.

1460. Thorn, R.B., "The Design of Land Drainage Works," Butterworths Scientific Publications, London, 1959, pp. 235.

A collection of papers on the design of land drainage works of the type normally carried out by River Conservancy Catchment, and Drainage Boards in Great Britain.

1461. Thorn, R.B., "Development of Rigid Boundary Open Channel Flow Formula," Dock and Harbour Authority, Vol. 42, No. 490, Aug. 1961, pp. 118-120.

Review considers historical background and development of expression through those recently developed from pipe flow investigations; effects of developments in connection with design of river improvement and work on natural channels are mentioned.

1462. Thornton, J.F., "Summary of Hydraulics of Furrow Irrigation Studies in Missouri," United States Agricultural Research Service, United States Department of Agriculture, ARS-41-43, Oct. 1960, pp. 63-66.

1463. Thornton, J.F., "Characteristics of Flow in Irrigation Furrow," Abstracts of Dissertations and Titles of Theses, Louisiana State University, Baton Rouge, Louisiana, Feb. 1964, Vol. 24, No. 8, pp. 3267.

1464. Thornton, J.F., and Beasley, R.P., "Characteristics of Flow in Trapezoidal and Triangular Irrigation Furrows," Bulletin, Missouri, Agricultural Experiment Station, Columbia, Mar. 1964, No. 855, 36 pages.

1465. Till, M.R., "The Maintenance of Fixed Sprinklers," Citrus News, Melbourne, Australia, 1964, Vol. 40, No. 1, 5 pages.

1466. Tilp, P.J., and Scrivner, M.W., "Analysis and Descriptions of Capacity Tests in Large Concrete-Lined Canals," United States Bureau of Reclamation, Technical Memo. 661, 1964, 168 pages.

1467. Tilp, P.J., "Capacity Tests in Large Concrete-Lined Canals," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 91. No. HY3, Pt. 1, Paper 4337, May 1965, pp. 189-216.

1467. Continued

Between 1957 and 1962 series of tests were performed by Bureau of Reclamation to determine hydraulic performance of nine large concrete-lined irrigation canals; instruments and techniques developed to measure small changes in water surface elevations are described; results of backwater curves computed to match measured water surface profiles in sinuous reaches and reaches with piers are described.

1468. Timmons, F.L., and Klingman, D.L., "Control of Aquatic and Bank Vegetation and Phreatophytes," Water and Agriculture - American Association for the Advancement of Science Symposium Papers, 1960, pp. 157-170.

1469. Timmons, F.L., "Control of Weeds Harmful to Water Uses in the West," Journal of the Waterways and Harbors Division, American Society of Civil Engineers, Vol. 92, No. WW1, Proc. Paper 4645, Feb. 1966, pp. 47-58.

Expansion of the cooperative research program in 1961 resulted in the development of several effective and other promising chemical methods of controlling submerged weeds, the most troublesome water-wasting phreatophytes growing on river flood plains, along small streams, and around reservoirs. Investigations are being continued to discover more effective, less expensive, and safer chemical, mechanical, biological, and ecological methods of controlling weeds harmful to water uses.

1470. Tingley, R.J., "The Value of Good Irrigation Practices," Holly Agricultural News, 1963, Vol. 11, No. 2, pp. 16-17.

1471. Tinney, E.R., and Hsu, H.Y., "Mechanics of Washout of an Erodible Fuse Plug," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 87, No. HY3, Proc. Paper 2208, May 1961, pp. 1-29.

Laboratory and field experiments are described that were undertaken to demonstrate the feasibility of a fuse plug in the spillway of a major dam. From the data and from tractive force theory, similitude relationships are derived that permit the application of model tests results to rates of washout.

1472. Tisdall, A.L., "Irrigation and Drainage Policy and Farm Costs," Australasian Irrigator and Pasture Improver, Sydney, Australia, Apr. 1963, pp. 21-23.

Discusses the three ways in which irrigation and drainage policy can affect farm costs.

1473. Tisdall, A.L., "The Water of Irrigation to Australia," Aqua, Dec. 1963, pp. 75-81.

The aspects dealt with include: the history and pattern of development which has occurred in Victoria over the last 60 years, the indirect benefits to be gained from irrigation.

1474. Topp, T., "Irrigation Automation in the East," Bulletin of the New York Turfgrass Association, 1963, No. 73, pp. 281-283.

1475. Tovey, R., and Myers, V.I., "Evaluation of Some Irrigation Water Control Devices," Idaho Agriculture Experiment Station, B319, Dec. 1959, 32 pages.

1476. Tovey, R., Myers, V.I., and Martin, J.W., "Furrow Erosion on Steep Irrigated Land," Agricultural Experiment Station, Department of Agricultural Engineering, Research Bulletin No. 53, University of Idaho, Moscow, Idaho, May 1962.

The amount of erosion on steep irrigated land is directly related to the rate of advance, size of fur row streams, and infiltration rates of the soil. There was considerable variation in the extent of erosion shown by the various cultivation and moisture treatments. The lowest erosion rate occurred in the uncultivated furrows. The amount of erosion can be multiplied many times by a slight increase in the size of the furrow stream.

1477. Tovey, R., "A Portable Irrigation Sprinkler Evaluation Device," Agricultural Engineering, Dec. 1963, Vol. 44, No. 12, pp. 672-673.

1478. Tovey, R., and Pair, C.H., "Measurement of Intake Rate for Sprinkler Irrigation Design," Transactions of the American Society of Agricultural Engineers, Vol. 9, No. 3, 1966, pp. 359, 363.

Measurement of maximum sprinkler-design intake rates were made on several farms having uniform soils and various crops growing; considerable variation in measured maximum sprinkler-design intake rates on some soil types in various crops was found.

1479. Townson, J.M., "Calibration of Horseshoe Weir," Water and Water Engineering, London, England, Feb. 1964, Vol. 68, No. 816, pp. 59-64.

Describes study of an old weir in the river Lune, downstream of the recently completed Selset reservoir.

1480. Tracy, H.J., and Lester, C.M., "Resistance Coefficients and Velocity Distribution, Smooth Rectangular Channel," United States Geological Survey, Water Supply Paper No. 1592-A, 1961, 18 pages.

1481. Trewhella, W.N., "Fixed Pipes and Portable Syphon Tubes," Aqua, Jan.-Feb. 1962.

1482. Trewhella, W.N., "Pipe Outlets and Siphon Tubes," Australian Irrigator and Pasture Improver, Dec. 1962, Vol. 8, No. 1, pp. 13-18.

Dwells on the advantages of using portable siphon tubes and fixed pipes for discharging water onto furrows, discusses flow characteristics of these devices and their operation.

1483. Troskolanski, A.T., "Hydrometry: Theory and Practice of Hydraulic Measurements," Oxford, Pergamon Press, 1960, pp. 684.

1484. Tsuchiya, A., and Katsuyoshi, I., "The Mechanics of Dune Formation in Erodible-Bed Channels," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A59, Vol. 1, 1967, pp. 479.

The mechanics of dune formation was analyzed by introducing the interaction between surface waves and sand waves on the bed. The height of dune was also analyzed in connection with the bed load transportation.

1485. Tsutsui, H., "Water Management in Waterlogged Paddy Fields with Reference to Drainage Improvement," International Commission on Irrigation and Drainage Bulletin, 1963, pp. 62-66.

1486. Turnbul, W.J., Krinitzsky, E.L., and Weaver, F.L., "Bank Erosion in Cohesive Soils of the Lower Mississippi Valley," American Society of Civil Engineers Water Resources Conference, Preprint No. 178, Mobile, Alabama, Mar. 8-12, 1965.

In the Alluvial Valley, the river erodes its thalweg in sands and gravels. Periodic erosion may steepen the toes of the banks from stable slopes to ones which are unstable and which cause subaqueous failures. The suaqueous failures may in turn trigger upper bank failures affecting a layer of cohesive to partly cohesive deposits known as the topstratum, which respond in certain characteristic ways to oversteepening of the bank slope so that the mechanics of their failure can be predicted in a general way.

1487. Uner, N., "Design and Layout of Farm Irrigation Systems," 2nd Regional Irrigation Practices Leadership Seminar, Teheran, 1959, pp. 113-119.

1488. United Nations, "Irrigation and Water Use," United Nations Conference Applied Science and Technology, Jan. 14, 1963, Vol. 12, No. 77(c), Doc. No. EICONF39 IGR77(c), 15 pages.

1489. Uppal, H.L., and Mohinder, S., "Use of Fine Grained Wind Blown Sand as Construction Material in Lining of Canals," Irrigation and Power, Journal of the Central Board of Irrigation and Power, Vol. 17, No. 4, Oct. 1960, pp. 639-644.

Experimental studies have shown that impermeable canal lining can be made with any quality or kind of sand when used with bitumen of required type with a suitable surface treatment.

1490. Uppal, H.L., Midha, D.C., and Sohan, S., "Evolving Low-Cost Canal Linings - Part I," Indian Journal of Power and River Valley Development, May, 1962, Vol. 12, No. 5, pp. 11-24.

Describe the experimental investigations carried out to test the suitability of polythylene as a lining material for irrigation channels.

1491. Uppal, H.L., and Mohinder, S., "A Study of Characteristics of Certain Hydraulic Structures - Part I - Canal Lining," Indian Journal of Power and River Valley Development, July 1962, Vol. 12, No. 7, pp. 7-16.

1492. Uppal, H.L., Singh, G., Dass Dhand, A., "Investigation of Suitable Sub-Surface Drainage System for Anti-Water Logging," Indian Journal of Power and River Valley Development, Vol. 14, No. 9, Sep. 1964, pp. 19-24.

Performance characteristics of different types of subsurface drains including burnt clay tiles, porous cement concrete, and flat brick tiles are examined.

1493. Uppal, H.L., and Singh, M., "Irrigation by Canals from Reservoirs - Some Problems Considered," Indian Journal of Power and River Valley Development, Vol. 15, No. 11, Nov. 1965, pp. 1-7.

Problems associated with canal irrigation in India concerning exclusion of silt are discussed; silt ejectors or excluders are provided at headworks or other places in canal to be diverted to some natural drains or bypass channels and back to river; other means adopted were to clear deposited silt in bed during its closures whenever found necessary; solutions to meet continuous depletion of essentials in soil.

1494. United States Army Corps of Engineers, "Hydraulic Design Criteria," Issues 1-14, United States Army Engineer, Waterway Experiment Station, Vicksburg, Mississippi, Jan. 1952- Aug. 1968.

Gives data on physical constants, fluid properties, open channel flow. air demand and entrainment, gate vibration, spillways, outlet works, gates and valves, navigation dam culverts, artificial channels and rip rap.

1495. United States Army Corps of Engineers, "A Quarter-Century Assessment of Experimental Prediction in Hydraulics," Miscellaneous Paper No. 2-340, United States Army Engineer, Waterway Experiment Station, Vicksburg, Mississippi, 1959.

1496. United States Army Corps of Engineers, Coastal Engineers Research Center, "Sand Movement by Wind Action (on Characteristics of Sand Traps)," Technical Memorandum No. 119, United States Army Engineer, Waterway Experiment Station, Vicksburg, Mississippi, 1960.

1497. United States Army Corps of Engineers, "Fixed-Bed River Models," Miscellaneous Paper No. 2-406, United States Army Engineer, Experiment Station, Vicksburg, Mississippi, 1960.

1498. United States Army Corps of Engineers, "Types of Flow in Open Channels," Miscellaneous Paper No. 2-498, United States Army Engineer Waterway Experiment Station, Vicksburg, Mississippi, June 1962.

1499. United States Army Corps of Engineers, "Riprap Requirements for Overflow Embankments," Miscellaneous Paper No. 2-552, United States Army Engineer, Waterway Experiment Station, Vicksburg, Mississippi, 1963.

1500. United States Army Corps of Engineers, "A Study of Water Pressure on Roller Gates," Report No. 77, District Engineer, United States Army Engineer District, St. Paul, Minnesota, 1963.

1501. United States Army Corps of Engineers, Committee on Channel Stabilization, "Review of Research on Channel Stabilization of Mississippi River 1931-1962," Technical Report No. 2, United States Army Engineer, Waterway Experiment Station, Vicksburg, Mississippi, 1963.

1502. United States Army Corps of Engineers, "The Use of Radioisotopes in Sediment Transport Studies," Miscellaneous Paper No. 2-564, United States Army Engineer, Waterway Experiment Station, Vicksburg, Mississippi, 1963.

1503. United States Army Corps of Engineers, "Nonuniform Flow Functions, Circular Sections," Miscellaneous Paper No. 2-601, United States Army Engineer, Waterway Experiment Station, Vicksburg, Mississippi, Sep. 1963.

1504. United States Army Corps of Engineers, Coastal Engineering Research Center, "Sand Movement by Wind," Technical Memorandum No. 1, United States Army Engineer, Waterway Experiment Station, Vicksburg, Mississippi, 1964.

1505. United States Army Corps of Engineers, Coastal Engineering Research Center, "Transportation of Bed Material Due to Wave Action," Technical Memorandum No. 2, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi, 1964.

1506. United States Army Corps of Engineers, "Laboratory Determination of Current Meter Performance," Report No. 843-1, United States Army Engineer North Pacific Division, Portland, Oregon, 1966.

1507. United States Army Corps of Engineers, "A Momentum Approach to Open Channel Transitions," Miscellaneous Paper No. 2-848, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi, 1966.

1508. United States Army Corps of Engineers, "Prototype Performance and Model - Prototype Relations," Miscellaneous Paper No. 2-857, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi, 1966.

1509. United States Army Corps of Engineers, "Laboratory Research on Design of Dikes for River Regulation," Miscellaneous Paper No. 2-860, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi, 1966.

1510. United States Army Corps of Engineers, Committee on Channel Stabilization, "Publications Available in Corps 2 Engineers Office," Technical Report No. 4, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi, 1966.

1511. United States Army Corps of Engineers, Committee on Channel Stabilization, "Effect of Water Temperature on Discharge and Bed Configuration, Mississippi River at Red River Landing, Louisiana," Technical Paper No. 3, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi, 1966.

1512. United States Army Corps of Engineers, Committee on Channel Stabilization, "Symposium on Channel Stabilization Problems," Technical Report No. 1, Vol 1, 1967, Vol. 2, 1964, Vol. 3, 1965, Vol. 4, 1966, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi.

1513. United States Army Corps of Engineers, Coastal Engineering Research Center, "Annotated Bibliography of Beach Erosion Board and Coastal Engineering Research Center Publications," Miscellaneous Paper No. 1-68, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi, 1968.

1514. United States Army Corps of Engineers, Committee on Channel Stabilization, "A Procedure for Computation of Detailed Distribution, Bed to Surface," Technical Report No. 5, United States Army Engineer, Waterways Experimental Station, Vicksburg, Mississippi, 1968.

1515. United States Army Corps of Engineers, "Boundary Effects of Uniform Size Roughing Elements in Two-Dimensional Flow in Open Channels," Miscellaneous Paper No. H-68-5, United States Army Engineer, Waterways Experiment Station, Vicksburg, Mississippi, Dec. 1968.

1516. United States Bureau of Reclamation, "Irrigation Operation and Maintenance," United States Bureau of Reclamation, Reclamation Instructions.

1517. United States Bureau of Reclamation, "Design of Small Dams," United States Bureau of Reclamation Manual.

Standards and procedures for design of concrete, gravity, rolled earthfill and rockfill dams and their spillways and outlet works. Intended to serve as a guide to safe design practice.

1518. United States Bureau of Reclamation, "Hydraulic and Excavation Tables," United States Bureau of Reclamation, 11th Edition.

Tables for open channel flow based on Manning's formula.

1519. United States Bureau of Raclamation, "Theory and Problems of Water Percolation," Engineering Monograph No. 8, United States Bureau of Reclamation.

1520. United States Bureau of Reclamation, "Discharge Coefficient for Irregular Overfall Spillways," Engineering Monograph No. 9, United States Bureau of Reclamation.

1521. United States Bureau of Reclamation, "Hydraulic Design of Stilling Basins and Energy Dissipators," Engineering Monograph No. 25.

1522. United States Bureau of Reclamation, "Buried Asphalt Membrane Canal Linings," Research Report No. 12, United States Bureau of Reclamation.

1523. United States Bureau of Reclamation, "Selective Bibliography of Soil Mechanics and Foundation Engineering," Bibliography No. 241, United States Bureau of Reclamation.

1524. United States Bureau of Reclamation, "Bibliography of Dam Failure," Bibliography No. 242, United States Bureau of Reclamation.

1525. United States Bureau of Reclamation, "Canal Safety," United States Bureau of Reclamation, 1958.

Safety facilities and practices in the design and operation of canals and waterway structures.

1526. United States Bureau of Reclamation, "Investigation of Meyer-Peter, Müller Bedload Formulas," Sedimentation Section, Hydrology Branch, Division of Project Investigations, United States Bureau of Reclamation, June 1960.

Develops conversion formulas from metric to english units as well as nomographs for solving the formulas.

1527. United States Bureau of Public Roads, "Hydraulics of Bridge Waterways," Hydraulic Design Series No. 1, United States Government Printing Office, Aug. 1960, 53 pages.

Deals with the hydraulics of bridge waterways including computation of backwater for normal, skew and eccentric crossings as well as effect of scour on backwater.

1528. United States Bureau of Reclamation, "Canals and Related Structures," United States Bureau of Reclamation, Design Standards No. 3, 1961.

1529. United States Bureau of Reclamation, "A Rapid Method of Construction Control for Embankment of Cohesive Soils," Engineering Monograph No. 26, United States Bureau of Reclamation, 1961 Edition.

1530. United States Bureau of Reclamation, "Tables of Pipe Hydraulic Properties," Vol. I Pipe Sizes 4 to 24 inches, Vol II Pipe Sizes 26 to 120 inches, United States Bureau of Reclamation, 1964.

Tables showing pipe frictions losses for precast concrete pipes or mortar lined steel pipe based on Scobey's formula to expedite hydraulic computations for pipe line distribution systems.

1531. United States Bureau of Reclamation, "Hydraulic Design of Transitions for Small Canals," Engineering Monograph No. 33, United States Bureau of Reclamation, 1964.

1532. United States Bureau of Reclamation, "Aquatic Pests on Irrigation Systems," United States Bureau of Reclamation, 1965.

An identification guide with colored illustrations and narrative description of some of the commonly observed organisms that become pests in the operation of irrigation systems in western United States.

1533. United States Bureau of Reclamation, "Federal Reclamation Laws Annotated," Vol. I (1943 Edition and Supplement of 1966), Vol. II (without annotation, with supplement, June 1959-Nov. 1965).

Public statutes of United States Bureau of Reclamation activites in the development and use of water for irrigation and other purposes.

1534. United States Bureau of Reclamation, "Computation of 'Z's' for Use in the Modified Einstein Procedure," Sedimentation Section, Hydrology Branch, Division of Project Investigations, United States Bureau of Reclamation, June 1966, 5 pages.

1535. United States Bureau of Reclamation, "Aquatic Weed Control Studies," Research Report, United States Bureau of Reclamation, 1966.

1536. United States Bureau of Reclamation, "Soil Tests Computer Programs," Research Report No. 2, United States Bureau of Reclamation, 1966.

1537. United States Bureau of Reclamation, "Hydraulic Downpull Forces on Large Gates," Research Report No. 4, United States Bureau of Reclamation, 1966.

1538. United States Bureau of Reclamation, "Annual Report of Progress on Engineering Research, 1966," Research Report No. 10, United States Bureau of Reclamation, 1966.

1539. United States Bureau of Reclamation, "Linings for Irrigation Canals," United States Bureau of Reclamation, 1967.

Present instructions, standards and proceedures developed by United States Bureau of Reclamation for use in the lining of irrigation canals. Includes information on Bureau's low cost canal lining program from 1946 to 1962.

1540. United States Bureau of Reclamation, "Water Measurement Manual," United States Bureau of Reclamation, Second Edition 1967.

Comprehensive publication on water measurement method and devices used on recent development such as remote control devices in canal structures; dilution techniques, radioisotopes. Includes tables, charts, formula useful for designers and irrigation system operators.

1541. United States Bureau of Reclamation, "Earth Manual," United States Bureau of Reclamation, Second Printing 1968.

Field and laboratory investigation and constriction control of soils used as foundation and as materials for dams and canals.

1542. United States Department of Agriculture, "Subsurface Drainage of Irrigated Land in Arid and Semiarid Area," United States Department of Agriculture, Soil Conservation Service, Mar. 1959, pp. 3.1-3.59.

1543. United States Department of Agriculture, "Irrigation SCS - National Engineering Handbook - Section 15 - Chapter 9 - Measurement of Irrigation Water," Washington, 1962, pp. 9-72.

1544. United States Department of Agriculture and National Science Foundation, "Sedimentation Annotation Bibliography of Foreign Literature," Survey No. 1, 1959-1964, Survey No. 2 1959-1965, Survey No. 3 1965-1967, Survey No. 4, Survey No. 5, Clearing House for Federal Scientific and Technical Information, United States Department of Commerce, Springfield, Virginia.

Annotated bibliography covering literature published in non-English speaking world. Covers mainly periodicals, monographs and individual papers and pamphlets.

1545. United States Geological Survey, "Techniques of Water Resources Investigation of the United States Geological Survey,"
Book 3 Chapter A1: General Field and Office Procedures for Indirect Discharge Measurement, by Benson, M.A., and Dalrymple, T.
Book 3 Chapter A2: Measurement of Peak Discharge by the Slope-Arc Method, by Dalrymple, T., and Benson, M.A.
Book 3 Chapter A4: Measurement of Peak Discharge at Width Contractions by Indirect Methods, by Matthai, H.F.
Book 3 Chapter A5:Measurement of Peak Discharges at Dams by Indirect Methods, by Hulsing, H.
Book 3 Chapter A6: General Procedures for Gaging Streams.
Book 3 Chapter A7: Stage Measurement at Gaging Stations, by Buchanan, T.J., and Somers, W.P.
Book 3 Chapter A12: Fluorometric Procedures for Dye Tracing, by Wilson, J.F.
Book 4 Chapter A1: Some Statistical Tools in Hydrology.
Book 4 Chapter A2: Frequency Curves, by Riggs, H.C.
Book 8 Chapter A1: Methods of Measuring Water Levels in Deep Wells, by Garber, M.S. and Koopman, F.C.
Book 8 Chapter B2: Calibration and Maintenance of Vertical-Axis Type Current Meters.
Superintendant of Documents, United States Government Printing Office, 1968.

Series of manuals on techniques for planning and executing specialized work in water-resources investigations. Section A of Book 3 relates to surface water. Section A of Book 4 is on statistical analysis. Section A of Book 8 relates to instruments for measurement of water levels, while Chapter B of Book 8 is on instruments for discharge measurements.

1546. United States Geological Survey, "Stream-Gaging Procedures," (By Corbett, D.M. and others), Water Supply Paper No. 888, Superintendent of Documents, United States Government Printing Office, reprinted 1962.

A manual describing method and practices of United States Geological Survey in stage recordings, discharge measurements, studying flow characteristics in open channels, related instrumentation and field work.

1547. United States Geological Survey, "Evaluation and Control of Corrosion and Encrustation in Tube Wells of the Indus Plains, West Pakistan," Gelogical Survey Water Supply Paper 1608-L, 1969, Paper No. 1608-L, 63 pages.

Seepage from rivers and irrigation canals has contributed to waterlogging and soil salinization problems in much of the Indus plains of West Pakistan. These problems are being overcome in part by tube-well dewatering and deep leaching of salinized soils. The ground waters described here are anaerobic and some are supersaturated with troublesome minerals such as calcium carbonate (calcite) and iron carbonate (siderite).

1548. United States Federal Inter-Agency River Basin Commission, "Annotated Bibliography on Sedimentation," Sedimentation Bulletin No. 2, Feb. 1950.

A bibliography on the engineering aspects of sedimentation was compiled from all known sources of information in the English language. It is estimated that over 90% of important articles on sedimentation published prior to 1950 are included. Each reference has been annotated and indexed with respect to subject matter and geographical location. The bibliography also contains references to some unpublished theses and translations of foreign-language articles.

1549. United States Federal Inter-Agency River Basin Commission, "Annotated Bibliography on Hydrology, 1941-1950," Notes on Hydrologic Activities, Bulletin No. 5, June 1952.

1549. Continued

A selected list of papers, articles and books published between 1941 and 1950 in the United States and Canada was compiled. Brief annotations are made to indicate the type of information furnished by the article. Many papers on sedimentation and soil science are included. Listings are arranged alphabetically by author, followed by an index arranged alphabetically by subject.

1550. United States Inter-Agency Committee on Water Resources, "A Study of Methods Used in Measurement and Analysis of Sediment Loads in Streams, Determination of Fluvial Sediment Discharge," United States Inter-Agency Committee on Water Resources Report, 1964, Vol. 14, pp. 151, (70 figures, 2 tables, 83 references).

Reviews the equipment, practices, and some of the basic concepts commonly associated with fluvial sediment investigations. The fundamental concepts of sediment transport are described, and the vertical distribution of suspended sediment is explained on the basis of the turbulence theory. The general principles of sediment discharge measurements are discussed as well as the practical aspects of selecting sampling points.

1551. Utah State University, "Design and Calibration of Submerged Open Channel Flow Measurement Structures," Water Research Laboratory, Logan, Utah, Reports W6 31-2, W631-3, W6 31-4 and W6 31-5, Feb., Mar., Apr., and May 1967.

1552. Vaadia, Y., and Hagan, R.M., "Factors Influencing Plant Growth Under Sprinkler and Surface Irrigation," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 4, 1960, pp. 12.33-12.45.

Considers soil and climate factors controlling plant growth in relation to irrigation practice.

1553. Vanoni, J.A., and Nomicos, G.N., "Resistance Properties of Sediment-Laden Streams," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 85, No. HY5, Paper 2020, May 1959, pp. 77-107.

Experiments were made to determine relative effects on friction factor of flow of suspended sediment load and configuration which form on sand beds of streams; results showed that friction factor of stream carrying suspended sediment is less than comparable one without sediment; reduction of friction factor due to changes in bed configuration is much larger than that due to suspended sediment.

1554. Vanoni, V.A., "Hydraulic Roughness of Alluvial Streams," Proceedings of the 8th General Meeting of the International Association for Hydraulics Research, Seminar II, 1959, pp. 16-SII-1/3.

1555. Vanoni, V.A., "Measurement of Critical Shear Stress for Entraining Fine Sediments in Boundary Layer," California Institute of Technology, Division of Engineering and Applied Science, Report KH-R-7, May 1964, 47 pages.

To simulate flow in settling tank used to remove solids from water, experiments were made to determine shear stress for critical motion of fine sediment in growing boundary layer; for two sediments (geometric mean sieve size of 0.102 mm and 0.037 mm) intensity of sediment motion was judged from frequency of bursts of motion over small area varying from 7 to 18 mm in diam.; when burst frequency fell between 1/3 and 1 burst/sec., critical conditions for inception of motion were considered to obtain.

1556. Van Schilfgaarde, J., "Design of Tile Drainage for Falling Water Tables," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 89, No. IR 2, Pt. 1, Paper 3543, June 1963, pp. 1-11.

Equation is derived for spacing of drains in terms of rate of water-table drop, depth of impervious layer below drains, etc.

1557. Van Schilfgaarde, J., "Transient Design of Drainage Systems," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 91, No. IR3, Proc. Paper 4458, Sep. 1965, pp. 9-22.

1557. Continued

Review of existing transient water table analyses of drainage problems reveals that present techniques permit prediction of water table behavior with sufficient accuracy for the purpose of the practicing engineer. Prediction equations are presented for water table decay. A method is described and illustrated that uses the water table histogram functions for the development of a probability distribution of water table heights from a long-term precipitation record, a corresponding temperature record, and a knowledge of the drainage system's dimensions and the soil's properties.

1558. Vant Woudt, B.D., "Infiltration Behavior Under Furrow and Sprinkler Irrigation," Agricultural Engineering, Vol. 38, No. 5, May 1957, pp. 301-311, 319-320.

1559. Vant Woudt, B.D., "Methods of Irrigating Diversified Crops," Hawaii Agriculture, Vol. 13, 1958, pp. 26-28.

1560. Vant Woudt, B.D., "Recent Advances in the Irrigation of Pastures in New Zealand," World Crops, Vol. 10, 1958, pp. 214-217.

1561. Vant Woudt, B.D., "When to Irrigate Diversified Crops," Hawaii Agriculture, Vol. 13, 1958, pp. 30-32.

1562. Vant Woudt, B.D., "Concrete Pipe for Irrigation in Hawaii," Hawaii Agriculture Experiment Station, No. C-57, Dec. 1959, pp. 62.

1563. Vant Woudt, B.D., "Recent Developments in Boom Sprinkler Irrigation," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 26, 1960, pp. 12.463-12.471.

Points out the weaknesses of the conventional sprinkler irrigation, utilizing rotating sprinklers.

1564. Vant Woudt, B.D., "Uniform Discharge from Multiorificed Pipes," Transactions of the American Society of Agricultural Engineers, Vol. 7, No. 3, 1964, pp. 352-355.

Experiments were conducted to study possibility of obtaining uniform discharge all along length of suspended pipes; difference between measured and calculated pressure caused by head loss by turbulence, friction and expansion across branch was studied.

1565. Vant Woudt, B.D., "Irrigating by Automatically Moving Suspended Pipes," Irrigation Engineering and Maintenance, Mar. 1964, Vol. 14, No. 3, pp. 11-13.

Describes the system consisting of mounting 1200 feet of aluminum pipe centrally which can be operated by hand, or machine-moved over the field; observes that further research is required to solve in a satisfactory way some of the problems involved.

1566. Vant Woudt, B.D., "A Zippered-Pipe Principle for Irrigation Water Supply," Technical Progress Report Hawaii Agriculture Experiment Station 140, Oct. 1964, 12 pages.

1567. Varshney, R.S., "Stilling Basin Characteristics for Low Froude Numbers," Irrigation and Power, Vol. 22, No. 2, 1965, pp. 157-172.

1568. Velev, D., "Irrigation in Bulgaria," Water and Water Engineering, Vol. 61, No. 742, Dec. 1957, pp. 517-522.

1569. Velev, D., Strahilov, E., and Kochev, K., "Lining of Small Irrigation Channels with Asbestos Cement Flumes," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 6, 1960, pp. C.313-C.326.

1570. Venabler, J.R.C., "Private Diversions for Irrigation," Aqua, May 1962.

1571. Vicinelli, P., "Irrigation in Italy," International Journal for Agrarian Affairs, Oxford, Jan. 1963, Vol. 3, No. 4, pp. 205-232.

1572. Vimoke, B.S., and Taylor, G.S., "Approximate Equation for Fluid Flow into Buried Drains," Soil Science Society of American Proceedings, Vol. 24, No. 5, Sep.-Oct. 1960, pp. 418-419.

1573. Vimoke-Suntava, B., "Use of an Electrical Resistance Network in Solving Problems of Steady State Flow of Water in Soil," Abstracts of Dissertations and Titles of Theses, Louisiana State University, Baton Rouge, Louisiana (USA), May 1962, Vol. 22, No. 11, pp. 3956.

1574. Vincent, J., "Effect of Bed Load Movement on the Roughness Coefficient Value," Proceedings of the 12th Congress of the International Association for Hydraulic Research, Paper A20, Vol. 1, 1967, pp. 162.

1574. Continued

The effect of bedload movement on the magnitude of the roughness coefficient is investigated on the basis of experimental results in a rectangular flume, 70 m long. On the basis of results obtained during the experimental research it was possible to derive empirical equations for the computation of roughness coefficient at bedload movement in the range investigated.

1575. Viparelli, M., and Pica, M., "Streams in Large Alluvial Beds of High Slope," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A8, Vol. 1, 1967, pp. 57.

Large alluvial beds of high slope are possible only if they are formed of coarse noncohesive sand or gravel or of their mixture. In this case the water streams do not present a well defined channel: shallow sections, large or almost as large as the bed, are followed by other narrower and deeper ones. Sand discharges and local slopes are continuously varying around their average values without apparent cause. For higher bottom slopes a linear relation between slopes and sand discharges results for each sand size and each water flow; for smaller slopes sand discharge decreases very slowly with decreasing slope. Relation between sand discharges and slopes appears to depend on channel width, only if the latter decreases below a certain value.

1576. Visser, W.C., "Soil Science and Sprinkler Irrigation," Institute for Land and Water Management Research (Netherlands), Technical Bulletin 10, 1959, 13 pages.

1577. Vivian, C.P., "A Miniature Open Flume," Civil Engineering and Public Works Review, Apr. 1962, No. 669, pp. 475-476.

1578. Vladisavljevic, M.Z., "Hydraulics of Small Irrigation and Drainage Structures," Proceedings of the 9th General Meeting of the International Association for Hydraulic Research, Seminar A-General Report, 1961, pp. 1305-1313.

1579. Vlugter, H., "Some Aspects of Water Control in West Pakistan," Pakistan Journal of Science, Vol. 12, No. 4, July 1960, pp. 181-183.

1580. Vlugter, H., "Sediment Transportation by Running Water and the Design of Stable Channels in Alluvial Soil," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 6, 1960, pp. C239-C255.

1581. Vlugter, H., "Sediment Transportation by Running Water and the Design of Stable Channels in Alluvial Soil," Proceedings of the West Pakistan Engineering Congress, Vol. 45, Pt. 1, Paper No. 347, 1961, pp. 23-26.

Draws attention to the main factors governing the transport of debris by running water and shows how the sinking material theory could be applied in hydraulic engineering when designing canals or training works in rivers.

1582. Wagner, V.J., "Laying Tile Drains," Queesland Agricultural Journal, Brisbane (Australia), May 1962, Vol. 88, No. 5, pp. 261-263.

1583. Walker, P., and Lillard, J.H., "Land Forming - Accepted Drainage Practice," Agricultural Engineering, Vol. 41, No. 1, Jan. 1960, pp. 24-27.

Study of engineering practices and costs of various operations required for land forming; on heavy coastal plain soil in eastern Virginia.

1584. Wallis, J.R., and Anderson, H.W., "An Application of Multivariate Analysis to Sediment Network Design," Symposium: Design of Hydrological Networks, Quebec, June 15-22, 1965, Vol. 1, Publication No. 67, pp. 357-371.

Most stream sedimentation stations are selected to answer the simple question, "What Sedimentation Problem Would Confront a Structure Installed at the Site Today?"

1585. Walter, J., Shanmugam, S., and Raj, A.N., "Flume-Type Sediment Excluders," Transactions of the 6th Congress of the International Commission on Irrigation and Drainage, No. 3, 1966, pp. 20.325-20.335.

Results are reported of studies on the development of a new type of sediment excluders.

1586. Wantland, D., and Goodman, D.L., "Electricity Detects Canal Seepage," Reclamation Era, Aug. 1962, Vol. 48, No. 3, pp. 63-65.

1587. Ward, K.J., "Echo Sounding Recorder," Aqua, Nov. 1962.

1588. Washington State University, Agricultural Extension Service, "Alternate Row Irrigation Rotation," Washington University Agriculture Extension, Jan. 1962, 3 pages.

1589. Water and Water Engineering, "New Automatic Channel Flow Regulator," Water and Water Engineering, Vol. 60, No. 724, June 1956, pp. 250-251.

Describes the arrangement of a floating cylinder with notches for use in maintaining constant flow in distribution channels under conditions of varying water level in the main channel.

1590. Watson, C.E., Rundle, V.A., Hunte, M.J., and Cornell, J.E., "New Process for Reducing Seepage From Canals," 6th Congress of World Petroleum, Proceedings Section 6, 1963, pp. 453-462.

Treating process using certain petroleum emulsions was developed that reduces seepage of water from irrigation canals by as much as 90%; process involves ponding or flowing diluted emulsion in canals; emulsion penetrates soil and forms water impermeable subsurface membrane.

1591. Watts, J., Simons, D.B., and Richardson, E.V., "Variation of α and β Values in a Lined Open Channel," Journal of the Hydraulics Division, American Society of Civil Engineering, Vol. 93, No.HY6, Proc. Paper 5593, Nov. 1967, pp. 217-234.

A study of the variation in magnitude of the energy coefficient, α, and the momentum coefficient, β, was conducted for subcritical open-channel flow in concrete-lined trapezoidal canals containing horizontal curves. The Manning's n was 0.013 for reaches without bends; values of α and β were found to be smaller than values proposed in current literature, and there was only small variation of α and β values with stage, channel geometry, position, and radius of curvature. For all cross sections analyzed, the energy and momentum coefficients may be considered constant with values of 1.04 and 1.02, respectively.

1592. Webber, R.T.J., "Value and Use of Broad Based Furrows," Water Talk, State Rivers and Water Supply Commission, Victoria, Australia, Mar. 1964, pp. 12-15.

1593. Wefly, E.F., "The Use of Sprinkler Irrigation Systems for Wastewater Disposals," Irrigation Engineering and Maintenance, Jan. 1958, pp. 21-27.

1594. Wellman, H.W., and Wilson, A.T., "Salt Weathering, A Neglected Geological Erosive Agent in Coastal and Arid Environments," Nature, 1965, Vol. 205, No. 4976, pp. 1097-1098.

Salt weathering of rocks occurs in sites protected from wind and rain where salts are concentrated, or where there is a rapid supply. Cyclic changes in humidity and/or temperature must include the crystallization point of at least one of the salts present.

1595. The White House, "Report on Land and Water Development in the Indus Plain," The White House, President's Advisory Committee, Jan. 23, 1964.

1596. Whittington, R.B., "The Rapid Computation of Backwater Curves Without Recourse to Tabulated Functions," Journal of the Institution of Water Engineers, Vol. 14, No. 1, Feb. 1960, pp. 67-71.

1597. Whittington, R.B., "Friction Factors in Smooth and Rough Pipes," Journal of the Institution of Water Engineers, Vol. 14, No. 4, July 1960, pp. 301-306.

1598. Wiersma, D., "Irrigation in Humid Regions," Crops and Soils, Vol. 13, No. 7, Apr.-May 1961, pp. 14-16.

1599. Wilke, O., and Smerdon, E.T., "Solution of Irrigation Advance Problem," Proceedings of the American Society of Civil Engineers, No. IR3, Pt. 1, Paper 4471, Sep. 1965, pp. 23-24.

Dimensionless curves for solution of infiltration-advance problem in irrigation hydraulics are developed for accumulated infiltration; curves allow direct determination of either stream size or length of run; empirical equation for prediction of depth of flow and average area of surface storage for typical furrows.

1600. Willardson, L.S., "A Method for Irrigation Intake-Rate Determination," Transactions of the American Society of Agricultural Engineers, Vol. 3, No. 1, 1960, pp. 21-24.

1601. Willardson, L.S., "What is Irrigation Efficiency," Irrigation Engineering and Maintenance, Apr. 1960, pp. 13, 14, 18.

Defines project water use efficiency, farm water use efficiency, farm water application efficiency, field water application efficiency, water conveyance efficiency, farm water application efficiency, field water application efficiency, etc.

1602. Willardson, L.S., and Bishop, A.A., "Analysis of Surface Irrigation Application Efficiency," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 93, No. IR2, Proc. Paper 5267, June 1967, pp. 21-36.

1602. Continued

Precise analytical design of surface irrigation is not possible at the present time (as of 1967). Designs can be improved, however, if the interrelationships of design parameters of infiltration and advance are understood. Two analyses are presented that show the effect of advance time and infiltration rate on water-application efficiency, and that surface irrigation water-application efficiencies above 60% are easily attainable under reasonable design and operation conditions. Low water-application efficiencies measured in the field are attributed to overirrigation after the root zone is filled.

1603. Willardson, L.S., Fouss, J.L., Reeve, R.C., and Fausey, N.R., "Entry Velocity Control Limits Drain Sedimentation," Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 94, No. IR4, Proc. Paper 6300, Dec. 1968, pp. 455-463.

Control of the velocity of water entering a subsurface drain will effectively prevent sedimentation. An anti-sedimentation concept based on the Stokes Law settling velocity of particles is described in detail. Laboratory tests are reported for different sized particles, shapes of opening, and cross-sectional areas of flow. Tentative design criteria are suggested. The prevention of sediment entry into drains by this method is not by a filtering process.

1604. Willen, D.W., "Surface Soil Textural and Potential Erodibility Characteristics of Some Southern Sierra Nevada Forest Sites," Proceedings of the Soil Science Society of America, 1965, Vol. 2, No. 29, pp. 213-218, (3 figures, 5 tables, 13 references).

Samples of residual, upland forest soils collected at elevations of 6,500 to 8,000 ft. in the southern Sierra Nevada were analyzed for texture and potential erodibility. Variations in the soil forming factors of parent rock, vegetation, aspect, slope, and elevation, were found to affect surface texture and potential soil erodibility as shown by regression analysis.

1605. Williams, D.A., "Lessons in Land Use," Journal of Soil Water Conservation, Soil Conservation Society of America, 838 Fifth Ave., Des Moines 14, Iowa (USA), Nov.-Dec. 1962, Vol. 17, No. 6, pp. 255-260.

1606. Willson, G.B., "Self-Regulating Head-Gate for Controlling Ditch-Water Flow," Transactions of the American Society of Agricultural Engineers, Vol. 7, No. 4, 1964, pp. 469-470.

Tests of self-regulating headgate consisting of flow-regulating device, channel, and flow-sensing device designed to control flow in irrigation canals are described; flow-regulating device is undershot radial gate; flow-sensing device is impluse plate designed so that force of water on plate is nearly constant for any flow through gate, regardless of depth of flow, and is function of flow or discharge.

1607. Willson, R.J., "United States Bureau of Reclamation's Lower-Cost Canal Lining Program," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Vol. 84, No. IR2, Pt. 1, Paper 1589, Apr. 1958, pp. 30.

Report on practices carried out by Bureau of Reclamation in canal lining; evaluation of linings on 1000 units of canals using unreinforced concrete, shotcrete, asphalt and earth, as well as some reinforced concrete; methods used to place linings, thickness required, and advantages of each type under varying soil conditions; note on experimental sediment and plastic linings.

1608. Willson, R.J., "Use of Chemical Soil Sealants to Reduce Seepage from Canals," United States Bureau of Reclamation, Federal Center, Denver, Colorado, 1962, 15 pages.

1609. Willson, R.J., "Chemical Sealants and Canal Seepage," Transactions of the American Society of Agricultural Engineers, Vol. 7, No. 1, 1964, pp. 56-60, 66.

Review of research projects and studies of linings for irrigation canals by Bureau of Reclamation; detailed data on field results obtained from treating with cationic asphalt emulsions, petroleum-base emulsions, and resinous polymers.

1610. Willson, R.J., "Controlling Canal Seepage with Soil Sealants," American Society of Civil Engineers, Water Resources Engineering Conference, Preprint 335, May 16-20, 1966, 45 pages.

1610. Continued

Use of materials by United States Bureau of Reclamation to seal soils of unlined canals and laterals in western part of United States is discussed; types of materials used, their method of application, and both laboratory and field studies are described; results of 42 field tests, in which chemicals or related materials were used as sealants, are presented.

1611. Wimberly, J.E., "Designing a Furrow Irrigation system for Sugar Cane," Agricultural Engineering, St. Joseph, Michigan, Ames, Louisiana (USA), Mar. 1964, Vol. 45, No. 3, pp. 138-139.

1612. Winter, E.J., "A Glossary of Terms Used in Irrigation," Scientific Horticulture, Canterbury, England, 1962, 1963, No. 16, pp. 87-95.

1613. Wiser, E.H., "Irrigation Planning Using Climatological Data," Proceedings of the American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, Dec. 1964, Vol. 9, No. IR4, Paper 4551, pp. 1-11.

Mentions briefly several available water balance models that use climatological data and which may be used to simulate irrigation systems for the long periods of climatological records when no actual irrigation systems are in operation.

1614. Witzigman, F.S., "United States Inter-Agency Sedimentation Instruments," Proceedings of the 8th General Meeting of the International Association for Hydraulics Research, Seminar II, 1959, pp. 19-SII-1/2.

1615. Witzigman, F.S., "Automatic Sediment Sampling Equipment and Rapid Analysis Methods," Publication de l'Association Internationale d'Hydrologie Scientifique, No. 59, 1962, pp. 327-335.

1616. Wolfe, J.W., "New Ideas About Sprinkler Irrigation," Oregon State Horticultural Society, Annual Report, Vol. 52, 1960, pp. 152-155.

1617. Wolman, M.G., and Brush, L.M., "Factors Controlling the Size and Shape of Stream Channels in Coarse Noncohesive Sands," United States Geological Survey, Professional Paper 282-6, 1961, pp. 183-210.

1618. Wolman, M.G., and Schick, A.P., "Effects of Construction on Fluvial Sediment, Urban and Suburban Areas of Maryland," Water Resources Research, 1967, Vol. 3, No. 2, Richmond, Virginia, pp. 451-464.

The equivalent of many decades of natural or even agricultural erosion may take place during a single year from areas cleared for construction.

1619. Woo, D.C., and Brater, E.F., "Laminar Flow in Rough Rectangular Channels," Journal of Geophysical Research, Vol. 66, No. 12, Dec. 1961, pp. 4207-4217.

Results of investigation of open channel flow in laminar and transition ranges; values of friction factor were determined for 2 roughnesses and for 11 slopes varying from 0.001 to 0.060; for laminar flow, values departed significantly from theoretical ones derived for smooth surfaces for very rough surfaces, variations depended on slope; results for both laminar and transition ranges are presented graphically.

1620. Woo, K.B., Boersma, L., and Stone, L.N., "Dynamic Simulation Model of the Transpiration Process," Water Resources Research, 1966, Vol. 2, No. 1, pp. 85-97.

Plant life processes are related in a complex way to the balance between the water demand of the atmosphere and the availability of water to the plant root. An exploration of the dynamic status of water in the plant is very important. As an approach to an integrated analysis of the dynamic system of water movement through the soil-plant-atmosphere continuum, a simulation model of the transpiration process is presented.

1621. Wood, D., "The Provision of Water for Irrigation," World Crops, Vol. 10, No. 6, June 1958.

Discusses relative merits of irrigation by surface waters brought from distant sources and by subsurface waters pumped to the surface at site.

1622. Wood, I.D., "Shaping the Land for Irrigation," World Farming, Vol. 3, No. 3, Mar. 1961, pp. 30-32, 35.

1623. Wood, I.D., "Irrigation Structures for the Farm," World Farming, Vol. 3, No. 6, June 1961, pp. 16-18, 23.

1624. Wood, I.D., "Irrigation Equipment for Small Farms," World Farming, Vol. 3, No. 8, Aug. 1961, pp. 16, 18, 23-24.

1625. Woods, A.J., and Macmillan, D.H., "A New Development in Current Meters," Dock and Harbor Authority, Vol. XI, No. 469, Nov. 1959, pp. 205-208.

1626. Wooldridge, D.D., "Effects of Parent Material and Vegetation on Properties Related to Soil Erosion in Central Washington," Proceedings of the Soil Science Society of America, 1964, Vol. 3, No. 28, pp. 430-432.

In a preliminary study of physical properties of wild land soils, three soil parent materials were sampled by horizons under forest and adjacent grass cover. Soil properties analyzed were mean water-stable aggregate, bulk density, organic matter, Ph, total porosity, and percent clay, silt, and sand.

1627. Wright, C.S., "Sprinkler Irrigation Compared with Surface Irrigation," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 4, Report 14, 1960, pp. 12.221-12.230.

Discusses advantages and disadvantages of sprinkler irrigation vis-a-vis surface irrigation.

1628. Wylie, E.B., "Control of Transient Free-Surface Flow," Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 95, No. HY1, Proc. Paper 6360, Jan. 1969, pp. 347-361.

A theory is presented to define methods of optimum gate operation for altering flow conditions in an open channel. The analytical procedure prescribes the motion of the control devices in the channel so the transient conditions are known and controlled during the period when the flow is being changed from one given situation to another desired flow condition. The theory is developed from the basic differential equations for unsteady flow in a prismatic channel, including frictional losses. Two examples are detailed in this study.

1629. Yalin, M.S., "Expression for Bed-Load Transportation," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY3, Pt. 1, Paper 3525, May 1963, pp. 221-250.

Formula for calculation of bed-load transportation per unit time and per unit width of flow; formula is valid for steady and uniform turbulent flow and for bed material consisting of grains of equal size and shape.

1630. Yalin, M.S., "Similarity in Sediment Transport by Currents," Great Britain, Department of Science and Indus Research, Hydraulics Research Paper 6, 1965, pp. 24.

Study concerns dynamic similarity of mechanical complex which results from flow of real fluid over movable bed and transportation of solid particles which are lifted from bed by flow; steady and uniform flow or real fluid, having free surface, over cohesionless movable bed is considered; dimensionless expression of simultaneous motion of phases of fluid and bed material is derived, and characteristics and dynamic similarity of two-phase motion analyzed; experiments and results are described.

1631. Yalin, S., and Lehn, F., "Experimental Investigation of the Laws of Filter Flow," International Association for Hydraulic Research, 9th Convention, Dubrovnik, Yugoslavia, 1961, Theme 2, pp. 324-331.

The purpose of this report is to make a contribution to the investigation of the filtration law in a homogeneous porous medium, especially by large values of Reynolds number. It is further limited to the investigation of an equal-size sphere medium.

1632. Yaron, D., Bieloral, H., Wachs, J., and Putter,J., "Economic Analysis of Imput-Output Relations in Irrigation," 5th Congress of the International Commission on Irrigation and Drainage Transactions, Vol. 4, 1963, pp. 16.13-16.34.

Empirical analysis of irrigation experiments of cottom is presented, through fitting empirical production functions to experimental data; theoretical work underlying analysis is reviewed and problems of methodology are discussed; production functions are described and optimal irrigation practices for various farm situations are pointed out.

1633. Yevjevich, V., and Quimpo, R.G., "Stochastic Description of Daily River Flows," Proceedings, International Hydrology Symposium, Ft. Collins, Colorado, Sep. 6-8, 1957, Vol. 1, Paper No. 38, pp. 290.

A mathematical representation for series of daily streamflows is postulated. The model is made up of a periodic and a stochastic component. The periodic component is applied both to 365 mean daily flows and to 365 standard deviations about these means. Five rivers are used to show the method of approach.

1634. Yevjevich, V., "Prediction of Water Yield in High Mountain Watersheds Based on Physiography," Report prepared for the Bureau of Reclamation, Hydrology Series, Colorado State University, Technical Paper No. 22, Aug. 1967.

1635. Yevjevich, V., and Filmer, R.W., "Experimental Results of Dye Diffusion in Large Pipelines," Proceedings for the International Association for Hydraulic Research, Ft. Collins, Colorado, Sep. 11-18, 1967, Vol. 4, Paper No. D-13, pp. 115.

A Study was made of the lateral diffusion resulting from continuous point-source injection of soluable tracers into a 36-inch pipeline at high Reynold's numbers.

1636. Zafar, I.A., "Impact of Floods on Water Resources Development," Symposium on Floods in West Pakistan, West Pakistan Engineering Congress, Lahore, Feb. 1958, Vol. II, No. 20.

1637. Zaidi, H.S., "When and How to Apply Water to Crops," 3rd Regional Irrigation Practices Leadership Seminar Nesa Region, Feb. 15-26, 1960, pp. 95-97.

Discusses the water requirements of the Indus Valley soils with reference to salinity hazard and turn system of water distribution.

1638. Zakon, D.L., "Flooding System Saves Time, Labour in Irrigation," American Nurseryman, Vol. 112, No. 4, Aug. 15, 1960, pp. 9, 48-49, 52-54.

1639. Zanker, K., "A New Method for the Determination of Appropriate Depths and Spacing of Tile Drains with Regard to Hydraulic Conductivity of Soil and to Depth of an Impermeable Layer," Transactions of the 4th Congress on Irrigation and Drainage, International Commission on Irrigation and Drainage, Vol. 3, Report 22, 1960, pp. 11.393-11.416.

1640. Zernial, G.A., and Laursen, E.M., "Sediment-Transporting Characteristics of Streams," Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 89, No. HY1, Pt. 1, Paper 3396, Jan. 1963, pp. 117-137.

Study to determine scatter of observed sediment load discharge relationship; data of measurements made by Geological Survey, United States Department of Interior were utilized in studies that covered Middle Loup River in Nebraska, Fivemile Creek in Wyoming, and Rio Grande in New Mexico.

1641. Zetzsche, J.B., and Newman, J.S., "Subirrigation with Plastic Pipe," Agricultural Engineering, Vol. 47, No. 2, Feb. 1966, pp. 74-75.

Tests were conducted to establish field design using polyethylene and polyvinyl chloride plastic pipes and to determine friction loss rate at very low flow in plastic pipe; calcu lated friction loss for laminar flow range and friction loss for turbulent flow range were tabulated for use in graphical integration to obtain pressure gradient; selection of effective orifice flow area, sq. ft. value; methods of forming orifice outlet in high density and low density plastic pipe.

1642. Zimmermann, U., Ehhalt, D., and Munnich, K.O., "Soil-Water Movement and Evapotranspiration: Changes in the Isotopic Composition of the Water," Proceedings of the Symposium on Isotopes in Hydrology, International Atomic Energy Agency and IUGG, Vienna, Nov. 14-18, 1966, Vienna, 1967, pp. 567-584.

An artificial rainfall spiked with tritium, marks the boundary between older rainwater below and younger rainwater above. When the tracer mark has reached a certain depth the amount of soil water above the tracer mark gives that fraction of the rain fallen since the date of tracer input, which is still present in the soil.

1643. Znamenskaya, N.S., "The Analysis and Estimating of Energy Losses by Instantaneous Velocity Distribution of Streams with Movable Bed," Proceedings of the 12th Congress of the International Association for Hydraulics Research, Paper A4, Vol. 1, 1967, pp. 27.

Deals with the kinematic structure of turbulent stream with movable bed. Analysis of the velocity distribution images for dunes of different forms used to evaluate energy losses in different fragments and to obtain necessary empiric relationships. Obtained empirical relationships used to perform hydrodynamic estimation of energy losses.

LIST OF SOURCES

1. Agricultural Engineering, American Society of Agricultural Engineers, 420 Main Street, St. Joseph, Michigan, United States.

2. Agricultural Engineering Research, Silsoe, England.

3. Agricultural Experiment Station, Montana State College, Bozeman, Montana, 59715, United States.

4. Agricultural Experiment Station, University of Arkansas, Fayetteville, Arkansas, 72701, United States.

5. Agricultural Leaders Digest, 120 East Collin Avenue, Corsicana, Texas, United States.

6. Alexandria Journal of Agricultural Research, Alexandria, United Arab Republic.

7. American City, New York, New York, United States.

8. American Geophysical Union, 1530 P Street, Northwest, Washington 5, D.C., United States.

9. American Journal of Science, New Haven, Connecticut, United States.

10. American Nurseryman, Rochester, Massachusetts, United States.

11. American Scientist, New Haven, Connecticut, United States.

12. American Society of Agricultural Engineers, 420 Main Street, Saint Joseph, Michigan, United States.

13. American Society of Agronomy, 2702 Monroe Street, Madison 5, Wisconsin, United States.

14. American Society of Civil Engineers, 345 East 47th Street, New York, New York, 10017, United States.

15. American Society for Horticultural Science, College Park, 615 Elm Street, Saint Joseph, Michigan, 49085, United States.

16. American Society of Mechanical Engineers, 20th E Northampton Street, Easton Pennsylvania, United States.

17. American Waterworks Association, 500 5th Avenue, New York 18, New York, United States.

18. Aqua, The State River and Water Supply Commission, Melbourne, Victoria, Australia.

19. Association Internationale d'hydrologie Scientifique, (International Association for Scientific Hydrology), Assemble General, Washington, D.C., United States.

20. Australian Journal of Experimental Agricultural and Animal Husbandry, Australia.

21. Better Crops with Plant Food, Washington, D.C., United States.

22. Bhagirath, The Director of Publications, Publications Division, Ministry of Information and Broadcasting, Government of India, Old Secretariat, Delhi, (India).

23. Cane Growers' Quarterly Bulletin, Brisbane, Australia.

24. Central Board of Irrigation and Power, Curzon Road Barracks, New Delhi, India.

25. Civil Engineering and Public Works Review, 154 Fleet Street, London, E.C.4, England.

26. Commission Internationale du Genie Rural, 15 Avenue du Maine, Paris 15e, France.

27. Commonwealth Engineer, Tait Publishing Company, 349 Collins Street, Melbourne, Australia.

28. Colorado State University Agricultural Experiment Station, Fort Collins, Colorado, 80521, United States.

29. Colorado State University, Engineering Research Center, Fort Collins, Colorado, 80521, United States.

30. Crops and Soils, Madison, Wisconsin, United States.

31. Dairy Digest, Department of Agriculture, Victoria, Australia.

32. Department of Scientific and Industrial Research, Hydraulic Research Station, Howbery Park, Wallingford, Berks, England.

33. Dock and Harbour Authority, London, England.

34. The Engineer, 28 Essex Street, London, W.C.2., England.

35. Engineering, 35-36 Bedford Street, London, W.C.2., England.

36. Engineering Association of Ceylon, Colombo, Ceylon.

37. Engineering Institute of Canada, 2050 Mansfield Street, Montreal, Canada.

38. Engineering News, Quarterly Journal of West Pakistan Engineering Congress, Irrigation and Power Secretariat, Lahore, Pakistan.

39. Engineering News Record, McGraw-Hill Publishing Company, Inc., 99-129 North Broadway, Albany, New York, United States.

40. Farmers' Club Journal, London, England.

41. Geotechnique, London, England.

42. Hawaii Sugar Technological Report, Honolulu, Hawaii, United States.

43. Idaho State Horticultural Society, Boise, Idaho, United States.

44. Indian Construction News, 24 Brabourne Road, P. O. Box 934, Calcutta, India.

45. Indian Farm Mechanisation, Gautampur, New Delhi - 16, India.

46. Indian Farming, Manager of Publications, Government of India, Civil Lines, Delhi, India.

47. Indian Journal of Agricultural Economics, Indian Society of Agricultural Economics, 46-48, Esplanade Mansions, Mahatama Gandhi Road, Bombay - 1, India.

48. Indian Journal of Agronomy, Bangalore, India.

49. Indian Journal of Engineering and Technology, Janmabhoomi Chambers, Fort Street, Ballard Estate, Bombay, India.

50. Indian Journal of Power and River Valley Development, 6/2 Madan Street, Calcutta - 13, India.

51. Indus, Monthly Journal of West Pakistan Water and Power Development Authority, Wapda House, Lahore, Pakistan.

52. Industrial Wastes, Chicago, Illinois, United States.

53. Institute of British Agricultural Engineers, 24 Portland Place, London W.1., England.

54. Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1, England.

55. Institution of Engineers (Australia) Science House, Gloucester and Essex Streets, Sydney, Australia.

56. Institution of Engineers (India), 8 Gokhale Road, Calcutta - 20, India.

57. Institution of Engineers (Pakistan), Dacca, Pakistan.

58. Institution of Water Engineers, Parliament Mansions, Abbey Orchard Street, London S.W.1, England.

59. Instrument Engineer, George Kent Ltd., Luton, Beds, England.

60. Instruments and Automation, 845 Ridge Avenue, Pittsburg 12, Pennsylvania, United States.

61. International Association for Hydraulic Research, Raam 61, P. O. Box 117, Delft, Netherlands.

62. International Atomic Energy Agency, Radioisotopes in Hydrology, Kartner Ring 11, Vienna 1, Austria.

63. International Commission on Irrigation and Drainage, 184 Golf Links, New Delhi - 3, India.

64. International Congress on Irrigation and Drainage - see International Commission on Irrigation and Drainage.

65. International Geodetic and Geophysical Union, International Union of Geodesy and Geophysics, Geophysics Laboratory, University of Toronto, Toronto 5, Ontario, Canada.

66. International Rice Commission Newsletter, Bangkok, Thailand.

67. Irrigation Engineering and Maintenance, 264 Gravier Street, New Orleans 12, Louisiana, United States.

68. Irrigation Research Institute, West Pakistan Irrigation Department, Lahore, Pakistan.

69. Irrigation Research Station, Poondi - Madras, India.

70. Journal of Agriculture, Victorian Department of Agriculture, Melbourne, Australia.

71. Journal of Chartered Land Agents' Society, London, England.

72. Journal of Geology, Chicago, Illinois, United States.

73. Journal of Geophysical Research, 5241 Broad Branch Road, North West, Washington 15, D.C., United States.

74. Journal of Range Management, Portland, Oregon, United States.

75. Journal of Royal Society of Arts, Royal Society of Arts, 6-8 John Adam Street, London W.C.2., England.

76. Kentucky University, Engineering Experiment Station, Lexington, Kentucky, United States.

77. La Houille Blanche, Rue Paul Verlaine, Boite Postale 41, Grenoble, France.

78. Land Economics, Madison, Wisconsin, United States.

79. Massachusetts Institute of Technology, Department of Civil and Sanitary Engineering, Cambridge, Massachusetts 02139, United States.

80. National Reclamation Association, Washington, D.C., United States.

81. Near East and South Asia Region (NESA), Irrigation Practices Seminar USAID Mission to India, New Delhi, India, or USAID Mission to Pakistan, Islamabad, Pakistan.

82. Nebraska Agricultural Experiment Station, Lincoln, Nebraska 68508, United States.

83. New Irrigation Era, Chepauk, Madras India.

84. New Mexico Agricultural Experiment Station, State College, New Mexico, United States.

85. New Zealand Engineering, 5th Floor, Dominion Building, Wellington, New Zealand.

86. Pacific North West Bulletin, Pullman, Washington, United States.

87. Pakistan Geographical Review, University of the Punjab, Department of Geography, New Campus, Lahore, Pakistan.

88. Pakistan Journal of Science, Lahore, Pakistan.

89. The Port Engineer, 51 Circular Garden Reach Road, Kidderpore, Calcutta - 23, India.

90. Portland Cement Association, Research and Development Laboratories, Shokie, Illinois, United States.

91. Proceedings of First Intersociety Conference on Irrigation and Drainage, United States National Committee ICID, Denver 15, Colorado, United States.

92. Reclamation Era, Superintendent of Documents, United States Government Printing Office, Washington 25, D.C., United States.

93. Science and Culture, Indian Science News Association, 92 Upper Circular Road, Calcutta, India.

94. Scottish Journal of Agriculture, (later. Scottish Agriculture), Department of Agriculture for Scotland, H.M. Stationery Office, 17 Blackfriars Street, Edinburgh, England.

95. Sedimentology, Amsterdam, Netherlands.

96. Society of Economists, Paleontologists and Mineralogists, P. O. Box 979 Tulsa, Oklahoma 74101, United States.

97. Soil Conservation Society of America 838 Fifth Avenue, Des Moines 14, Iowa, United States.

98. Soviet Hydrology, Published by American Geophysical Union, 1530 P. Street, Northwest, Washington 5, D.C., United States.

99. Spreckles Sugar Beet Bulletin, Sacramento, California, United States.

100. Sprinkler Irrigation Association, Santa Monica, California, United States.

101. UNESCO, UNESCO House, Palace de Fontenoy, Paris - 7, France.

102. United Nations Food and Agricultural Organization, Rome, Italy.

103. United Nations Conference on the Application of Science and Technology for the Benefit of Less Developed Areas, Geneva, 1962. (see UNESCO).

104. United States Bureau of Mines, Washington D.C., United States.

105. United States Department of Agriculture, Agriculture Research Service, Washington 25, D.C., United States.

106. United States Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, Mississippi 39181, United States.

107. United States Geological Survey, Colorado State University, Fort Collins, Colorado 80521, United States.

108. United States Geological Survey, Water Resources Division, Washington D.C., 20242, United States.

109. University of California, Department of Water Science and Engineering, College of Agriculture, Davis, California 95616, United States.

110. University of Florida, Engineering and Industrial Experiment Section, Coastal Engineering Laboratory, Gainesville, Florida 32603, United States.

111. Washington Agricultural Experiment Station, Pullman, Washington 99163, United States.

112. Water Power, Tothill Press Ltd., 33 Tothill, Westminster, London S.W.1, England.

113. Water Resources Development Training Center, University of Roorkee, India.

114. Water Resources Research, 2901 Byrdhill, Richmond, Virginia 23205, United States.

115. Water and Sewage Works, Gillett Publishing Company, 22 West Maple St. Chicago 10, Illinois, United States.

116. Water and Water Engineering, 30/31 Furnival Street, London EC4, England.

117. Western Construction News, 600 Mission Street, San Francisco, California, United States.

118. Western Crops and Farm Management, California, United States.

119. West Pakistan Engineering Congress, Irrigation and Power Secretariat, Lahore, Pakistan.

120. World Crops, Leonard Hill Ltd., Stratford House, 9 Eden Street, London N.W.1, England.