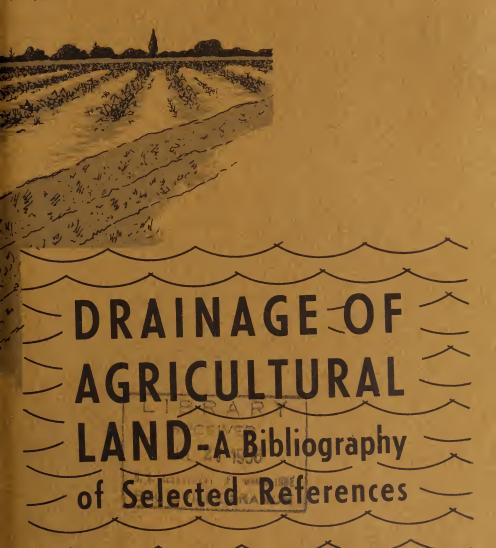
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DRAINAGE OF AGRICULTURAL LAND-A Bibliography of Selected References

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PREFACE

This bibliography contains selected, annotated references to the literature published between 1936 and 1955 on the drainage of land for farming. Subjects included are methods and techniques, equipment, soil science and hydrology as related to drainage problems, needs and effects of drainage, descriptions of specific projects in many different countries, and drainage law and financing of drainage projects in the United States. Drainage for mosquito control and drainage of forests have been included, but references on drainage of land for nonagricultural uses such as roads and airports have been omitted except when techniques described are specifically applicable to agricultural projects. Because of the importance of the ground-water problem in the Western States to drainage questions, references on ground water in this area have been included, even when they do not themselves relate specifically to drainage.

Material in languages other than English has been limited to the practical aspects of drainage. Such references are cited in the vernacular with either a translation of the title into English or a brief abstract in English, except that for languages not using the Roman alphabet, titles of journal articles are given only in translation.

The bibliography is arranged according to a subject classification, and is provided with a combined author, subject, and geographic index. Because of the preponderance of material relating to the United States, this term has not been used in the index. Names of individual States and groups of States, however, will be found in the index.

For literature published before 1936 the reader should consult Bibliography on Land Drainage, by Dorothy W. Graf, published in 1936 by the Bureau of Agricultural Engineering of the Department of Agriculture, now out of print, but available in many libraries.

The Library acknowledges gratefully the assistance of Mr. John G. Sutton of the Soil Conservation Service, who helped in the formulation of the bibliography, answered many technical questions as it progressed, and advised on the inclusion of doubtful references.

All references except those marked with an asterisk have been examined by the compilers. Call numbers following the body of the citation are those of the Library of the Department of Agriculture. The location in another library of the copy used has been shown in the case of publications not available at the Department of Agriculture.

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CONTENTS

| G T V T T T T T T T T T T T T T T T T T | Page |
|---|-------------------------------------|
| GENERAL | . 1 |
| ResearchSoil Science in Relation to Drainage | . 7 |
| LEGISLATION AND FINANCE | 29 |
| SPECIAL PROBLEMS IN DRAINAGE | 33 |
| Irrigated Lands Peat and Muck Soils Forests Mosquito Control | . 44 49 |
| DRAINAGE PRACTICES | 56 |
| Surface Drainage Open-ditch Drainage Subsurface Drainage Pump Drainage and Wells Dams, Dikes, and Levees Equipment. | 79 86 103 109 |
| DRAINAGE NEEDS AND EFFECTS. | 121 |
| PROJECTS AND PROGRAMS | 129 |
| North America. U. S. A. Canada. Greenland. Mexico. Central America and the West Indies. South America. Continental Europe. British Isles. Africa. Asia. Australia, New Zealand, and the Pacific Islands. | 129 137 137 137 138 139 139 147 151 |
| INDEX | 155 |

DRAINAGE OF AGRICULTURE LAND A Bibliography of Selected References

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76. CHILDS, E. C. Stability of clay soils. Soil Sci. 53:79-92, illus., tables. Feb.1942. 56.8 So3

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drainage.

77. CHILDS, E. C. The water table, equipotentials, and stream-lines in drained land. 1-6. Soil Sci. 56:317-330; 59:313-327,405-415; 62:183-192; 63:361-376; 71:233-237,illus. Nov.1943, Apr.-May 1945, Aug.1946, May 1947, Mar.1951. 56.8 So3

Three sets of experiments are presented to show (a) how the water table falls with increase of drain diameter; (b) the relation of watertable height to rate of rainfall; and (c) the influence of the depth of the

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A tentative explanation is presented, relating the field-capacity values to the water supply available for drainage and the distribution of permeability and moisture potential gradients through the wet zone at the time when the drainage rate has become insignificantly small. The study suggests that shallow field irrigations or the irrigation and drainage of short soil columns in the laboratory do not necessarily provide valid measures of the field capacity of a soil

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Some morphological features of profiles showing various degrees of hydromorphism are described from soils under permanent pasture in northwest England. It is suggested that certain basic patterns are discernible in most gley soils, and the modifications resulting from variations in texture, structure, and position of the water table in the profile are discussed.

82. DAHL, N. J., and JUUSELA, T. Dränering. Nord. Jordbr-forsk. 1948:657-672, illus. 11 N752

The hydraulic basis for calculating distance between drainage pipes, by N. J. Dahl, p. 657-663; Heat and moisture conditions in drained and open ditch fields, by T. Juusela, p. 663-670. Discussion, p. 670-672.

83. DAIGH, F. C., and STEARNS, L. A. Effect of ditching for mosquito control on the pH of marsh soils. N. J. Mosquito Extermin. Assoc. Proc. 26:39-43, tables. 1939. 420 N46

A study conducted at the Delaware Agricultural Experiment Station shows that the pH of marsh soils increases somewhat in proportion

to the extent of drainage.

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Soc. London Proc. A. 175:346-365. 1940. 501 L84A

Mathematical solutions are presented for percolation through a broad embankment with vertical faces, and for percolation from a dyke of rectangular section into the surrounding soil. The motion of water outside a number of parallel draining tubes is investigated. 85. DAY, P. R., and LUTHIN, J. N. Sand-model experiments on

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The efficient network of drainage in the Dunkirk area hastened the

leaching process. In the Le Verdon area the slow leaching was due to

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Lysimetric studies applied to agronomy. Report of 10 years of research at Versailles. The composition of drainage water is discussed, and the degrees of progressive exhaustion of bare and cultivated soils are compared.

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89. DOMINGO, W. R. De physische rijping van de jongere Zuiderzee-afzettingen in de Noordoostpolder. Van Zee tot Land 2,

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oration-transpiration, and storage of water in the soil.

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A summary of data on percolation of soil through monolith lysimeters with an 8-foot profile covering the period 1938 to 1953. The

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Abstract of thesis (Ph. D) - Cambridge University, England.

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103. HANKS, R. J., HOLMES, W. E., and TANNER, C. B. Field capacity approximation based on the moisture-transmitting properties of the soil. Soil Sci. Soc. Amer. Proc. 18:252-254, illus., table. July 1954. Ref. 56.8 So3

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tion of surface water and the development of surface gley (mud).

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meability, liability to overflow, and natural fertility.
111. HOOGHOUDT, S. B. Bijdragen tot de kennis van eenige natuurkundige grootheden van den grond. 7. Algemeene beschouwing van het probleem van de detailontwatering en de infiltratie door middel van parallel loopende drains, greppels, slooten en kanalen. Netherlands. Dir. van de Landb. Verslagen van Landbk. Onderz. 46(14)B:

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Contributions to knowledge of some natural properties of soil. 7. General consideration of the problem of local draining of soil, and of infiltration from parallel running drains and open drain furrows,

ditches, and drainage channels. Netherlands.

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The composition of the soil of the Fen counties; the permeability of the water-bearing stratum to a maximum depth of 20 metres under the meadow, and the conclusions to be drawn therefrom regarding the drainage of the Fens.

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Surface drains and subdrains, or both, can be used in reducing ex-

cessive moisture in soils of reasonable depth.

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V. I. Lenina. Dok. 3:44-48, tables. 1940. 20 Ak1

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Both surface and tile drainage are discussed. Investigation indicates that considerable variation in the permeability rates may exist in the

same soil type.

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An equation for the rate of fall of a water surface is derived in terms of the hydraulic head function, the slope of the water table, the soil permeability, and drainable porosity. The computation method developed requires considerable labor to obtain accurate results when the spacing between drainage facilities is large.

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Measurements are reported for water-table heights, rainfall, permeability, and of ditch and draintile outflow, for tile drains and ditch drains in replicated plots in the recently reclaimed Northeast Polder of the Netherlands. It was found that tiles kept the water table lower at all times than did the ditches.

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Seepage of water into drain tubes. Streamlines, distribution of hy-

draulic head, and the seepage rate into unit length of ditch are computed.

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Amer. Geophys. Union Trans. 32:422-442. June 1951. Ref.

330.9 Am3

Expressions for drain flow, surface inflow distribution, and flow nets are derived for surface water seeping into drain tubes embedded in water-saturated soil. Drains both in and below the surface stratum are considered.

124. KIRKHAM, D. Seepage of artesian and surface water into drain tubes in stratified soil. Amer. Geophys. Union Trans. 35:775-

790. Oct.1954. 330.9 Am3

The problem of simultaneous upward seepage of water from an artesian basin and downward seepage from a ponded surface source into drain tubes is analysed for soil consisting of two horizontally stratified layers, each of different permeability, overlying artesian gravel. Theoretical formulas for hydraulic head, drain flow, and surface inflow distribution are given.

125. KIRKHAM, D. Studies of hillside seepage in the Iowan Drift area. Soil Sci. Soc. Amer. Proc. 12:73-80, illus. 1947. Ref.

56.9 So3

Drainage studies of three hillside problem areas typical of the region-a hillside, a tiled area, and an artesian area. It was found that hillside drainage difficulties were due to upward movement of the water resulting from artesian pressure developed by downward seepage over the upper portion of the hill.

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New Jersey Agricultural Experiment Station, cooperating.

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128. KOHNKE, H. Runoff chemistry, an undeveloped branch of soil science. Soil Sci. Soc. Amer. Proc. 6:492-500, illus. 1941. Ref. 56.9 So3

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tile-drainage water.

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nection with drainage, irrigation, runoff, and tillage.

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ed grazing area in the Yare Valley of England.

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tables. Ref. U. Ill. Libr.

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Thesis (M. S.)- University of Illinois, 1952.

Southwell's relaxation method is used to solve soil profiles with variable permeabilities. The effects of drain diameter, unsymmetrical drain sections, and the position and thickness of a slowly permeable layer are discussed also.

132. LEVI, E. Coeficiente de riego y coeficiente de drenaje.

Ingen. Hydraul. en Mex. 5(1):9-19, illus. Jan./Feb./Mar.1951.

290.8 In43

Technical discussion of irrigation, drainage, runoff and ground water in Mexico.

133. LOWDERMILK, W. C. Land-use and flood-flows. Amer. Geophys. Union Trans. 19:508-515, illus. Aug. 1938. 330.9 Am3

Concentrations of unabsorbed waters of drainage channels into trunk streams under variable rain patterns and the accumulation of erosional debris in stream channels.

134. LUTHIN, J. N., and GASKELL, R. E. Numerical solutions for tile drainage of layered soils. Amer. Geophys. Union Trans. 31:

595-602. Aug.1950. Ref. 330.9 Am3

Discussion in Amer. Geophys. Union Trans. 32:779-780. Oct.1951.

330.9 Am3

The problem of tile drainage of uniform soil lying above an impermeable layer. Tile drainage of 2-layered soil with surface soil used for trench backfill is dealt with numerically.

135. LUTHIN, J. N., and MILLER, R. D. Pressure distribution in soil columns draining into the atmosphere. Soil Sci. Soc. Amer.

Proc. 17:329-333, illus. Oct. 1953. Ref. 56.9 So3

Columns of soil were wetted and then allowed to drain, while measurements were made of the pressure distribution in the soil and of the rate at which the water drained out. The experimental results emphasize the importance in drainage of the tension required to produce entry of air into the soil surface.

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56.9 So3

Where soils are drained by tile, it is difficult to leach all of the soils adequately. It is proposed that a diking arrangement be used so that certain selected surface areas can be ponded while other surfaces remain dry.

137. LYON, A. V. Irrigation and drainage investigations. So.

Austral. Dept. Agr. J. 44:732-734. July 1941. 23 So84

The nature of the soil profile controls the depth of drains which are seated if possible on clay subsoil. In soils with a free-textured subsoil drains are usually five to six feet deep. Spacing of drains is determined by recording the fluctuations of the water table in a line at right angles to the drains. On heavy soils it is found that surface drainage gives better results.

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S. H. Winterberg, I. B. Clements, L. S. Jones, and B. Robinson, joint authors.

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139. MARIMPIETRI, L. A new conception of land tillage, settlement and drainage. Internatl. Cong. Soil Sci. 4th Trans. 3:13-17, illus.

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subsoil is not settled or if walls of the ditch are sound.

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The optimal drainage depth of humus-containing sandy soils.

141. MEINZNER, O. E., and others. The channel-storage method of determining effluent seepage. Amer. Geophys. Union Trans. 17: 415-418. July 1936. 330.9 Am3

R. C. Cady, R. M. Leggette, and V. C. Fishel, joint authors.

The results of an investigation on a small drainage basin in Virginia. 142. MERRILL, L. P. Some agricultural engineering problems in soil and water conservation. Agr. Engin. 32:481-482, illus. Sept.

1951. 58.8 Ag83

Water-disposal system for sloping cultivated land in the Western Gulf region (Texas, Oklahoma, Arkansas and Louisiana.) Chiefly runoff from terraces.

143. MOLEN, W. H. VAN DER. Bepaling van drainafstanden door een morphologische beoordeling van het bodemprofiel. Landbouwk. Tijdschr. 65:105-113, illus., tables. Feb./Mar. 1953. 105.2 Or 3

Determination of drain spacing by a morphological evaluation of the soil profile. Drainage calculation methods used for sandy soils of

the Zuiderzee are outlined.

144. MORGAN, M. F., JACOBSON, H. G. M., and LECOMPTE. S. B. Drainage water losses from a sandy soil as affected by cropping and cover crops. Conn. (New Haven) Agr. Expt. Sta. B. 466,32 p., illus.,tables. Oct.1942. Ref. 100 C76St

Lysimeter studies involving the effects of cropping, cover crops, and nitrogenous fertilizers with reference to drainage water losses and the removal of various constituents by crops and soil changes.

145. NEAL, J. H. Relation of drainage to erosion control. Minn. Agr. Engin. News Let. 78,1 p. Sept.15,1938. 287.29 M66Ag A well drained soil will lose by surface runoff only one-third as much as a saturated soil. Both tile and terrace drainage are discussed.

146. NELLER, J. R., and FORSEE, W. T., JR. Installation of lysimeters in the peat soil of the Florida Everglades. Soil Sci.

Soc. Fla. Proc. 3:102-106, illus. 1941. Ref. 56.9 So32

Details of the installation are given, including a subirrigation device which provides the type of subirrigation at controlled water-table levels practiced in cultivated lands of the Everglades.

147. NELSON, L. B., and MUCKENHIRN, R. J. Field percolation rates of four Wisconsin soils having different drainage characteristics. Amer. Soc. Agron. J. 33:1028-1036, illus., tables. Nov. 1941.

Ref. 4 Am34P

Field percolation rates were determined on undisturbed soil profiles of two poorly drained and two well-drained Wisconsin soils by means of a buffer compartment method. Results correlated well with the characteristics of the soil profiles and explain to a large extent the differences in cropping and drainage conditions found on these soils.

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Amer. Proc. 5:69-76. 1940. 56.9 So3

Research in Ohio indicates that permeability of soils is related to

volume of the pores drained at the flex point.

149. OCHOA, A. E. Pérdidas de nutrientes en los suelos, causadas por remoción en las cosechas y en las aguas de drenaje. Caracas, El Compás, 1949. 38 p., tables. Ref. 56.6 Oc3

Losses of soil nutrients in drainage waters are discussed. Venezuela.

150. ODELIEN, M., and VIDME, T. Lysimeterforsk på Ås, 1938-43, Norges Landbrgsk. Meld. 25:273-362, illus., tables. 1945. 104 N762M

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AND RECLAMATION. Amending Reclamation Act to include logged or cut-over lands and swamp lands. Hearings, 78th Cong., 2d sess., on H. R. 3787. Dec. 7, 1944. Washington, 1945. 23 p. 54 Un3

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350. U. S. LAWS, STATUTES, ETC. Federal reclamation laws annotated. Ed. 2. Washington, 1947. 766 p., map. 156.85 F317 Includes legislation concerning drainage, for which the index should be consulted.

351. U. S. NATIONAL RESOURCES COMMITTEE. WATER RE-SOURCES COMMITTEE. Drainage policy and projects. Washington, 1936. 22 p., illus., maps. 173.2 N214D

The nature of Federal drainage activities, purposes and methods of land drainage, and construction requiring subsequent drainage. Recommends the establishment of a Federal committee, headed by a civilian consultant, to coordinate drainage activities in the United States.

352. U. S. SOIL CONSERVATION SERV. SOUTHEASTERN RE-GION. General outline for review and study of drainage laws and physical drainage problems in Georgia. Spartanburg?S. C., 1949. 4 p. 1.9602 G28

Prepared at the request of the Georgia Association of Soil Conservation District Supervisors, "that, as a result of this review, any recommendations regarding changes in the present Georgia State Drainage Law be promptly referred to the Legislative Committee of the Georgia Association ... for any action deemed necessary," p. 1.

353. U. S. SOIL CONSERVATION SERV. SOUTHWEST REGION. Legal status of New Mexico drainage basins. Albuquerque, 1947. 6 p.

1.9608 L52

Contains a list of adjudication decrees, hydrographic surveys, and

interstate compacts in New Mexico.

354. WERNIMONT, K., AULL, G. H., and CLARK, O. M. Agricultural drainage administration in South Carolina; a proposed postwar drainage program. S. C. State Planning Bd. 13,39 p. 1943. 280.7 So8292B

Includes legislative history and current law, pertaining to drainage,

financing and maintenance problems.
355. WILLIAMS, M. B. Water laws in the United States of America relating to water rights, irrigation, conservation drainage, and flood and overflow protection for agricultural lands; a selected reference list of publications with some reproductions, basic excerpts, and lists of contents of special interest. Washington, Food & Agr. Organ. United Nations, 1948. 168 p. 241 F732W

356. WINTON, G. H., JR. Drainage and improvement districts. Calif. Mosquito Control Assoc. Proc. & Papers 20:76-78. 1952.

428 C763

Formation of drainage districts, and a discussion of drainage legislation.

357. YOUNG, G. E. Nature and extent of U. S. Department of Agriculture programs contemplated under the Watershed Protection and Flood Prevention Act. Assoc. West. State Engin. Proc. 27:49-53. 1955. 290.9 As 76

A discussion of P. L. 566, 83d Congress, 2d session, 1954.

358. YOUNG, G. E. Watershed protection and flood prevention policies. Washington, U. S. Soil Conserv. Serv., 1955. 6 p. 1.941 A2Y82

Speech at the Northeastern Extension Directors Conference, New

York City, Mar. 8 and 9, 1955.

A discussion of P. L. 566, 83d Congress, the Watershed Protection and Flood Prevention Act.

SPECIAL PROBLEMS IN DRAINAGE

Irrigated Lands

359. ALBUQUERQUE, H. C. DE. Irrigação e drenagem na zona canavieira de Pernambuco. Lavoura 51:58-61. Dec.1947. 9.2 L39 Irrigation and drainage in the sugarcane region of Pernambuco.

360. ALL-AMERICAN Canal progress. Engin. News-Rec. 118: 258-261, illus. Feb.18,1937. 290.8 En34

Includes discussion of drainage outlets. 361. ALLISON, L. E., and CHRISTIANSEN, J. E. Report on salinity and water table conditions in grapes and dates on Desert Sun Ranch, Coachella Valley, California. U. S. Region. Salinity Lab. Res. Rpt. 8,14 p.,tables. 1944. 1.965 A2R31

The increasing development of problem areas in the irrigated fruit ranches of the valley led to an investigation by the Salinity Laboratory to determine whether the trouble was caused by high salinity, poor

drainage, or both.

362. AMEMIYA, M., ROBINSON, C. W., and COWLEY, E. W. Reclamation of a saline-alkali soil in the Upper Colorado River Basin. Agron. Abs. 47:12. 1955. 241 Am39

363. ANDERSON, T. C. Drainage reclaims Pease bottom farms. Soil Conserv. 17:247-249,254,illus. June 1952. 1.6 So3S

Drainage of irrigated lands in Montana by means of open ditches. 364. ARNDT, F. R. Thirty years of irrigation. So. Austral. Dept. Agr. J. 46:357-366, illus. July 1943. 23 So84

Includes plans for surveys of drainage reserves for the location of a future main-drainage system for the removal of seepage waters. Tile or concrete drains are recommended for heaviest types of land. Depth of drain and type of pipes are discussed.

365. AYÊRS, Ĥ. D. Soil permeability as a factor in the translocation of salts on irrigated land. Sci. Agr. 31:383-395, illus. Sept.

1951. Ref. 7 Sci2

Canal lining and interception drainage are recommended to prevent excessive seepage and high water tables on soils of low permeability.

366. BAILY, P. J. Drainage on irrigated swamp areas. So.

Austral. Dept. Agr. J. 44:443. Mar. 1941. 23 So84

Primarily mole drainage.

367. BARTELS, L.C. Grading land for irrigation. Victoria Dept. Agr. J. 43:321-327, illus. Aug. 1945. 23 V66J

Includes construction and operation of drainage ditches on irrigated land. Australia.

368. BARTRAM, R. Overirrigation plagues Manson district. West. Fruit Grower 10(8):23-24, illus. Oct. 1954. 95.8 G762

Includes tile drainage of irrigated orchards in Washington.

369. BENNETT, H. Improved drainage in the Imperial Valley, California. Soil Conserv. 16:135-138. Jan.1951. 1.6 So3S Research on an unsuccessful project was followed by installing tile drains. Accomplishment is estimated in dollars per acre based on land values for abandoned land, virgin wet land, and cultivated land. Increase in crop production due to drainage is estimated at \$30 an acre.

370. BENNETT, H. Water in the ground: too much or too little?

Soil Conserv. 16:153-157, illus. Dec. 1950. 1.6 So3S

Drainage and levelling of irrigated lands in New Mexico and Colorado. Includes the Rio Grande Drainage District and its program.

371. BIXBY, F. S. Draining cotton fields the easy way. Excavating Engin. 36:196-198, illus. Apr. 1942. 290.8 Ex2

Tractor digging of a 14-foot wide drainage ditch 5 miles long in Ari-

zona irrigated land.

372. BLOODWORTH, M. E., and ROSS, P. E. Drainage of irrigated lands in the Lower Rio Grande Valley of Texas. Agr. Engin. 32: 669-671,673,illus. Dec.1951. Ref. 58.8 Ag83

Unwise use of irrigation water has contributed to salinity. Recom-

mendations for preventive and relief measures are given.

373. BLOODWORTH, M. E. General aspects of drainage and irrigation in the Lower Rio Grande Valley of Texas. Lower Rio Grande Val. Citrus & Veg. Inst. Proc. 3:2-6. 1948. 81 L95 Six relief measures are listed for the local drainage and salinity

problems.

374. BOL'SHAKOV, A. F. Soils of the saline complex in the northwestern part of the near-Caspian Lowlands and methods for their reclamation. (In Russian.) Pochvovedenie 11:1-13. Nov.1954. Ref. 57.8 P34

Irrigated soils.

375. BRENNER, W. W. Storm drainage structures, Gila Gravity Main Canal. Reclam. Era 35-36, illus. Feb. 1941. 156.84 R24

Description of several automatic spillways, wasteways, and overchutes for disposal of storm waters of creeks and washers.

376. CAMERON, A. E. Over-watering citrus trees. Citrus News 23:45. Mar.31,1947. 80 C494

Even after tiles have been installed, occasional soil auger checks are necessary to detect waterlogging of citrus roots.

377. CHAPPLE, L. A. Drainage. So. Austral. Dept. Agr. J. 46: 333-334. June 1943. 23 So84

Under a community system of irrigation at Berri soil deterioration has been caused by faulty drainage and land has gone out of production through salt accumulation. An effective system of main drains is necessary to take water right away after tile drainage. Recommendations are made for establishing proper drainage systems on different types of soils.

378. CHRISTIANSEN, J. E. Some permeability characteristics of saline and alkali soils. Agr. Engin. 28:147-150, illus., tables. Apr.

1947. 58.8 Ag83

The success of drainage and leaching of irrigated soils is dependent

upon the permeability of the soil and subsoil materials.

379. CLYDE, G. D. Relating basic resources in irrigation re-

search. Agr. Engin. 33:277-278, illus. May 1952. 58.8 Ag83
Includes drainage of irrigated lands. Excess applications of irrigation water, together with seepage from canals and natural channels, causes waterlogging or salt accumulation.

380. DEBLER, E. B. Conveyance losses in irrigation canals.

Civ. Engin. 11:584-585, illus. Oct. 1954. 290.8 C49

Artificial drainage may provide a remedy for loss due to seepage. 381. DIEBOLD, C. H. Permeability and intake rates of medium textured soils in relation to salt content and degree of compaction. Soil Sci. Soc. Amer. Proc. 18:339-343, illus., tables. July 1954. Ref. 56.9 So3

Experiments conducted in Arizona, Colorado, New Mexico, and Utah from 1948 through 1953 in order to aid in the design of effective drain-

age systems for irrigated lands.

382. DONNAN, W. W., and BRADSHAW, G. B. The disposal of seepage and waste water. U. S. D. A. Ybk. Agr. 1955:557-564. 1 Ag84Y

Drainage of irrigated lands in the Western States.

383. DONNAN, W. W. Model tests of a tile-spacing formula. Soil Sci. Soc. Amer. Proc. 11:131-136, illus., tables. 1946, pub., 1947. 56.9 So3

Formula applicable to drainage of irrigated lands, California.

384. DONNAN, W. W., ARONOVICI, V. S., and BLANEY, H. F. Report on drainage investigation in irrigated areas of Imperial Valley, California. Los Angeles, U. S. Soil Conserv. Serv., 1947. various paging, illus., tables. Ref. 1.96 R31Red

The objectives of the study were to: "Establish criteria by which the feasibility of drainage on any lands within the Imperial Irrigation District may be determined; where drainage is feasible to establish methods of designing and installing practical drainage facilities; and to develop techniques for improving irrigation practices," Summary, p.

385. DOWD, M. J. Silt problems of Imperial Irrigation District as affected by completion of Boulder Dam. Civ. Engin. 9:609-611.

Oct.1939. 290.8 C49

Growth of moss in drainageways has increased and may become a problem, while erosion due to seepage is increasing. California.

386. DUMM, L. D. Drain-spacing formula. Agr Engin. 35:726-730, illus. Oct. 1954. 58.8 Ag83

A new formula for determining depth and spacing of subsurface

drains in irrigated lands.

387. DUNNEWALD, T. J. Removal of alkali by drainage and leaching; restoring fertility of alkali soil by means of drainage and leaching at moderate cost, in Fremont County, Wyoming. Wyo. Agr. Expt. Sta. B. 276,28 p.,illus.,tables. June 1946. 100 W99

388. DUNNEWALD, T. J. Salinity conditions in the Big Horn River during the years 1938 and 1939. Wyo. Agr. Expt. Sta. B. 240,

28 p., tables. July 1940. 100 W99

A study made by the Montana and Wyoming Agricultural Experiment Stations in cooperation with the U.S. Geological Survey in order to ascertain the quantities of dissolved salts in irrigation waters in the area and the originating points of the salts, in connection with planning for the improvement by drainage of the existing irrigated lands.

389. EMERSON, W. O. Imperial digs out. Country Gent.

106(12):12-13,84-85,illus. Dec.1936. 6 C833

Concerned primarily with irrigation, the All-American Canal, and the flooding of the Colorado River in 1905-7. The need for proper drainage to correct the errors of over-irrigation is pointed out.

390. FITZHUGH, E. A. Goldbergian gadget may boost Valley's output. Soil Conserv. 9:228-231,illus. Apr.1944. 1.6 So3S

An apparatus for taking soil cores as a first step in search of solutions to the drainage problems in the irrigated Imperial Valley of California.

391. FLOTEN, C. G. Use of dynamite in constructing drainage ditches. Agr. Educ. Mag. 19:178. Mar.1947. 275.8 Ag8

In irrigated land in Oregon, where the saturated condition of the soil

would not support heavy ditching equipment.
392. FUHRIMAN, W. U., BLANCH, G. T., and STEWART, C. E.
An economic analysis of the agricultural potentials of the Weber Basin Reclamation project, Utah. Utah. Agr. Expt. Sta. Spec. Rpt. 7,39 p., map, tables. Dec. 1952. 100 Ut1Sp

The Utah Agricultural Experiment Station and the U.S. Bureau of

Agricultural Economics, cooperating.

Land classification, drainage, irrigation, and water requirements. 393. GAINES, H. F. Managed water brings good times. Soil Conserv. 19:250-251, illus. June 1954. 1.6 So3S

Irrigation and drainage in Washington.

394. GARDNER, R. Some soil properties related to the sodium salt problem in irrigated soils. U. S. D. A. Tech. B. 902,28 p., tables. Sept.1945. Ref. 1 Ag84Te

Drainage to remove accumulated salts is a necessary step in the improvement of saline soils. Treatment to improve the permeability of the soil may be necessary before drainage can be undertaken.

395. GEDDES, J. A., FREDERICKSON, C. D., and BERGESON, E. C. Drainage and irrigation, soil, economic, and social conditions, Delta area, Utah. Division 4, Social conditions. Utah. Agr. Expt. Sta. B. 288,93 p., illus., tables. June 1939. 100 Ut1

Divisions 1,2, and 3 appeared as Bulletins 255,256, and 273. Apr.-

May 1935, Oct. 1936.

396. GONZALEZ, R. A. Irrigation in Puerto Rican cane fields. Facts Sugar 35:52-55, illus. Feb. 1940. 65.8 F11

Drainage ditches are needed where water is applied by partial flood-

397. GREGOR, H. F. The Southern California water problem in the Oxnard area. Geog. Rev. 42:16-36, illus., maps, tables. Jan. 1952. Ref. 500 Am35F

Primarily irrigation, but includes drainage of irrigated lands, and

ground water.

398. HARDMAN, G., VENSTROM, C., and MASON, H. G. Irri-

gated lands of the Humboldt River area. Nev. Agr. Expt. Sta. Irrig. B. 1,36 p.,illus.,maps,tables. May 1939. 100 N415

Includes underground water in Nevada, and drainage of irrigated

lands.

399. HART, R. A. The drainage of irrigated farms. U.S. D. A.

Farmers' B. 805, 32 p., illus. Rev. Dec. 1937. 1 Ag84F

Covers open-ditch and tile drainage, depth, spacing and location of tile drains, flumes, wells, inlets, and outfalls, beneficial effects on crops of drainage, maintenance of the drainage system, and costs.
400. HART, R. A. Need for drainage of irrigated farms. Irrig.
Farmer 3(5):3,5,10-11. Sept.6,1945. 55.8 Ir78

For prevention of waterlogging and of accumulation of alkali.

401. HAYWARD, H. E. The control of salinity. U. S. D. A. Ybk. Agr. 1943/47:547-553. 1947. Ref. 1 Ag84Y

Good drainage is essential. Where artificial drainage is necessary three methods are used-tile systems, open drains, and pumped wells. In many places drainage water pumped from wells is mixed with irrigation water and used over again.

402. HAYWARD, H. E., and WADLEIGH, C. H. Plant growth on saline and alkali soils. Advn. Agron. 1:1-38. 1949. Ref. 30 Ad9

Discusses the effects of salinity on various crops and plants, and states that over-irrigation in arid regions "may accelerate the rise of the water table unless provision is made for adequate drainage," p. 3-4.

403. HAYWARD, H. E., and MAGISTAD, O. C. The salt problem in irrigation agriculture. U. S. D. A. Misc. P. 607,27 p., illus. Aug.

1946. 1 Ag84M

Stresses the importance of good drainage of irrigated lands. Publications of the U. S. Regional Salinity Laboratory, p. 25-27.

404. HOLBROOK, W. Irrigation from pumped wells; underground water sources increasing in importance as unappropriated surface supplies dwindle. Civ. Engin. 7:473-474, illus. July 1937. 290.8 C49

Describes a drainage system to collect surface water for a well in

a shallow deposit.

405. HUBBLE, G. D., and CROCKER, R. L. A soil survey of the Red Cliffs Irrigation District, Victoria. Austral. Council Sci. & Indus. Res. B. 137,63 p.,illus.,maps, tables. 1941. 514 Au72B

Includes drainage of irrigated lands, and salt removal.

406. HUBERTY, M. R., and PILLSBURY, A. F. Reclamation of saline soils in Coachella Valley, Calif., U. S. A. Internatl. Cong. Soil Sci. 4th. Trans. 1:383-385, table. 1950. 56.09 In844

Leaching experiments on trial plots indicate that only through careful irrigation and drainage practices will a proper salt balance be maintained in the valley.

407. ISRAELSEN, O. W. Drainage in the Lewiston area, Utah. Utah. Agr. Expt. Sta. Spec. Rpt. 9,25 p., illus., maps, tables. Ref. 1953.

100 Ut1Sp

Studies made by the Utah Agricultural Experiment Station with the purpose of developing improvements in the design, placing, and maintenance of tile drains, and to find the conditions under which, and the extent to which, drainage by pumping may be preferable to drainage by gravity, in a subirrigated area.

408. ISRAELSEN, O. W. Drainage of irrigated lands. In his Irrigation principles and practices, ed. 2, p. 268-283, illus., tables. New York, Wiley, 1950. Ref. 55 Is7

Section heads include: Benefits of drainage; Required water-table depths; Lowering the water table; Design of open drains; Construction methods and costs; Tile drainage systems; Installation of tile drains; Maintenance of drains; Drain depths, spacing, and ground-water flow; Pumping for drainage; and Drainage enterprises.

409. ISRAELSEN, O. W., and STEWART, C. D. Draining Lewiston flats will improve land conditions in Cache County [Utah]. Sugar Beet 9(8):10-13, 29, illus. Dec.1950. 66.8 Su34B

For growing sugar beets. Open-ditch, underdrainage with tile and control gates, and shallow-well pumping are used. Tile drainage is

considered most satisfactory here.

410. ISRAELSEN, O. W., PETERSON, D. F., JR., and REEVE, R. C. Effectiveness of gravity drains and experimental pumping for drainage, Delta area, Utah. Utah. Agr. Expt. Sta. B. 345,64 p., illus. Feb.1950. Ref. 100 Ut1

U. S. Regional Salinity and Rubidoux Laboratories, cooperating. Results of studies made on eight irrigated experimental sites be-

tween 1945 and 1948.

411. ISRAELSEN, O. W., MAUGHAN, J. H., and SOUTH, G. P. Irrigation companies in Utah; their activities and needs. Utah. Agr. Expt. Sta. B. 322,62 p.,illus.,maps,tables. Mar.1946. 100 Ut1

One of the most needed improvements in irrigation is the draining of

saturated soil formations to stabilize canal beds.

412. ISRAELSEN, O. W. Problems peculiar to irrigation farming. Agr. Engin. 18:437-439, illus. Oct.1937. 58.8 Ag83

Includes alkali control and drainage.

413. ISRAELSEN, O. W. Water application efficiencies in irrigation and soil conservation. Agr. Engin. 20:423-425, illus. Nov.1939. 58.8 Ag83

Drainage is considered. Utah.

414. JESSUP, L. T. Irrigated lands require drainage. Internatl. Soc. Soil Sci. Comn. Trans. 6B:271-274. 1937, pub., 1938. 56.9 In833 Salinity of irrigation waters and the need for drainage of irrigated land.

415. JONES, B. J. Irrigated pastures in California. Calif. Agr. Col. Ext. C. 125,47 p., illus., tables. Oct.1942. Ref. 275.29 C12C

Includes cost of drainage.

416. KAHAWITA, R. Waterlogging of irrigated lands and reme-

dial measures. Trop. Agr. 95:278-287. Nov.1940. 26 T751

The importance of drainage in irrigation schemes is stressed. Drainage of surface flow, control of subsoil flow, and prevention or reduction of soil alkalinity by drainage are considered. Rhodesia. Also in Rhodesia Agr. J. 38:302-313. June 1941. 24 R34

417. KELLEY, W. P. Alkali soils; their formation, properties and reclamation. New York, Reinhold, 1951. 176 p., illus., tables. Ref.

56.33 K28

Selected bibliography, p. 163-170. Reclamation of alkali soils, p. 131-161.

Drainage by open ditches, tiles, and pumping from wells, is dis-

cussed.

418. KELLEY, W. P. Permissible composition and concentration of irrigation water. Amer. Soc. Civ. Engin. Trans. 106:849-861. 1941. 290.9 Am3

Discussion, by C. S. Scofield, W. W. Weir, R. S. Stockton, L. D.

Batchelor, and E. B. Debler, p. 856-861.

Since it is necessary to apply saline irrigation water in quantities in excess of crop requirements, in order that some leaching of the root zone will take place, the maintenance of good drainage conditions in the soil is very important.

Also in Amer. Soc. Civ. Engin. Proc. 66:607-613. Apr. 1940. Ref.

290.9 Am3P

419. KELLEY, W. P. The reclamation of alkali soils. Calif. Agr. Expt. Sta. B. 617,40 p.,illus.,tables. Dec.1937. Ref. 100 C12S Experiments on over-irrigated soils of the Western States include drainage and the application of gypsum.

420. KOSTIAKOV, A. Drainage on irrigated lands. (In Russian.) Khlopkovodstvo 1:70-76. Jan.1952. 72.8 K522

421. LARSON, C. A. Reclamation of saline (alkali) soil in the Yakima Valley, Washington. Wash. Agr. Expt. Sta. B. 376,39 p.,illus., tables. July 1939. 100 W27E

Insufficient subsoil drainage had caused deposits of salts from irrigation water in certain areas of the valley, which could not be removed by later installed drains because the salts that had accumulated in the root zone were not leached out after drainage was provided.

422. LEWIS, M. R. Practical irrigation. U. S. D. A. Farmers'

B. 1922,69 p., illus., tables. Jan. 1943. 1 Ag84F

Drainage, p. 68-69.

423. LUNDGREEN, W. K. The human dragline. Reclam. Era 41:65-66, illus. Aug. 1955. 156.84 R24

Hand-digging of drainage ditches to relieve seepage due to irrigation on Nebraska farms.

424. LUTHIN, J. N., and BIANCHI, W. Alfalfa and water table levels. Calif. Agr. 8(5):4-5,illus. May 1954. 100 C12Cag

Tile drainage was necessary to counteract the effects of overirrigation and of seepage from the Sacramento River before adequate yields

of alfalfa could be achieved.

425. LYON, A. V., and TISDALL, A. L. Production of dried grapes in Murray Valley irrigation settlements. 2. Irrigation, drainage, and reclamation. Austral. Council Sci. & Indus. Res. B. 149,35 p., illus., tables. 1942. Ref. 514 Au72B

Discusses drainage systems: surface drainage, pumping schemes, gravitational schemes, dual-purpose drains, external and internal drains, drain depth, and distance between laterals. All in relation to

soil profile and texture.

426. MCALLISTER, L. Drainage and irrigation in the Willamett Valley. Reclam. Era 34:175-177, illus. Sept. 1948. 156.84 R24

Oregon.

427. MCCORMICK, J. A., and NAPHAN, E. A. Improving saline and alkali soils in Nevada. Nev. Agr. Expt. Sta. C. 1,11 p., illus. Aug. 1952. 100 N41S

Drainage and leaching of irrigated soils.

428. MCLAUGHLIN, W. W. Irrigation and the conservation of the range. Soil Conserv. 4:175-177. Jan. 1939. 1.6 So3S

Includes drainage and drainage ditches.

429. MAGISTAD, O. C., and CHRISTIANSEN, J. E. Saline soils, their nature and management. U. S. D. A. C. 707,32 p.,illus. Sept. 1944. Ref. 1 Ag84C

One of the first steps in reclamation of saline soils is good drainage.

Tile, open drains, and pumped wells are mentioned.

430. MAIERHOFER, C. R. The drainage of irrigated lands. Agr. Engin. 32:613-614. Nov.1951. 58.8 Ag83

Chiefly in the Western States. Basic principles are considered. Includes determination of the amount of artificial drainage needed.

431. MAIERHOFER, C. R. Drainage problems in the Rio Grande Valley. Reclam. Era 34:116-118. June 1948. 156.84 R24

The water table, and accumulations of salt in the soil. A four-point program towards solving the problems is suggested, including education of the landowners in the benefits of drainage, and research into the depth, spacing and type of drains for best results.

Also in Lower Rio Grande Val. Citrus & Veg. Inst. Proc. 2:22-30.

1947, pub., 1948. 81 L95

432. MAIERHOFER, C. R. Some aspects of drainage in reclamation. Internatl. Comm. Irrig. & Drain. Annu. B. 2:83-86. 1953. 55.9 In8A

Speaks of the drainage of irrigated lands in the Western United States and the function of drainage in removing salts as well as excess water.

433. MALHOTRA, S. L. Nangal Dam and Canal. Punjab (India). Internatl. Comn. Irrig. & Drain. Annu. B. 1:67-76, illus., maps. tables. 55.9 In8A

Includes drainage of irrigated lands.

434. MANLY, G. W. Storm-drainage structures on the All-American Canal. Reclam. Era 29:302-305, illus. Nov.1939. 156.84 R24 435. MAUGHAN, J. H., and ISRAELSEN, O. W. Management of

irrigation and drainage enterprises in Utah, with special reference to the northern Cache Valley area. Utah Agr. Expt. Sta. B. 349,49 p., illus., maps, tables. June 1951. Ref. 100 Ut1

Covers relations of irrigation and drainage, drainage methods, drainage enterprises, drainage districts, and landowners attitudes towards

irrigation and drainage organizations.

436. MILLER, C. K. Drainage in the Big Horn Basin. Soil Conserv. 20:135-139, illus. Jan. 1955. 1.6 So3S

Drainage of 10,000 irrigated acres in Wyoming by open ditches 30 feet wide and 7 to 8 feet deep cost only 18 dollars per acre.

437. MOSS, H. C. Soil surveys of Saskatchewan irrigation projects. Sci. Agr. 20:170-174. Nov.1939. 7 Sci2

The surveys included drainage and topographic conditions as related to soils, and vegetation and land use as related to soil and drainage conditions.

438. NOTES on waterlogging and land reclamation in the form of a questionnaire. India. Cent. Bd. Irrig. P. 17,41 p. Sept. 1938. 55.9 In222

Principles of and data on reclamation of waterlogged irrigated lands, and methods of determining suitability of land for reclamation, with special reference to experience in various sections of India.

439. OVER-irrigation. Reclam. Era 26:297. Dec. 1936.

156.84 R24

"All irrigated areas require drainage of some kind, either natural or artificial, surface or subsoil, varying only in method and degree."

440. PARIS, R. G. Comprehensive drainage in the River Murray irrigation areas. So. Austral. Dept. Agr. J. 55:571-579, illus., June/July 1952. 23 So84

Includes the Waikerie system, "external" and "internal" drainage, design and layout, construction, costs, sumps and outlets, size of main drains, block connections, and pumping and outfall mains.

441. PENNY, J. M. Irrigação e drenagem. Lav. Arroz. 5(52): 9-10. Apr.1951. 59.8 L39

Irrigation and drainage of rice in Brazil.

442. PETERSON, D. F., JR., and ISRAELSEN. O. W. Performance of existing gravity drains. U. S. Region. Salinity Lab. Res. Rpt. 25(Pt. 1), 10 p. Apr. 1948. 1.965 A2R31

In order to study the effectiveness of the present system of gravity drains in the Utah Delta area, piezometers for determining the elevations of the water table were installed at four locations where new open drains were being constructed. The paper describes results of the investigation. A continuation of the studies described in item 449, by Reeve, R. C., and Allison, L. E.

443. PILLSBURY, A. F. Drainage and reclamation; network of observation wells in Coachella Valley permits anticipation of possible drainage problems. Calif. Agr. 8(3):3-4, illus. Mar. 1954. 100 C12Cag

Coachella County, the U.S. Departments of Agriculture and the Interior, and the University of California cooperate in studies to devise methods of observing ground-water conditions so that drainage problems in the irrigated valley may be forecast in time to prevent serious damage to land and crop.

444. POE, E. J. Water problems in the Southwest. Soil Conserv. 13:142-144, illus. Jan.1948. 1.6 So3S

Bad irrigation and undiscovered clay substrata have caused waterlogging of soils in New Mexico, Utah, and Colorado. Deep drainage has been the answer.

445. POWERS, W. L. The drainage of irrigated lands. n.p.,

1941? 5 p. 55 Or34

Oregon Agricultural College and U. S. Department of Agriculture,

cooperating.

Contents: Lands of the arid region needing drainage; Drainage practice in the West; Treatment of drained land; The relation of economical irrigation to drainage.

446. RAE, R. Land drainage in low-rainfall areas. Allahabad

Farmer 28:215-219. Nov.1954. 22 A15

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450. REEVE, R. C., PILLSBURY, A. F., and WILCOX, L. V. Reclamation of a saline and high boron soil in the Coachella Valley of California. Hilgardia 24:69-91. Sept. 1955. Ref. 100 C12H

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July 1952. 156.84 R24

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Drainage of irrigated lands in California.

458. ROMERO M., A. La irrigación y el drenaje en la industria azucarera. Agr. Trop. 10(5):25-34, tables. May 1954. 26 Ag8 Irrigation and drainage in sugar culture in Colombia.

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462. SCOFIELD, C. S., and HOWE, O. W. Water input used for field crops at the United States Scotts Bluff (Nebr.) Field Station, 1941-44. U. S. D. A. C. 777,18 p., tables. July 1948. 1 Ag84C Drainage conditions included.

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464. SHELAEV, A. Biological drainage in the control of soil salinity in the Main Turkmen Canal zone. (In Russian.) Khlopkovodstvo 3:57-67. Jan.1953. 72.8 K522

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465. SPECIAL problems of the Bonneville Basin with reference to ground water. Utah Econ. & Business Rev. 13:(1A):51-56. Oct.

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Extensive areas of the basin's lowlands are unfit for cultivation because of the accumulations of salt. Much of this land can be reclaimed by the quick flushing of fresh water over the surface, dissolving the salts and draining them off to low depressions where they could evaporate.

466. STAFFORD, H. M., and HUBERTY, M. R. Soil characteristics and salinity in relation to irrigation and drainage. United Nations Sci. Conf. Conserv. & Util. Resources. Proc. 4:357-362. 1949,

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Jan. 1948. 10 Em7

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by means of drainage pumping.

468. THOMAS, E. E. Reclamation of white-alkali soils in the Imperial Valley. Calif. Agr. Expt. Sta. B. 601,15 p., illus., tables.

July 1936. 100 C12S

Due to faulty drainage the seepage from irrigation canals has tended to accumulate above the slowly pervious subsoil layers. The consequent high water table has brought the soluble salts to the surface where they have accumulated.

469. THOMAS, J. E. An investigation of the problems of salt accumulation on a Mallee soil in the Murray Valley irrigation area. Austral. Council Sci. & Indus. Res. B. 128,90 p., illus., maps, tables.

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471. THORNE, D. W., and PETERSON, H. B. Drainage. In their Irrigated soils; their fertility and management, p. 123-129, illus.

Philadelphia, Blakiston, 1949. Ref. 56.7 T393

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473. TISDALL, A. L. Drainage of sub-soil water through bores to limestone beds. Commonwealth Engin. 27:59-61, illus., table.

Sept.1,1939. 290.8 C73

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474. TISDALL, A. L. Internal drainage investigation in South Australian irrigation districts. So. Austral. Dept. Agr. J. 45:398-402,

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Research of major soil types to determine response to agricultural drainage, comparison between drains laid across and laid down the

main slope, depth and spacing of laterals.

475. TISDALL, A. L. A note on the use of drainage water. Austral. Council Sci. & Indus. Res. J. 14:260-263, illus. Nov. 1941.

514 Au72J

Australia faces the problem of converting drainage water from the underground tiles of irrigated lands to newly developed agricultural lands in the Murray Valley where water for irrigation is lacking. The drainage waters must first be made salt free.

476. UNIQUE method of drainage devised by San Fernando grow-

er. Calif. Citrog. 24:120, illus. Jan. 1939. 80 C125

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gated lemon grove.

477. U.S. DEPT. OF AGRICULTURE. The salt problem in irrigation agriculture; research at the United States Regional Salinity Laboratory. U. S. D. A. Misc. P. 607,27 p., illus. Aug. 1946. Ref.

Good drainage is absolutely essential in removing soluble salts from the soil and in restoring alkali lands to production. Drainage implies a relatively permeable soil and the absence of a water table within a depth where it would influence the water retained in the root zone.

478. VLADIMIROV, A. G. Empirical formula for calculating the distances between drains in irrigated districts. (In Russian.) Vsesofûzn. Akad. Sel'skokhoz. Nauk im. V. 1. Lenina. Dok. 17(9):44-48. illus.,tables. 1952. Ref. 20 Ak1

479. WALKER, A. W. Drainage of irrigated lands. Civ. Engin. 8:733-734. Nov.1938. 290.8 C49

Drainage to prevent the accumulation of soluble salts that render land sterile.

480. WARDLAW, H. H., and MASON, F. R. An account of irrigation and drainage control on an area of dwarf coconuts. Malayan Agr. J. 24:421-431, illus., tables. Sept. 1936. 22.5 F312

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482. WEIR, W. W. Drainage in the San Joaquin Valley as it may be affected by the Central Valley project. Amer. Geophys. Union.

Trans. 22:45-49. July 1941. 330.9 Am3

Old drainage situations, now partially alleviated by extensive pumping, will be aggravated to the point where they will again become serious. The whole drainage problem could be solved by withholding late-season gravity water to the extent that 25 or 30 percent of the annual requirement be pumped from deep wells.

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Water for irrigation is obtained by pumping from drainage ditches. The importance of well-drained soil in irrigated fields is discussed.

Peat and Muck Soils

484. ADAM, J. A modern approach to peat reclamation. New Zeal. Grassland Assoc. Proc. 15:166-173. 1953. 60.19 N48

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soils, and 429,000 acres of drained and developed peat and muck.

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487. CARPENTER, J. C., and BARBER, E. S. Vertical sand drains for stabilization of muck-peat soils. Amer. Soc. Civ. Engin. Proc. 79 (Separate 351), 17 p., illus. Nov. 1953. Ref. 290.9 Am3Ps

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periment Station, cooperating.

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Experiment Farm.

492. DAVIS, J. H. The peat deposits of Florida; their occurrence, development, and uses. Fla. Dept. Conserv. Geol. B. 30,247 p., illus., maps, tables. Dec.1946. Ref. 406 F66B

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494. DOGGETT, D. Controlled drainage, Outdoor Ind. 17(6):14-15,illus. June 1950. 279.8 Ou82

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Good mosquito control is difficult in any agricultural area where

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many parts of the world.

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605. RECTOR, N. H. The use of ditch linings, underground drains, and sanitary fills for malaria and mosquito control. Calif. Mosquito Control Assoc. Proc. & Papers 13:96-106, 1944. Ref.

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608. SMITH, E. A. Drainage for mosquito source reduction. Calif. Mosquito Control Assoc. Proc. & Papers 20:62-63. 1952.

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Dismal Swamp.

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611. VANNOTE, R. L. Fresh water swamps with reference to surface drainage. N. J. Mosquito Extermin. Assoc. Proc. 38:80-84. 1951. 420 N46

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621. BENDER. Dränung auf schweren böden. Hannoversche Land. u. Forstwirt. Ztg. 108:1051-1052; 1085-1086; 1116, illus. July 23-30, Aug. 6, 1955. 18 H194

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622. BLOOM, A. Drainage and irrigation. Garden 1:635-636.

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5(39):9-11, illus. Nov. 8, 1952. 19 B32 Ditches for drainage pipes in Austria.

1062. *FERGUSON, F. L. Farm underdrainage. Ontario Agr. Col. B. 360 rev., 21 p., illus. 1946. 101 On8B 1063. FRIDSTROM, A. E. Dränering—ett viktigt arbete.

^{*}Not examined.

Sveriges Pomol. För. Fruktodlaren, 6:178-179, illus. 1947. 86 Sv2F Drainage of orchards in Sweden by tile drains and wells.

1064. FURNEAUX, B. S., Land draining. Country Landowner 6:169-174. June 1955. 10 C836

Covers pipe, or tile, drainage, and mole-drainage practices in England. Building of outfalls and their maintenance, and maintenance of tile and mole systems are discussed.

1065. GALLETTI, A. C. Qualche cosa di nuovo sulla "fognatura" del terreno. Colt. e Gior. Vinic. Ital. 98:367-368, illus. Sept. 1952.

16 C72

Something new in the drainage of land. An inexpensive method of draining with baked earth in Italy.

1066. GALPIN, A. J. Quality in drain tiles. New Zeal. J. Agr.

79:24, July 15,1949. 23 N48J

Strength is more important than porosity.

1067. GARBOUA, M. Importance du drainage en Egypte. Egypte

Agr. 50:161-168. Sept./Oct.1952. 24 Un32

The superiority of covered to open drains in Egyptian agriculture. 1068. GARDNER, C. H. Market gardening on heavy land. Gt. Brit. Min. Agr. Agriculture 53:389-392. Dec.1946. 10 G79J

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1069. GAYFORD, G. W. Orchard drainage. Victoria. Dept. Agr. J. 42:147-149,illus. Apr.1944. 23 V66J

Recommends tile drainage, and discusses details of construction.

1070. GERMANY, REICHSMINISTERIUM FÜR ERNÄHRUNG UND LANDWIRTSCHAFT. Anweisung fur die planung, ausführing und unterhaltung von dränanlagen. Ed. 6. Berlin, Springer, 1941. 70 p., illus., tables. 54 G312

Drainage of marshlands, and types of drainpipe required.

1071. GLOTOV, M. N. Efficiency of mole drains. (In Russian.) Vsesofuzn. Nauk im. V. I. Lenina. Dok. 2:43-48,tables. 1940. 20 Akl Experiments in maintaining satisfactory moisture conditions in the soil in wet and dry weather with mole drainage.

1072. GT. BRIT. MINISTRY OF AGRICULTURE AND FISHERIES Drainage of the farm homestead. Gt. Brit. Min. Agr. L. 21,19 p.,illus.,

tables. June 1954. 10 G7944

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1073. GROUT, A. R. Tile drainage for Pennsylvania farms. Pa. State Col. Agr. Ext. C. 413,20 p.,illus.,tables. Mar.1953. 275.29 P38C Discusses underdrainage, tile drainage, installation of tile, cutting

laterals, protection of outlets, surface inlets, and pipelines.
1074. HAEGERMARK, F. Ingen lantbrukare har angrat att han

tackdikat sin gärd. Lantmannen 28:318-319, illus. Apr. 1, 1944.

11 L234

No farmer regrets having inaugurated subsoil drainage. Tile drainage in Sweden.

1075. HAGEM, K. Grøfting og grøftepriser. Norsk Landbr. 13: 411-414, illus. Oct. 10, 1947. 11 N8122

Ditches and cost of ditches in Norway.

Considers pipe, tile, and wood underdrains, and mole drains, and concludes that mechanical ditching for subsurface drainage is cheaper than hand labor in Norway.

1076. HAKANSSON, A. Tubuleringsmetoden vid dränering av

akerjord. Svensk Jordbrforsk. 1951:25-33, illus. 11 J763

The tubulation method in the drainage of arable land. Mole drainage, its history, cost, equipment, and suitability on marshland in Sweden.

1077. HALLGREN, G. De statliga dräneringsförsöken. Svensk Jordbr. Forsk. 1948:17-28, illus. 11 J763

The state drainage experiments, Sweden. The research has to do with alterations in the depth and distances of tile drains and their effect on yields.

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1078. HAMBLYN, C. J. Mole drainage. New Zeal. J. Agr. 70: 363,365-373,illus. Apr.16,1945. 23 N48J

Practical details of a technique evolved by a North-Island farmer that is efficient and has made durable drains. The mole is pulled to and from the outlets. Provision of proper connections between subsidiary mole drains acting as outlets is an important feature. Equipment and costs are discussed.

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1080. HAMBLYN, C. J. Trials with shallow, smallbore mole drains. New Zeal. J. Agr. 80:534,illus. June 1950. 23 N48J

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1081. HARBORD, W. L. The mole or plough drain. New Zeal. J. Agr. 58:432-433, illus. May 1939. 23 N48J

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1082. HARDING, S. W., and WOOD, J. K. Model tests of flow into drains. Soil Sci. Soc. Amer. Proc. 6:117-119, illus. 1941. 56.9 So3 Research at the Utah Agricultural Experiment Station.

1083. HART, R. A. Profundidad de los drenajes de "la hacienda". Campesino 71:72-76, illus. Feb. 1939. 9.3 So12

Soil factors affecting the optimum depth for tile drains in Chile.

1084. HARVEY, N. Relics of a great achievement; some veteran deep-drainage schemes. Land Agents' Soc. J. 54:475-477, Oct.1955. 282.9 L22

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1085. HASWELL, J. R. Drain the wet spots. Pa. Agr. Ext. C. 112, rev., 34 p., illus. May 1943. 275.29 P38C

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1086. HASWELL, J. R. Principles of tile drainage. Agr. Engin. 21:310,316,illus. Aug.1940. 58.8 Ag83

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1087. HASWELL, J. R. Some tile drainage experiences. Agr. Engin. 30:81-83,85,illus. Feb.1949. 58.8 Ag83

Dynamite ditching and other phases of tile draining in Pennsylvania since the First World War.

1088. HEIMPEL, L. G. Underdrainage. Macdonald Col. J. 4(1): 4-5,11,illus. Sept.1943. 101 M144

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1089. HERRMANN, H. Die durchführung von moormeliorationen. Allgäuer Bauernbl. 17:534-535. Sept.22,1949. 18 AL53

Drainage of marshland in Germany is possible with woodbox drains.

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1090. HEYNDRICKX, G. A. De stroming van het water in drainbuizen en de berekning van hun afvoer. Gent. Landbhogesch. Meded. 19:271-309. June 1954. Ref. 105.1 G344 English summary, p. 308-309.

The flow of water in tile drains and the computation of their discharge. 1091. HOCK, O. W. Now they are using moles to drain farm lowlands. Better Farming Methods 27(6):28-29, illus. June 1955.

Mole drainage of heavy muck soils in Florida and heavy clay and gumbo soils in Louisiana and Minnesota.

1092. HOOGHOUDT, S. B. Tile drainage and sub-irrigation. Soil Sci. 74:35-48,illus.,tables. July 1952. Ref. 56.8 So3

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1093. HOPEWELL, H. G. Mole drainage investigations in New Zealand. 2. Report on investigations of some methods of connecting minor mole drains to major mole drains. New Zeal. J. Sci. & Technol. 35A:237-244, illus., tables. Oct. 1953. Ref. 514 N48A

Four methods were studied, of which the McLeod method proved most effective. It involves pulling the major mole drain across the

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For Pt. 1 see item 1101.

1094. HOPEWELL, H. G. Mole drainage investigations in New Zealand. 3. Investigation to determine the effect of increasing the thickness of the mole plough blade or knife. New Zeal. J. Sci. & Tech-

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249-261, illus. Oct. 1953. Ref. 514 N48A

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1096. HORE, E. R., and KIDDER, E. H. Water table drawdown characteristics. Agr. Engin. 35:396-398,illus.,tables. June 1954. Ref. 58.8 Ag83

A comparative study of four field methods of water-table observation in clay loam soil. An evaluation and discussion of a new depth and spacing formula for lateral tile drains is presented also.

1097. HOWALD, R. Maulwurfs-drainage. Grüne 77:635-643.

June 17, 1949. 17 Sch9

Mole drainage in Switzerland.

1098. HUDSON, A. W. Drainage as a factor in increasing production. New Zeal. Grassland Assoc. Proc. 13:139-148, illus. 1951. 60.19 N48

Recommends tile draining over open-ditch draining for grasslands of New Zealand, as ditches are dangerous to livestock and are expensive to maintain. Discusses costs and returns from tile drainage, and describes a drainage-ditch trencher and excavator suitable for use in Taranaki.

1099. HUDSON, A. W. Even at present costs drainage can pay off handsomely as long term investment. New Zeal. Dairy Exporter

27(8):31,33. Feb.1952. 44.8 N484

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Covers: History of mole drainage; types, operation and maintenance of mole plows; soils suited to mole drainage; inflow and outflow of water in drains; depth, size, length, and spacing of mole drains; and

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1101. HUDSON, A. W., and FIFE, C. V. Mole drainage investigations in New Zealand. 1. The profiles of some mole-drainage soils and their relation to the depth of mole drains. New Zeal. J. Sci. & Technol. 42A:197-208, illus. Dec. 1940. Ref. 514 N48A

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1102. ANGOL, A. M. Moistening reclaimed marshes with the aid of mole drains. (In Russian.) Vsesofuzn. Akad. Sel'skokhoz. Nauk im V. I. Lenina Dok. 20(2):35-40. 1955. 20 Ak1

1103. ILLINOIS. UNIVERSITY. COLLEGE OF AGRICULTURE. EXTENSION SERV. Physical requirements for drain tile. Ill. Agr. Col. Ext. A Eng 605,3 p., tables. Oct. 18,1949. 275.29 IL62Pa

ASTM specifications for draintile (C4-24).

Includes formulas for number of acres that can be drained per 100 feet of tile by size.

1104. JACOBSEN, J. Wooden drain pipes. Mon. B. Agr. Sci. & Pract. 27:197. May 1936. 28 In8Mo

A Danish invention expected to be effective in Finland.

1105. JACOBSEN, P. Keep your tile drains working. U. S. D. A. L. 347,8 p., illus. Jan. 1954. 1 Ag84L

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blowouts, and mapping the tile system.

1106. JENSEN, H., and JAKOBSEN, J. M. Om forandring af okkerdannelse i draenrør ved hjaelp af kobber. Hedeselsk. Tijdschr. 67:81-86, illus., table. Apr. 20, 1946. 11 H35

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pipes.

1107. JOFFE, J. S., and KRUEGER, W. C. Surface swamping and its treatment. N. J. Col. Agr. Ext. B. 215,7 p., illus. Feb. 1940. 275.29 N46

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1108. JONES, H. I. Tackling the problem of underground seepage. Soil Conserv. 20:130-131,134, illus. Jan. 1955. 1.6 So3S

Deep tile drainage of three crop farms in Colorado promises to in-

crease yields in years to come.

1109. JUUSELA, T. Myyraojituksesta ja sen kayttomahdollisuuksista suomessa. Suomen Maataloustiet. Seura. Maataloustiet. Aikakausk. 22:152-163. 1950. Ref. 20 Su7M

English summary, p. 163.

On the possibilities of using mole draining in Finland,

1110. JUUSELA, T. Salaojasyvyyskysymyksen selvittelyä. Suomen Mattaloustiet. Seura, Maataloustiet. Aikakausk. 19:60-68, table. 1947. Ref. 20 Su7M

Pipe drainage methods in Sweden and Finland. Covers size and depth

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1111. JUUSELA, T. Salaojituskoetoiminnasta sumoessa. Suomen Maataloustiet. Seura. Maataloustiet. Aikakausk. 25:113-135, illus., tables. 1953. Ref. 20 Su7M English summary, p. 132-135.

Deep drainage trials in Finland. Investigations were concerned with different drainage methods, drain depth, and numbers of drains per area unit.

1112. KAITERA, P. Peltojen salaojituksesta, 1-2. Suomen Maataloustiet. Seura. Maataloustiet. Aikakausk. 23:1-31; 24:79-84,illus., tables. 1951-1952. Ref. 20 Su7M

English summary.

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1113. KANNENBERG, H. Über die maulwurfsdrainage und ihre auswirkungen. Landwirtbl. Weser-Ems 96:203-204. Mar.24,1949.

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1114. KARSTENS, G. A., and HARKER, D. H. Farm drainage in ten easy lessons. Purdue Ext. B. 269,16 p.,illus.,table. 1950. 275.29 In 2E

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English summary at end of each part.

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1116. KIDDER, E. H., and CUTLER, W. A. It pays to buy good drain tile. Mich. State Col. Agr. Ext. Folder F-166,8 p., illus., table. Feb.1952. 275.29 M58Ex

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1118. KIRKHAM, D. The artificial drainage of land; the artesian basin. 1-3. Amer. Geophys. Union Trans. 20:677-680; 21:587-593;

26:393-406, illus. Aug. 1939, July 1940, Dec. 1945. Ref. 330.9 Am3
Demonstration and analysis of the case of flow into horizontal, equally spaced drains, first, when the water originates solely from an artesian aquifer below the drains, and, second, when both artesian and surface water are flowing into the drains.

1119. KIRKHAM, D., and SCHWAB, G. O. The effect of circular perforations on flow into subsurface drain tubes. 1.-2. Agr. Engin. 32:

211-214,270-274,illus. Apr.-May 1951. Ref. 58.8 Ag83

Pt., 1, Theory; Pt. 2, Experiments and results.

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The order of the authors' names is reversed in Pt. 2.

1120. KIRKHAM, D. Flow of ponded water into drain tubes in soil overlying an impervious layer. Amer. Geophys. Union. Trans.

30:369-385, June 1949. Ref. 330.9 Am3

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units as used in the artificial drainage of soil is given.

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1123. KRIVONOSOV, I. M. Drainage of swampy mineral soils with draining tiles combined with mole drains. (In Russian.) Gidrotekh. i Melior. 6(4):15-23. Apr. 1954. 290.8 G362

1124. KUPPER. Entwässerung mit dem maulwurpflug. Landwirt. Z. der Nord-Rheinprov. 119:850-851, illus. Aug. 9, 1952. 18 L2344 Drainage with the mole plow. Discusses costs and construction.

1125. KUUM, IU. Method of constructing closed drainage in Estonian SSR with the aid of a trench digger. (In Russian.) Gidrotekh. i Melior. 6(12):54-55. Dec.1954. 290.8 G362 1126. LALLOY. Drainage et sous-solage. Génie Rar. 45:155-158, illus. May 1952. 58.8 Au8

Ditching and mole drainage in France. Describes equipment. 1127. LAPIDES, YITZHAQ, and BAUM, U. A mole drainage (In Hebrew.) Hassadeh 24:290experiment at Hazorea settlement. 292, illus. May 1944. 26 H27 Israel.

1128. LARSON, C. L. How to judge drain tile quality. Minn. Farm & Home Sci. 11:5,9,illus. Oct.1953. 100 M668

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1129. LARSON, J. E. Construction of underdrains. n.p., 1946.

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Details of construction in western Oregon.

1130. LEVITT, E. C. Irrigation and drainage in coastal citrus orchards. Agr. Gaz. N. S. Wales 58 (1):21-22. Jan.1,1947. 23 N472 Tile pipes are recommended for underdrainage. Interception and "spot" drains are explained, and spacing and depth of tile are discussed.

1131. LUEBCKE, H. N. Special drainage along Ohio Turnpike to protect farm tilling. Roads & St. 96(7):73-76,79-81, illus. July 1953.

288.8 R536

Supplemental design criteria pertaining to: The alterations and reconstructions of existing agricultural drainage systems affected by the construction of the Ohio Turnpike; the consideration which must be given to the design of turnpike drainage ditches when agricultural drainage is an influencing factor; and provisions which must be made for future agricultural drainage.

1132. LYNES, W. S. Concrete bulkheads for outlet protection.

Agr. Engin. 27:459-460, illus. Oct. 1946. 58.8 Ag83

Tile drainage outlets. A survey of drainage systems in Webster County, Iowa.

1133. MCCLURG, V.O. Heavy-duty clay tile drains. Engin.

News-Rec. 131:263, illus. Aug. 12, 1943. 290.8 En34

Tiles of 3,600 pounds per linear foot crushing strength were produced to withstand heavy equipment at a building site in Ohio.

1134. MCCULLOCH, R. Bog reclamation in Galway. Agr. Ireland 9:225-227. Oct.1952. 10.5 Ag8

Mole drainage.

1135. MCCULLOCH, R. Mole draining. Irish Agr. & Creamery

Rev. 14(138, n. s.):13-15. June 1945. 44.8 C866

Tile drainage costs are compared with those of mole drainage and the systems are described. For land unsuitable for mole draining,

excavators or trench cutters are recommended.

1136. MACPHERSON, H. N. Creosoted wood-stave drainage pipes on George VI Highway. Roads & Bridges 79(12):19,54, illus. Dec. 1941. 290.8 C16A

Particulars of a 1200-foot creosoted wood-stave pipe installed in existing side ditches to enable the road to be widened to four lanes. British Columbia.

1137. MALYGIN, V. S. A deep closed drainage system. (In Russian.) Tashkent, Soiuznikhi, 1939. 122 p., illus., tables. 54 M29

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Depth and spacing of drains in Turkestan. 1138. MANSON, P. W., and MILLER, D. B. Essential characteristics of durable concrete draintile for alkali soils. Agr. Engin. 29:

485-487,489,illus.,tables. Nov.1948. 58.8 Ag83

Admixtures and coatings were found to be inadequate for the protection of concrete in alkali soils in experiments conducted by the University of Minnesota Department of Agricultural Engineering. Tests showed that curing in water vapors at temperatures in excess of 212° F. increased the sulfate resistance of concrete.

1139. MANSON, P. W. Importance of drain tile testing. Minn. Farm & Home Sci. 12(20):14,17,illus. Feb.1955. 100 M668

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different types of soils.

1140. MANSON, P. W., and MILLER, D. G. Making durable concrete drain tile on packer-head machines. Minn. Agr. Expt. Sta. B. 426,16 p., illus., tables. May 1954. 100 M66

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1954. Ref. 58.8 Ag83

Recommendations for tiles subject to freezing, alkali, or acid con-

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1142. MANSON, P. W. Sulphate resistance of 94 commercial cements. Agr. Engin. 21:135-137, illus., tables. Apr. 1940. 58.8 Ag83 Studies to determine the extent of sulphate resistance of 94 brands of concrete draintile.

1143. MARKWICK, A. H. D., and DOBSON, A. F. Application of electroosmosis to soil drainage. Engineering 163:121-123, illus. Feb.7,1947. 290.8 En322

Research into a method of drainage of silty soils.

1144. MAYO, K. L. Installation of effective mole drainage. New

Zeal. J. Agr. 90:395-399, illus. Apr. 15, 1955. 23 N48J

On clay soils in New Zealand. Mole plows, depth and distance apart of mole drains, life of drains, effects of drainage, and costs, are discussed.

1145. MILLER, D. G., and MANSON, P. W. Durability of concretes and mortars in acid soils with particular reference to drain tile. Minn. Agr. Expt. Sta. Tech. B. 180,80 p., illus., tables. June 1948. Ref. 100 M66

Partial contents: Ch. 2, Experimental drain tile in peats and mineral soils; Ch. 3, Experimental concrete and mortar cylinders in peats and mineral soils; Ch. 4, Comparison of results of drain tile and cylinders

1146. MILLER, D. G., and MANSON, P. W. Essential characteristics of durable concrete drain tile for acid soils. Agr. Engin. 29: 437-441, illus., tables. Oct. 1948. 58.8 Ag83

Tests of some 1,100 commercial and experimental tiles made in peat soils of Minnesota and Wisconsin, and in an acid mineral soil in

North Carolina.

1147. MILLER, D. G., and SNYDER, C. G. Expansion of clay and concrete drain tile due to increase of temperature and moisture

content. Agr. Engin. 25:179-180, illus., tables. May 1944. 58.8 Ag83 Studies show that clay tile is affected not at all by moisture and tem-

perature, and concrete only slightly.
1148. MILLER, D. G. Improving drain-tile resistance to alkali conditions. Agr. Engin. 17:513-515,544,illus.,tables. Dec.1936.

Cement curing in draintile manufacture.

1149. MILLER, D. G., and MANSON, P. W. Longtime performance of some clay draintile. Agr. Engin. 32:95-97,100-101, tables.

Feb.1951. 58.8 Ag83

Report on tests of frost-resisting properties of clay tile installed at shallow depths in farm drainage systems in the Upper Mississippi Val-

ley. "Clay draintile" means burned product of clay or shale.
1150. MILLER, D. G., and MANSON, P. W. Long-time tests of concretes and mortars exposed to sulfate waters. Minn. Agr. Expt. Sta. Tech. B. 194,111 p., tables. May 1951. Ref. 100 M66

Gives results of tests of draintiles made with portland cement and

with alumina cements.

1151. MOHRMAN, K. J. M. Draineren. 1-3. Nederland. Heidemaatsch. Tijdschr. 58:338-340,362-367; 59:3-7,illus. Nov.1947-Jan. 1948. 12 N282

Pts. 2-3 have title Drainage.

Discusses the drainage layout in the Netherlands. Cost, equipment, laying and selection of tiles, depth and spacing of draintiles, equipment for hand labor, and trenching for tile drains.

1152. MOLE drainage. New Zeal. J. Agr. 73:253,255,illus. Sept.

1946. 23 N48J

Use of small plugs at shallow depths for draining seasonal wetness from New Zealand fields.

1153. MOLE drainage procedure. Agr. Mach. J. 8(3):46,54. Mar.

1954. 58.8 Ag86

Its effectiveness depends on the quality of the soil, the quality of the bore of the mole, and the grading of the channel.

1154. MORRIS, W. Tile drainage in the U. S. A. Farm Mech. 4: 354-356, illus. Sept. 1952. 58.8 B722

Includes equipment.

1155. MUIRHEID, B. F. Buying good drain tile. Ill. Agr. Ext. C. 696,6 p.,illus.,table. July 1952. 275.29 I162C Judging soundness, regularity, density, and strength.

1156. MURAYAMA, S. J. Drenos de bambus. Rev. de Agr. [Pira-

cicaba] 22:323-325. Nov./Dec.1947. 9.2 R324

The use of bamboo drains in Brazil.

1157. NICHOLSON, H. H. Drainage development in Britain. Worcestershire Agr. Chron. 11:323, 325, 327, 329, 331. Nov. 1943. 10 W892 History of drainage since 1750, and the evolution of draintile.

1158. NICHOLSON, H. H. Field drainage; its fundamental importance. Times Trade & Engin. (n.s.) 48(924):28. Feb.1941. 286.8 T482

Renovation of old tile drains, and mole draining in England.

1159. NICHOLSON, H. H. Field drainage problems. 1-8. Estate Mag. 43:211-212;237-238;258-259;289-290;318-320; 44:12-14;41-43; 69-70. Aug.1943-Mar.1944. 10 Es8

Pt. 2. The design of field drainage systems; Pt. 3, Drain tiles; Pt. 4, Tile draining; Pt. 5, The mole plough; Pt. 6, Mole draining; Pt. 7, The scope of mole draining; Pt. 8, The best time for draining work.

1160. NICHOLSON, H. H. The importance of mole draining in present circumstances. J. Min. Agr. Agriculture 46:671-676. Dec. 19**39.** 10 G79J

Drainage and food production — costs, methods, and equipment. 1161. NICHOLSON, H. H. Mole drainage for heavy land. Gt. Brit. Min. Agr. "Growmore" L. 44,8 p., illus. 1940? 10 G79Gr

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153, illus. Aug. 1941. 10 W892

1162. NICHOLSON, H. H. Some problems in field drainage. Scot. J. Agr. 25:213-219. Jan. 1946. 10 Sco82So

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tile drainage in Great Britain.

1163. NICHOLSON, H. H. Tile draining; sit back for a season and watch. Power Farmer 10:126-128, illus. Apr. 1953. 58.8 P872 Locating and renovating old tile systems and giving them a chance to work, before installing new systems. Relates to England. 1164. OLSEN, J. T. Orchard drainage. Fruit Grower 58:10,19, 23, illus. Apr. 1938. 80 G85

Discusses tile drainage, surface inlets, and the problem of roots clogging drains. Includes testing for drainage by soil borings.

1165. OVERHOLT, V. Farm drainage. Farm Q. 2(1):40-45,103-104,illus.,tables. Spring 1947. 6 F22995

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1166. PEARCE, O. W. M. Nitrogen and drainage. So. African

Sugar Technol. Assoc. Proc. 24:77-82. 1950. 65.9 So83

Includes discussion.

French drains remove the minimum of plant nutrients from the soil. Their construction is described and their merits compared with those of shallow open drains.

Also in So. African Sugar J. 34:387-393. 1950. 65.8 So8

1167. PEARSON, C. H. O. Mole drains and their uses; their practicability in the Sugar Belt. So. African Sugar J. 35:625,627,629, illus. Oct.1951. 65.8 So8

Mole drains are preferred to open ditches for draining valley bottoms and clay lands. Layout, equipment, and depth of the drains are dis-

cussed.

1168. PIJLS, F. W. G. Drainage in de tuinbouw. Netherlands. Dir. van de Tuinbouw. Meded. 12:709-716. Aug./Sept.1949. 86 N384 English summary, p. 716.

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1169. PIPE drains stop an earth slide. Engin. News-Rec. 128:

539-540, illus. Apr. 9, 1942. 290.8 En34

Drainage of an earth slide near San Francisco by putting down vertical holes from which perforated drainpipes allow escape for ground water.

1170. POWERS, W. L. The durability of concrete drain pipe. Agr. Engin. 29:77. Feb.1948. 58.8 Ag83

The effect of alfalfa roots and of acid soil on concrete.

1171. RAMSAUER, B. Die Maulwurfdränung. Bodenkultur 6: 170-195, illus., tables. 1952. Ref. 19 B635

Mole drainage in Austria. Technique, machinery, and layout in rela-

tion to soil type are discussed.

1172. RECORD well-point installation used to drain exposition site. West. Constr. News 13(6):209-212, illus. June 1938. 290.8 W522 The salt-water level over 300 acres was lowered by drainage preliminary to landscaping the site of the Golden Gate International Exposition.

1173. RESHETKINA, N. Vertical drainage of saline lands of Uzbekistan. (In Russian.) Khlopkovodstvo 5(5):47-50. May 1955.

72.8 K522

1174. RIDDOLLS, A. W. Mole drainage. Canterbury Chamber

Com. Agr. B. 264,4 p., illus. July 1951. 23 C162

Discusses the mole plow, conditions suitable for mole drainage, action of mole drains, spacing, diameter, and depth of mole drains, and economic factors in mole drainage.

1175. RIDDOLLS, A. W. Tile drainage. Canterbury Chamber.
Com. Agr. B. 297,6 p.,illus. Apr.1954. 23 C162

Covers materials for drains, action of tile drains, diameter, fall, depth, and distance apart of tile drains, laying the tiles, backfilling, surface inlets, outlets, joining mole drains to tile drains, and tile drainage systems, costs, and returns.

Also in Power Farming Austral. & New Zeal. 63(7):11,133-135,illus.

July 1954. 58.8 P87

1176. RIDIGER, V. Mineralization of excreta in mole drains. (In Russian.) Vsesoiuzn. Akad. Sel'skokhoz. Nauk im. V. I. Lenina. Dok. 10(9/10):34-38. 1945. 20 Ak1

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1177. RIDIGER, V. R. The use of mole drains without reinforced walls in the leaching of saline soils. (In Russian.) Vsesofuzn. Akad. Sel'skokhoz. Nauk im. V. I. Lenina. Dok. 12(1):38-41. 1947. 20 Ak1 1178. RIDIGER, V. R., and DOLGOV, S. I. Utilization of deep

mole drains in the improvement of saline soils. (In Russian.) Vsesofuzn. Akad. Sel'skokhoz. Nauk im. V. I. Lenina. Dok. 17(8):44-46, illus. 1952. 20 Ak1

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1179. SAVESON, I. L. Some factors affecting mole drains. Agr. Engin. 27:316,320,illus. July 1946. 58.8 Ag83

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1180. SCHILDKNECHT, H. Reclamation in Switzerland. Reclam.

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1181. SCHMITT, E. A., and MACQUEEN, P. O. Perforated-pipe underdrains for rapid sand filters. Amer. Waterworks Assoc. J. 34: 857-876, tables. June 1942. 292.9 Am32J Discussion by E. A. Hardin, p. 875-876.

1182. SCHROEDER, G. Die dränung. In his Landwirtschaftliche wasserbau, p. 186-234, illus., tables. Berlin, Springer, 1937. 290 Sch72 Includes drainage of mineral and marsh soils, tile and mole drain-

age, and costs in Germany.

1183. SCHWAB, G. O. Plastic tubing for subsurface drainage. Agr. Engin. 36:86-89,92,illus. Feb.1955. Ref. 58.8 Ag83

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1184. SCHWAB, G. O. Subsurface drainage with small perforated flexible tubes in mole drains. Iowa State Col. J. Sci. 26:285-286.

Jan. 1952. 470 Io9

Abstract of thesis (Ph.D.) - Iowa State College, 1951.

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1185. SEARLE, K. D., and STEWART, D. Land reclamation on the shores of the Great Salt Lake. Land Impr. 2(7):16-17, illus. July 1955. 282.8 L224

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around the tile.

1186. SEIDEMANN, J. Planung und erhaltung der kulturtechnischen anlagen in den landwirtschaftlichen produktionsgenossenschaften. Deut. Akad. Landwirtwiss. Schrreihe. f. die Landwirt. Produkgenossensch. 10,18 p., illus. 1953. 18 D4825S

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1187, SHAFER, F. F. Causes of failure in tile drains. Agr. Engin. 21:17-18,20. Jan.1940. 58.8 Ag83

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1189. SHOJI, H., and MORISHIMA, S. On the past and present under-drain at Kyushu. (In Japanese.) Nogyodoboku-Kenkyu 16:2-9, illus. Oct.1948. Ref. 290.8 N68

1190. SISSON, D. R. Tiling for 30,000. Land Impr. 2(11):15,35, illus. Nov.1955. 282.8 L224

The Indiana Drainage Contractors Association demonstrates equipment and methods for draining seventeen acres of poorly drained clay farmland.

1191. SLATER, C. S. The depth and spacing of tile drains. Agr. Engin. 31:448-450, illus. Sept. 1950. Ref. 58.8 Ag83

A formula is derived for the calculation of drain spacing.

1192. SPANGLER, M. G. The structural design of flexible pipe culverts. Iowa Engin. Expt. Sta. B. 153,84 p., illus., tables. Dec. 1941. Ref. 290.9 Io9

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1193. STEIN, C. Die beherrschung des wasserhaushalts im boden durch eine kombinierte untergrund-ent-und -bewässerungsanlage. Deut. Landwirt. 2:259-263. May 1951. 18 D4822

Discusses depth of pipe drains in respect to future maintenance. Bitumen pipes are preferred because they can be nearer the surface

of the soil.

1194. STEIN, C. Nene gesichtspunkte bei der landwirtschaftlichen ent- und bewässerung. Wasser u. Boden 2:209-212, illus. Oct. 1950. 56.8 W28

New viewpoint on agricultural drainage and irrigation in Germany.

Describes method for connecting pipe with asphalt.

1195. STRINGER, N. E. Mole ploughing as applied to irrigated swamp areas. So. Austral. Dept. Agr. J. 45:283-286, illus. Dec. 1941. 23 So84

Mole drains may be used in swamp areas provided the soil is plastic enough to hold the drain. Depth and spacing of the moles varies according to the type and condition of the soil. Benefits and costs are discussed.

1196. SUBDRAINAGE with Toncan drainage products. Cleveland, Toncan Culvert Mfg. Assoc., 1939. 31 p. 54 T61

Requirements of pipes for farm drainage included.

1197. SUTTON, J. G. How to plan a tile drainage system. Washington, U. S. Soil Conserv. Serv., 1942. 11 p., illus. 1.96 Op2Ho Address prepared for the American Society of Agricultural Engi-

neers, Southwest Section, Shreveport, La., Apr. 3, 1942.

Covers location of tile lines, capacity of tile drains, depth and spac-

ing of tiles, computation of flow in drains, surface inlets, outlet pro-

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1199. SUTTON, J. G. Tile drainage. Washington, U. S. Soil Conserv. Serv., 1954. 9 p. Ref. 1.96 OP2Sut

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vision of the U. S. Soil Conservation Service, May 1954.

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Some ideas on the maintenance of irrigation works. Includes a dis-

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1201. TATARINOVA, N. K. Mole drainage on meadows of excessively mineral soils in the non-Black soil area. (In Russian.) Sotsialist. Zhivotnovod. 12(6):15-19, illus., tables. June 1950. 49 So71

1202. TRUSS, P. Effect of mole drainage and subsoil plowing on water-salt process in soils, and yields under conditions of Baraba. (In Russian.) Pochvovedenie 4:62-68. Apr.1955. Ref. 57.8 P34 Cereals.

1203. U. S. SOIL CONSERVATION SERV. Laying tile by hand. U. S. Soil Conserv. Serv. J. S.-40,2 p., illus. June 1953. 1.9605 J11 Setting crossbars, digging trenches, laying the tile, and filling the

1204. VALENTIN. J. Assainissement des terres dans la région

de l'ouest. Potasse 20:153-154, illus. May 1946. 57.8 P84 Land drainage in the west of France. Primarily tile drainage.

1205. VAN BAVEL, C. H. M. Will this soil drain? Crops & Soils 2(7):10-11, illus. Apr./May 1950. 6 W55

Determing soil permeability for spacing of draintiles.

1206. VAN SCHILFGAARDE, J. Analytical and empirical evaluation of water table behavior as affected by drainage systems. (Abs.) Iowa State Col. J. Sci. 29:524-525. Feb.15,1955. 470 Io9

Abstract of Thesis (Ph.D) — Iowa State College, 1954.

A field laboratory investigation of the effect of the depth and spacing

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1207. VAN SCHILFGAARDE, J., FREVERT, R. K., and SCHLICK, W. J. Effect of present installation practices on draintile loading. Agr. Engin. 32:371-374,378,illus.,tables. July 1951. 58.8 Ag83 Most of the tile installed with modern equipment is at moderate depths not subject to excessive loading.

Comment on this article by R. Chen in Agr. Engin. 32:600. Nov. 1951.

58.8 Ag83

1208. VAN SCHILFGAARDE, J., FREVERT, R. K., and KIRKHAM, D. A tile drainage field laboratory. Agr. Engin. 35:474-478, illus.

July 1954. Ref. 58.8 Ag83

Discusses an attempt to find an empirical criterion for the appropriate selection of the depth and spacing at which tile lines should be placed in different soils. Methods and equipment used in the study are described.

1209. VAN VLACK, C. H., and NORTON, R. A. Tile drainage for increased production. Iowa. Agr. Expt. Sta. B. P65,31 p., illus. June 1944. 100 Io9

Practical details of all aspects of tile drainage including notes on management practices which improve drainage conditions. Sketches and illustrated descriptions of layouts, operations, implements, outlets, and a surface inlet are given.
1210. VILLENEUVE, G. O. L'utilité du drain. Forêt Québecoise
14:231-232. Apr.1949. 99.8 F79

Necessity of tile drains to lower a high water table. Some directions for selecting and laying tile are given. Recommends grading to a slope for the tile system.

1211. VIŠSER, W. C. Tile drainage in the Netherlands. Netherlands. J. Agr. Sci. 2:69-87, illus., tables. May 1954. 12 N3892

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1212. VOGELZANG, H. Ontwatering van grasland. Nederland. Heidemaatsch. Tijdschr. 62:290-293, illus. Nov. 1951. 12 N282 Drainage of grasslands. Brush, pipe, and mole drains are discussed,

and a trenching machine is described.

1213. WAĞNER, V. J. Drainage problems — how to tackle. Queensland Fruit & Veg. News 5:390-391. Apr.1,1954. 280.38 Q3 Cost of mole and tile drainage in Australia.

1214. WALKER, C. Management of poaching soils. New Zeal. J.

Agr. 78:365-367, illus. Apr. 1949. 23 N48J

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1215. WEBB, C. T., and HICKMAN, W. D. Tile solves problem in Palouse. Soil Conserv. 19:283-285, illus. July 1954. 1.6 So3S Tile drainage of hard clay soils in Washington and Idaho.

1216. WESSELING, J., and WIJK, W. R. VAN. Optimal depth of drainage. Netherlands J. Agr. Sci. 3:106-118, illus. May 1955. Ref.

12 N3892

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1218. WIANCKO, A. T., WALKER, G. P., and ROBBINS, C. The tile drainage experiment. Ind. Agr. Expt. Sta. C. 244:5-6, tables. May

1939. 100 In2P

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1219. WIKLANDER, L. Om järnutfällning i täckdikesledninger. Lantbr. Akad. Tidskr. 84:358-367,tables. 1945. Ref. 104 Su3

German summary.

Oxidation of divalent iron and subsequent precipitation in drainpipes may seriously disturb the operation of drainage installations. The harmful effects of iron bacteria can be minimized by sloping the conduits at a steep angle, by putting the mouth of the drain below the water table, or by using copper nets in the pipes or copper casings

at the pipe joints, thereby poisoning the iron bacteria.
1220. WOODWARD, G. O., and MILLER, W. MCN. A study of soil-water movement by electroosmosis. Agr. Engin. 34:29-33. Jan.

1953. Ref. 58.8 Ag83

"This paper was prepared for the purpose of assimilating the major-

ity of published references dealing with the electrical treatment of soils. It is intended as general information for persons who may become associated with what appears to be a developing interest in the possibility of electrical drainage of agricultural lands," p. 29.

1221. ZWERMAN, P. J. Problems of drainage in a soil and water conservation program. J. Soil & Water Conserv. 6:185-186,199,illus.

Oct.1951. 56.8 J822

The most intensively drained areas in the United States are discussed in general, with particular attention to Tiffin, Ohio. Details of a tile drainage system are given, including depth and spacing of tiles, and the effect of poor drainage on crops.

Pump Drainage and Wells

1222. AUGMENTED Fen drainage scheme. Oil Engine & Gas Turbine 18:88-90, illus. July 1950. Libr. Cong.

Gwynne flow pumps in England.

1223. BANKS, H. O., and RICHTER, R. C. Sea-water intrusion into ground-water basins bordering the California coast and inland bays. Amer. Geophys. Union Trans. 34:575-582, map. Aug. 1953. Ref. 330.9 Am3

The erection of dikes and pumping stations is among the solutions

offered for the salinifacation of ground water in California.

1224. BARRON, R. A. Consolidation of fine-grained soils by drain wells. Amer. Soc. Civ. Engin. Proc. 73:811-835, illus. June 1947. 290.9 Am3P

Complete formulas for consolidation by vertical and radical flow to wells, for cases with or without peripheral smear and drain-well resistance, are presented.

Discussed in Amer. Soc. Civ. Engin. Proc. 74:153-158,707-710,875-

Jan., May-June 1948. 290.9 Am3P

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Drainage of low-lying lands in Georgia by means of dug wells 200

feet deep.

1226. BISAL, F. Siphon drainage in the Hyde-Park-Benson area, Cache Valley, Utah. Soil Sci. 67:395-401, illus. May 1949. 56.8 So3 Proposed siphon-connected well-drain system for relieving hydrostatic pressure of an artesian aquifer.

1227. BOONENBURG, K. De windmolens van Nederland. Tijdschr. v. Econ. Geog. 37:300-307, illus., tables. Oct. 15, 1946. 280.8 T44

Windmills on the Netherlands polders.

1228. BUSQUET, J. C. Large pumps for drainage and irrigation. Way Ahead 5:24-29,illus. 1955. 280.8 W362

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1229. BUTLER, C. Problems of a present day homesteader. Natl. Reclam. Assoc. Proc. 18:72-76. 1949. 55.9 N212

Includes drainage by sump wells drilled through lava rock until a

crack is found that will carry off the waste water.

1230. CAMPBELL, R. D. Eldred Drainage and Levee District installs two more diesels. Diesel Power 18:855-858. Oct.1940. 291.8 D562

Eldred, Ill. Drainage pumps.

1231. CAMPBELL, R. D. Keach Drainage and Levee District. Diesel Prog. 6(12):34-35,48-50. Dec.1940. 291.8 D56

Drainage pumping plant in Illinois.

1232. CLARK, R. G. St. Germans sluice and pumping station. Inst. Civ. Engin. J. 6:377-392. Apr.1936. 290.9 In74J

Revamping old drainage works in Cambridgeshire in England's Fens,

and the construction of sluiceways and three new pumping units.

1233. CLASSEN, A. G. Practical aspects of flood control and reclamation of overflowed lands. Tex. Reclam. Dept. B. 27,80 p.,illus. Dec.1935. Ref. 54.9 T31

Includes drainage, sluice gates, and pumping plants.

1234. CLAY, C. Pumping stations, with special reference to land drainage and storm-water disposal. Inst. Civ. Engin. J. 5:35-58, illus.

Mar.1945. 290.9 In74J

Describes functions and operations, with costs, of axial-flow and centrifugal drainage pumps in use for land drainage in England by the Catchment Board of the Ministry of Agriculture. Also gives a brief history of agricultural drainage in England, and outlines the benefit to agriculture of planned drainage.

1235. COFFEY, J. H. Vertical pump applications. Amer. Water

Works Assoc. J. 31:1684-1690, illus. Oct. 1939. 299.9 Am32J

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1236. CRAWFORD, A. Development of derelict land. New Zeal.

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1237. DIESEL-pump team cuts drainage cost. Diesel Power

29(2):42-43. Feb.1951. 291.8 D562

Diesel drainage pump on farmlands in the South River Drainage Dis-

trict, Missouri. Includes cost.

1238. DIESELS help hold back the river. Diesel Power & Diesel Transportation 17:964-965, illus. Dec.1939. 291.8 D562

Diesel-driven pumps of the Henderson County, Ill., Drainage Districts Nos. 1 and 2 maintain the water level of the district's rich bottom lands to prevent the highly cultivated fields from reverting to swamps.

1239. DRAINAGE in East Anglia. Elect. Rev. 121:400, illus.

Sept.24,1937. 335.8 E122

Wind pumps have been supplanted by electric pumps in the drainage

of England's Fens.

1240. DRAINING the Fens; gradual change-over to electric pumping. Elect. Rev. 148:421-425, illus., map. Mar. 2, 1951. 335.8 E122 Description of the pumps used to drain the 240 square miles covered by the South Holland Drainage Boards, England.

1241. ESTATE power supplied by many engines. Oil Engine &

Gas Turbine 19:266-268, illus. Nov. 1951. Libr. Cong.

Describes drainage pumps on an 8,000-acre potato farm in England. 1242. EVANS, C. B., and ALLISON, R. V. The soils of the Everglades in relation to reclamation and conservation operations. Soil Sci. Soc. Fla. Proc. 4A:34-46,illus.,maps,tables. 1942. 56.9 So32 It is recommended that a unit plan of development be adopted with principal reliance placed upon pumping units rather than gravity

drainage in order to provide greater flexibility in water control. 1243. FEN ENGINE experiences. Oil Engine & Gas Turbine 15:24-

25. May 1947. Libr. Cong.

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small diesel Fen-drainage pumps were not harmed.

1244. FILMAN, C. C., TRUSCOTT, J. H. L., and GOODWIN-WIL-SON, R. A. 5,000 acre water garden? Better Crops 32:15-18,46,illus., tables. Apr. 1948. 6 B46

Drainage of marshes in Canada by means of pumps. Includes an

analysis of drainage water.

1245. FULLERTON, W. H. Recovery of Louisiana bayou farm-

land. Diesel Prog. 13(10):40-41, illus. Oct. 1947. 291.8 D56

Reclaiming the bayous with ditches, levees, and diesel pumps. 1246. GARDNER, W., and ISRAELSEN, O. W. Design of drainage wells. Utah Engin. Expt. Sta. B. 1,15 p., illus. Dec. 2,1940. Ref.

The paper presents a design to increase the effective diameter of **shallow wells** by using a central well together with a number of feeder

wells in circular arrays.

1247. GARDNER, W., and PETERSON, A. H. Well battery design. Agr. Engin. 17:293-295, illus. July 1936. 58.8 Ag83

Mathematical calculations for the design of a well battery intended for drainage.

1248. GOTTLIEB, W. H. Diesel-pump team cuts drainage costs. Pub. Works 80(11):34,36,illus. Nov.1949. 290.8 M922

Diesel-engined drainage pumps in use in the South River Drainage District, Missouri.

1249. GOTTLIEB, W. H. Farming a lake thanks to diesel-pump team. Diesel Prog. 16:51. Jan. 1950. 291.8 D56

Pump drainage in Illinois.

1250. GOTTLIEB, W. H. Keeping Corpus dry. Diesel Prog. 17(8):48-50,illus. Aug.1951. 291.8 D56

Diesel pumping plants handle drainage in Corpus Christi, Tex., when tides block the normal outflow and when rainfall is too heavy for normal gravity flow.

125I. GRÉENE, M. T. Men against the sea in Holland. Contemp. Rev. 183:278-283. May 1953. Libr. Cong.

Construction of the Netherlands polders by diking and pumping, and finally by the digging of drainage ditches. Describes the electricallydriven pumps capable of removing 250,000 gallons a minute, and the diesel-operated pumps which lift 120,000 gallons a minute. Tractordriven plows that dig drainage ditches ten feet deep are also discussed.

1252. HARRISON, G. R. Small muck drainage outfit. Elect. Farm 22(5):20-21. May 1949. 335.8 EL27

A 2-hp. electric pump lifts water from a lateral ditch in the muck area of Indiana up over the bank into the main canal.

1253. HELLINGA, F. Water control. Soil Sci. 74:21-33, illus.

July 1952. 56.8 So3

Drainage by windmill, ditch, and pumping station, in the Netherlands.

Emphasis is on main drainage in open waterways.

1254. HIDVEGHY, L. A belviz-atemelotelepek altal szallitott vizmennyisegek folyamatos merese. Vizügyi Közlem. 30:470-480, illus. 1948. 290.9 H89

English summary, p. 103-104.

Recording the discharge of drainage pumps.

Hungary.

1255. HOOPER, W. T. Cornish pumping engines. Engineer

197(Supp.):22-23, illus. June 11, 1954. Libr. Cong.

Illustrated description of pumping engines used in Cornwall, and based on a plan invented for the draining of Haarlem Mere in Holland in 1924.

1256, IHRIG, D. A belvizatemelo telepek vizhozamanak merese. Vizügyi Közlem. 30:436-444. 1948. 290.9 H89

English summary, p. 97-98.

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Hungary.

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1317. SMALL, C. J. The floods and the farmer. Foreign Trade

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1330. BACKSTROM, C. C. Dikning med mullskopa. Lantmannen 32:252, illus. Apr. 10, 1948. 11 L234

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1331. BAMBERG, K. K. Crevice drainage and deepening of arable layer of the soil with crevices. (In Russian.) Latv. PSR Zinatnu Akad. Vest. 9(74):31-38. 1953. 511 R442

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1332. BARFORD drainage machines. Power Farmer (n.s.) 3:393, 396, illus. Nov.1949. 58.8 P872

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1333. BARR, H. T., and TURNBULL, J. A new implement for mole drainage. Agr. Engin. 24:417-418, illus. Dec. 1943. 58.8 Ag83

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1338. BOUMA, H., JELIES, H., and BAKKER, J. De greppel snijder. Drentsche Landb. 2:126-127. Apr.17,1947. 12 D81

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1344. CRANDELL, H. A. Jeep-mounted scoop digs and cleans ditches. Engin. News-Rec. 141:79, illus. July 22, 1948. 290.8 En34 Description of a new drainage ditcher and cleaner.

1345. DALIN, A., and SERDECHNYI, A. New equipment for the improvement of meadows and pastures. (In Russian.) Kolkhoz. Proizvodstvo 12(2):51-52,illus. Feb.1952. 281.8 K83

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1346. *DE VRIES, L. L. Performance and operating costs of tile trenching machinés. Ames, 1951.

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1347. DIRECT tractor mole draining simplified. Farm Impl. & Mach. Rev. 68:229, illus. July 1, 1942. 58.8 Im72 Suckling's direct tractor mole drainer.

1348. DOMENIGHETTI, C. Macchina per lo scavo dei canali. Macch. e Motori Agr. 6:257-263, illus. June 1948. 58.8 M13

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1477. BEAUCHAMP, C. E. Influence of drainage on the yield of sugar from cane. Assoc. de Téc. Azucareros de Cuba. Proc. 21:99-101. 1947. 65.9 As5

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1479. CHATSKII, P. V. High yields on [reclaimed] marshy soils. (In Russian.) Dostizhenifa Nauk. i Peredovogo Opyta v Sel'sk. Khoz. 4:72-73. Apr.1953. 20 D742

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1482. CHOWDHURY, S. Heart or stem rot of pineapple. Indian J. Agr. Sci. 15:139-140, illus. June 1945. 22 Ag83I

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1483. COLMAN, R. Nutrients, drainage, texture, all required for soil productivity. Miss. Farm Res. 4(7):1-2. July 1941. 100 M69Mj

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1484. CORMACK, R. M. M. The causes of, and remedies for waterlogging of crops. Rhodesia Agr. J. 50:213-222, illus. May/June 1953. 24 R34

1485. DAHLBECK, N. Skall halva Uppland törrlaggas? Sveriges Nat. 42:85-89,illus. 1951. 410 Sy2

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1488. DUSHINSKE, R. L. Drainage and subsidy payments. No. Amer. Wildlife Conf. Trans. 18:73-80. 1953. 412.9 N814

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1489. FLODKVIST, H. Agronomisch-hydrotechnische ergebnisse von dränungsversuchen auf tonböden. Internatl. Cong. Soil Sci. 3d. Trans. 3:164-168. 1936. 56.09 In843

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1495. ĤALLGREN, G. Torrläggningsgrad och markvärde. Jord-Groda - Djur 11:49-58. 1955. 11 J763

Drainage and soil fertility in Sweden.

1496. HALLIN, S. Aktuella problem vid värdering av jordförbättring och skada torrläggningsoch vattenregleringsföretag. Nord. Jordbrforsk. 33:745-747. 1951. 11 N752

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1497. HAPP, S. C. Fertile valleys laid waste by upland erosion. Soil Conserv. 2:194-198, illus. Mar. 1937. 1.6 So3S

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1498. HARPER, H. J. The effect of terrace ridges on the produc-

tion of winter wheat. Soil Sci. Soc. Amer. Proc. 6:474-479, illus.,

tables. 1941. 56.9 So3

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1945. 43.8 C63

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1502. JOFFE, J. S. Keep your soil well drained. N. J. Ten-Ton Tomato Club. Rptg. 1946:25-27, illus. 81 T253

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1503. JOHNSON, E. A. G. Land drainage in England and Wales. Inst. Civ. Engin. Proc. 3:601-651, illus., maps. Dec. 1954. Ref. 290.9 In74P

Discussion, p. 629-651.

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1504. JONES, L. A. Drainage as a tool for increased crop production. Washington, U. S. Soil Conserv. Serv., 1952. 8 p. 1.96 R31Dra Paper presented at the American Society of Agricultural Engineers' Soil and Water Program, Centennial of Engineering, Chicago, Sept.9, 1952.

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1942. 4 C82

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1507. JONES, L. A. What drainage has accomplished. Washing-

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1508. JUUSELA, T. Täckdikningens inverkan pa jordens vattenhalt, tjälbildning och temperatur. Prakt. Försöksverks. 5:47-48. May/June 1948. 20 P88

Effect of drainage on soil-moisture content, frost formation, and

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1509. KAITERA, P. Om uppskattning av markytans sättning vid torrläggningsarbetena. Nord. Jordbrforsk. 36:532-537,illus. 1954. Ref. 11 N752

Estimation of land surface settling in drainage.

1510. KEEN, B. A. Land drainage: the area of benefit. Gt. Brit. Min. Agr. Agricúlture 43:521-526. Sept.1936. 10 G79J

Effects of flood, and need for drainage on the higher unflooded surrounding land.

1511. KEILHOLZ, F. J. Drainage needs a doctor. Country Gent. 115(5):18,42-43,illus. May 1945. 6 C833

"Approximately 50,000,000 acres - enough to make a 49th State can be brought into more profitable use with the weapons we have at hand," p. 18.

1512. KENNEY, F. R., and MCATEE, W. L. The problem: Drained areas and wildlife habitats. U. S. D. A. Ybk. Agr. 1938:77-83,

illus. 1 Ag84Y

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1513. KLESTRUP-HANSEN, F. Draening og hvorfor. Dansk Landbr. 69:242-243, May 4, 1950. 280.28 V91 Drainage, and why. Its effect on crops in Denmark.

1514. KOHLER, K. O., and MUNCEY, J. A. The water-facilities program. Soil Conserv. 5(7):175-178,195,illus. Jan.1940. 1.6 So3S Two Texas farms and an Idaho community benefit from improved water facilities, including drainage.

1515. LIERE, W. J. VAN. De afwatering en de drainage in het

Westland. Tuinbouw 2:39-41. Feb. 1947. 80 T815

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1516. LOURDIN, L. Économie du drainage. Chambres d'Agr. (Tech.-Agr.) 25(49):9-13. Apr.1,1954. 14 T69

Economic aspects, objectives, costs, and returns in France.

1517. MCCRORY, S. H. Water and the land. Reclam. Era 28:184-186, illus. Sept. 1938. 156.84 R24

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East, but in the irrigated areas of the West.

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1518. MANSON, P. W. Drainage requirements of crops. Minn.
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1519. MANSON, P. W., and ROST, C. O. Farm drainage—an important conservation practice. Agr. Engin. 32:325-327,illus. June

1951. 58.8 Ag83

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1520. MANSON, P. W., and ROST, C. O. Farm drainage can increase the size of your farm. Minn. Farm & Home Sci. 8:12-13, illus.

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productivity of cultivated land.

1521. MANSON, P. W. A laboratory study of the drainage requirements of sweet clover. Minn. Agr. Expt. Sta. Tech. B. 144,28 p.,

illus., tables. June 1940. Ref. 100 M66

The purpose of the study wasto determine the optimum soil-moisture requirements of a given crop, especially in those areas in need of subdrainage, and the minimum rate at which the removal of a saturated condition of the soil must be accomplished to obviate serious injury to the crop.

1522. MARTIN, H. B. A blotter for the Pelican State. Soil Con-

serv. 13:212-214, illus. May 1948. 1.6 So3S

There are nearly seven million "wet" acres in Louisiana which can be put in full production by proper drainage.

1523. MEASURES needed to manage watersheds. J. Soil & Water Conserv. 10:237-240, illus. Sept. 1955. 56.8 J822

Includes drainage measures such as the construction and rehabilitation of natural and artificial drainage channels, open or covered drains, and control structures such as gates, pumps, drops, and flumes.

1524. MILLER. D. G. Effect of drainage on water levels of farm wells. Minn. Agr. Engin. News Let. 87,1 p., tables. June 15, 1939.

275.29 M66Ag

Because drainage enterprises cover less than 5 percent of the total area of the Mississippi Valley, any effect on water levels of farm

wells is local and of small economic importance.

1525. MOREL, C. Pour rénover le sol français. Le drainage; définition, historique, effets et résultats. Génie Rur. 39(11):16-18. Nov.1946. 58.8 Au8

Definition, history, and effects of drainage in France.

1526. MOTOOKA, T. Some economic characteristics and problems of land reclamation by drainage. (In Japanese.) Nogyo Keizai Kenkyu 27:6-19. Mar.1955. 281.8 N68 Japan.

1527. NICHOL, G. E. Tile drainage is profitable. Sugar Beet J. 19(10):1,3,illus. July 1954. 66.8 Su38

Tile drainage increases sugar-beet yield by more than three tons per acre for an average monetary gain of 48 dollars per acre.

1528. NICHOLSON, H. H. The control of ground water level in crop production. Internatl. Hort. Cong. 13th. Rpt. 2:904-912, illus. 1952. 90.09 C7613

The drained lands of England's Fens.

1529. NICHOLSON, H. H. Field drainage and increased production. Roy. Agr. Soc. Eng. J. 109:212-221, tables. 1948. 10 R81

Between 1939 and 1948 the British Government aided farmers of England and Wales in the draining, by tile and mole, of more than 5,000,000 acres of farmland. The results in increased crop production are discussed.

1530. NICHOLSON, H. H. Some aspects of field drainage. Agr. Prog. 20:65-69. 1945. 10 Ag86

During the five and one-half years of war the areas scheduled for ditching, mole draining and tile draining in England and Wales were extensive. It is believed that these large-scale drainage operations have promoted floods and adversely affected public water supplies.

1531. NITSENKO, A. A. Observations on changes in the vegetative cover effected by drainage [of marshes]. (In Russian.) Bot. Zhur.

36:349-355. July/Aug.1951. Ref. 451 R923

1532. O'BRIEN, H. R. Surface drainage can double yields; when tile failed to drain their flat land effectively, farmers on hardpan in Ashtabula County, Ohio, perfected an old drainage method with surprising results. Country Gent. 120(11):26-27,71-72,illus. Nov.1950. 6 C833

Grassed shallow waterways in cornfields.

1533. OGG, W. G. Improving soil productivity: temperate climates. United Nations Sci. Conf. Conserv. & Util. Resources 6:209-213. 1949, pub. 1951. 279.9 Un 32P

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1534. OLNEY, A. J., LOWRY, S. J., and CALDWELL, L. M. Effect of cover crops and tile drainage on growth and yield of peaches. Ky. Agr. Expt. Sta. B. 547,8 p., tables. May 1950, 100 K41 Experiments at the Western Kentucky Substation.

1535. PALMER, L. Less water, more corn. Soil Conserv. 14: 267-268,279,illus. July 1949. 1.6 So3S

Drainage in Iowa for increased corn yields.

1536. PARKER, E. R., and ROUNDS, M. B. Avocado tree decline in relation to soil moisture and drainage in certain California soils. Amer. Soc. Hort. Sci. Proc. 44:71-79, illus. 1944. Ref. 81 Sol2

Removal of rainwater by means of broad, shallow furrows located between the tree rows, and by means of tile drains appeared to benefit tree condition. The planting in deep tree holes blasted out of clay subsoil was observed to have resulted in the formation of basins in which free water accumulated and caused decline.

1537. PARKER, G. G. Salt water encroachment in southern Florida. Amer. Waterworks Assoc. J. 37:526-542, illus., tables. June 1945.

Ref. 292.9 Am32J

The drainage program of southern Florida has upset the delicate balance between salt water and fresh water by lowering the water table to sea level. Unless water levels are restored to proper heights irreparable damage will be done to the soil by salt.

1538. PIJLS, F. W. G. Irrigation investigations in Dutch fruit growing. Internatl. Hort. Cong. 13th Rpt. 2:925-934, illus. 1952. Ref.

90.09 C7613

Intense drainage of the lowlands has necessitated irrigation of higher

land in the Netherlands.

1539. PILLSBURY, A. F., and HUBERTY, M. R. Drainage of avocado orchards. Calavo News 18(3):5,8-11,illus. Oct./Dec.1944. 280.28 C12

Discusses ground-water conditions, the means of determining the need for drainage, surface drains in terraced orchards, installation of tile drains, and costs and quantities for draintile.

1540. PONNAMPERUMA, F. N. The chemistry of submerged soils in relation to the growth and yield of rice. Ithaca, 1955. 427 p.

Thesis (Ph.D.) — Cornell University, 1955.
Abstract in Diss. Abs. 15:931-932. 1955. 241.8 M58
A combination of low Ph and high organic matter, causing "mentek" disease in rice, may be corrected by subsoil drainage and an application of sodium nitrate.

1541. RAMSAUER, B. Die bedeutung der meliorationen für land-

und volkswirtschaft. Agr. Rundschau 8:42-47. Summer 1952.

280.8 Ag82

Irrigation and drainage in Austria. Importance of reclamation in

land and political economy.

1542. ROE, H. B. Farm drainage in relation to drought. Minn.

Agr. Engin. News Let. 61,1 p. Apr. 15, 1937. 275.29 M66Ag

Good tile drainage forces the root system of plants to reach to the lowered water table while they are still immature, thus spreading the roots so that when drought comes they have an increased area from which to draw the decreasing water supply.

1543. ROE, H. B. Some soil changes resulting from drainage. Soil Sci. Soc. Amer. Proc. 4:402-409, illus. 1939. Ref. 56.9 So3

A critical discussion of chemical and biological changes, with special reference to the removal of alkali, and of changes in permeability, for which the evidence is suggestive but not conclusive; and an account of subsidence in drained peat bogs. Tile drainage was used for these experiments in Minnesota.

1544. RUSSELL, M. B., and FIRKINS, B. J. Few farms well drained. Farm Sci. Rptr. 5(3):10-11, illus., table. July 1944.

275.28 F22

Effect of poor drainage on corn crop losses in Iowa.

1545. SALOHEIMO, L. Den lampliga tegbredden pa myrmark. Forsk. - och Försöksresultat 2:59-62, tables. Dec. 15, 1950. 20 F77 Drainage for grain planting in Finland. Research on drainage by open

and covered ditches and its effect on crop yield.

1546. SALTER, R. M. The engineer's job in developing America's capacity to produce. Agr. Engin. 34:83-87, illus. Feb. 1953. 58.8 Ag83 Address before the special meeting of the American Society of Agricultural Engineers, Chicago, Sept. 1952. Includes drainage.

1547. SALTER, R. M. Wildlife and our soil conservation objecttives. No. Amer. Wildlife Conf. Trans. 18:81-93. 1953. 412.9 N814

Discussion, p. 91-93.

The Soil Conservation Service has assisted in the drainage of over 7,000,000 acres, of which less than 1 percent was marsh or swampland. The SCS encourages farmers to create wildlife refuges on damp

ground that is unsuitable for either cropland or pasture.

1548. SAVESON, I. L. Drainage research for sugarcane land in southern Louisiana. Sugar J. 10(7):7-8,15,illus. Dec.1947. 65.8 Su391 Includes land grading for drainage, mole drainage, and construction and maintenance of lateral ditches. Gives increased returns in dollars per acre due to drainage and increased yields in pounds of sugar per

1549. SCHEROTZKI. Geregelte wasserwirtschaft grundlage jeder ertragsleistung. Landwirtbl. Weser-Ems 98:140-142. Feb.15,1951.

18 L2345

A regulated water economy is the basis for profitable yields. Drain-

age in Germany.

1550. SINGLETON, J. R. Coastal drainage problems in relation to waterfowl. Tex. J. Sci. 1(3):25-28. Sept. 30, 1949. 470 T31 Drainage of uplands on the Texas gulf coast is destroying the wildlife refuges by filling the marshes with fresh water during the rainy

season and drying them out during periods of drought.

1551. SKEPPER, A. H., and DAVISON, J. R. Economics of subsoil drainage dependent on improving reduced yields from suitable soils. Citrus News 31:26-27. Feb.28,1955. 80 C494

Tile drainage of citrus orchards in Australia.

1552. SMITS, J. Kwaliteit tegen lage kostprijs. Betuws Tuinbouwbl. 9(2):4. Mar.17,1951. 80 B464

Quality versus cost. The effect of drainage on the quality of fruit in

Netherlands orchards.

1553. SUTTON, J. G. Drainage as an aid to increased food production. Agr. Engin. 24:327-329, 331, illus. Oct. 1943. 58.8 Ag83

Also separate, 8 p. Jan. 1944. 1.96 Op2Dr

1554. SUTTON, J. G. Farm drainage to increase wartime production. Soil Conserv. 8:195-199,214,illus. Mar.1943. 1.6 So3S Discusses drainage projects essential to the war effort, and suggests principles and methods of carrying out these projects under conditions at that time. Increased yields per acre of corn, soybeans, hay, and sugarcane are given for the United States as a whole.

1555. TILE drainage and its effect on plants. Horticulture 18:

453-454, illus. Nov. 15, 1940. 80 H787

Drainage lowers the water table, deepening the soil and permitting the roots to penetrate to a point of safety in time of drought. Spacing of drains is discussed.

1556. TURNBULL, J. Drainage and the Food for Freedom pro-

gram. Soil Conserv. 7:265-266, illus. May 1942. 1.6 So3S

It is estimated that over 31 million acres of cultivated farmland are in need of improved drainage to realize potential maximum of production.

1557. UHLAND, R. E. Drainage doubles yields on Maryland's Eastern Shore. Soil Conserv. 9:221-223,231,illus.,table. Apr.1944.

Farmers of three east Maryland counties have reduced the acreage of nonproductive land from 1,945 to 80 by drainage. Tables show increase in yield of corn, wheat, and hay in bushels per acre after drainage.

1558. ULRICH, R. Relative costs and benefits of land reclamation in the humid Southeast and the semiarid West. J. Farm Econ. 35:62-

73. Feb.1953. 280.8 J822

Drainage in Mecklenburg County, in the Virginia Piedmont, and irri-

gation in the Columbia River Basin, Washington.

1559. U. S. NATIONAL RESOURCES PLANNING BOARD. Drainage in the river valley of the lower basin. <u>In its</u> The Pecos River joint investigation, p. 231-243, illus., tables. Washington, 1942. 173.2 N214Pec

"Without effective artificial relief to supplement the good natural underground drainage into Pecos River, agriculture could not continue

successfully in the areas worst affected," p. 231.

1560. VAN VLACK, C. H. We need more drainage. Farm Sci.

Rptr. 5(1):11-14,illus. Jan.1944. 275.28 F22

Recommended as one way to increase acreage and yield. Discusses outlets, location, depth and spacing, selection and laying of tile. Maintenance is considered for open ditches as well as tile.

tenance is considered for open ditches as well as tile.
1561. VERMAAT, J. G. Observations on drainage conditions of
Ceylon paddy soils with particular reference to those of the low-country wet zone. Trop. Agr. (Ceylon) 109:279-286. Oct./Dec.1953. Ref.
26 T751

For optimal production of rice, paddy requires subsoil and surface drainage to balance the water supply with water consumption.

1562. VIK, K. Nytte og skade ved felles tørrleggingstiltak. Nord.

Jordbrforsk. 33:748-751. 1951. 11 N752

Benefits and disadvantages of joint drainage enterprises in Norway. Discusses erosion of land by drainage water, and the injury to fishing caused by the lowered water table.

1563. WALTON, L. Drainage for oats studied in Black Belt. Miss. Farm Res. 13(8):4,table. Aug.1950. 100 M69Mi

Experiments at the Black Belt Branch Experiment Station, Mississippi.

1564. WEIR, W. W. Drainage for orchards. West. Fruit Grower 8(5):15-16,illus. May 1954. 95.8 G762

Drainage of almond, walnut, pear, and peach orchards in California. 1565. WESTON, A. D. The drainage of low lands, and malaria. Boston Soc. Civ. Engin. 25:476-483, map, tables. Oct. 1938. 290.8 B65 Drainage of the Charles River Basin has decreased the incidence of malaria in Boston and Cambridge materially since 1915.

1566. WOOD, I. D. The engineering revolution in agriculture. Agr. Engin. 33:613-616,626,illus. Oct.1952. 58.8 Ag83

Includes drainage. One hundred and three million acres of land "once water-logged through centuries with rainfall or spoiled by overirrigation or seepage are now in high production through the magic of drainage," p. 614.

1567. WOOTEN, H. H., and LEE, A. T. M. Costly development is needed for most potential farm land. Agr. Situation 33:6-7. Jan.

1949. 1 Ec7Ag

Requires drainage, clearing, and large-scale irrigation projects. 1568. YOUNG, T. W. The economy of adequate drainage for citrus in Florida coastal areas. Fla. State Hort. Soc. Proc. 64:60-64. 1951. 81 F66

The economy of adequate drainage extends through all phases of citrus grove operations from planting to picking. The deeper rooting made possible by good drainage is the chief factor of benefit.

Also in Citrus Indus. 32(12):10-12. Dec.1951. 80 C49

PROJECTS AND PROGRAMS

1569. HUBERTY, M. R. Some irrigation and drainage problems of Mediterranean and Middle East countries. Amer. Soc. Civ. Engin. Proc. 79(Separate 319),10 p.,illus. Oct.1953. 290.9 Am3Ps

Includes drainage projects in Yugoslavia, Turkey, Pakistan, and India. 1570. MAGOON, E. H. Drenaje y salud en la zona Caribe. Salubridad y Asistencia Social B. Ofic. 48:57-213,217-404,407,614,illus.,

maps. Feb.-Oct.1945. 449.75 C892S

Text in Spanish and English.

Drainage and health in the Caribbean area. Drainage projects for malaria control in Cuba, Puerto Rico, Southern United States, Panama, Venezuela, Haiti, Mexico, the Virgin Islands, Guatemala, El Salvador, and Costa Rica.

North America

U. S. A.

1571. ACTIVITIES of the National Water Resources Committee. Civ. Engin. 7(3):167-177, illus. Mar. 1937. 290.8 C49

A survey of drainage district projects and problems from regional

and national viewpoints.

1572. ALLRED, C. E., ATKINS, S. W., and HENDRIX, W. E. Land drainage. Tenn. U. Rur. Res. Ser. Monog. 48:94-99, maps, tables. June 1937. Ref. 173.2 W89Co

Discusses drainage districts in Tennessee.

1573. ANDERSON, C. A. Middle Rio Grande District concludes basic program. West. Constr. News 11(7):229-231, illus., map. July 1936. 290.8 W522

Irrigation, drainage, and flood control in New Mexico. The project

includes 334 miles of drains and 1,000 miles of ditches.

1574. AUGUSTADT, W. W. Drainage in the Red River Valley of the North. U. S. D. A. Ybk. Agr. 1955:569-575. 1 Ag84Y

History of drainage for flood control and agricultural production in

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1646. U. S. NATIONAL RESOURCES COMMITTEE. Drainage basin problems and programs. Rev. ed. Washington, 1938. 154 p., maps, tables. 173.2 N214Dr

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1664. BISTRAIN, P. Desecación y drenaje de terrenos. Ingen. Hidrául. en Méx. 3(3):67-77, illus., tables. July/Sept. 1949. Ref. 290.8 In43

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INDEX 155

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| | Item | | <u>[tem</u> |
|------------------------------|-------|--|-------------|
| Ableiter J K | 1469 | American Institute of Real | |
| Adam J 484 | 536 | Estate Appraisers | 740 |
| Adams M J | 1013 | American Society for Test- | |
| Adolfsson T | 1014 | ing Materials 1018-1020 | 1103 |
| Africa 630 | 636 | 1116 1199 | |
| Ahlstrom B | 1686 | American Society of Agricul- | - |
| Ahmed A A | 1834 | tural Engineers 1053 | |
| Ahuriri Lagoon project | | 1504 1505 1634 | |
| (New Zealand) | 1867 | Committee on Soil Erosion | |
| Aiken W C | 914 | Control | 813 |
| | 1038 | | 1470 |
| 1192 | 1000 | 21 41111000 0 0 0 1111111111111111111111 | 1663 |
| Akademie für Raum- | | Andalucia la Baja Swamps | 1000 |
| | 1 | | 1722 |
| forschung und Landesplanu | | (2) | 1573 |
| Akishin F D | 1015 | | |
| Alabama 486 | 914 | | 1499 |
| Albert A R | 485 | | 363 |
| Alberta | 342 | | 1471 |
| Albrecht W A | 915 | Andrews D A | 191 |
| Albuquerque H C de | 359 | 111111111111111111111111111111111111111 | 1021 |
| Alderfer R B | 66 | Anemiya M | 362 |
| Alderman G | 519 | Angle dozers 1343 | |
| Alexander W H Jr | 190 | Angola | 1838 |
| Alfalfa | 424 | Angola Reclamation | |
| | 1840 | | 1838 |
| Alim-du-Din M | 1845 | | 1472 |
| Alkali soils SEE Saline-alka | | Anthony H G | 867 |
| soils | | Appalachian region | 200 |
| All-American Canal 56 | 360 | Appropriations 330 | 346 |
| 389 434 452 | 000 | TIPPE OF THE THE | 1683 |
| Allison L E 28 361 | 448 | Arizona 29 191 192 | 225 |
| 449 451 | 410 | 273 274 344 | 371 |
| | 1242 | 1258 | 311 |
| Allred C E | 1572 | Arizona Agricultural Experi- | _ |
| | 1314 | ment Station | 29 |
| Alluvial soils | 1.071 | Arizona Underground Water | 20 |
| Australia | 1871 | | 192 |
| Gt Brit | 1820 | Commission | 194 |
| Mississippi Delta | 1643 | Ark-La-East Texas | |
| New Zealand | 662 | Sandy Lands Conservation | 000 |
| Oregon | 1623 | Experiment Station | 308 |
| Tonga | 1873 | Arkansas 142 298 308 | |
| Trinidad | 944 | 1603A | |
| Almena soils | 909 | Armco Drainage Products | 000 |
| Almlof E 1016 1017 1326 | 1687 | Association | 938 |
| Ambatalempahala project | | | 1792 |
| (Ceylon) | 1862 | Arndt F R 67 | 364 |
| • | | | |

| Commission 606 Barnes K K 7 760 Augustadt W W 1574 Barr H T 1333 Aull G H 354 Barrakette A E 1854 Australia 1 137 172 364 Barrett L A G 1334 366 367 377 405 440 Barron R A 70 1224 469 474 475 478 692 Barrows S B 194 770 809 825 840 842 Barrews S B 194 845 868 894 905 910 Bartram R 368 977 992 1038 1069 1130 Basse N 1691-1693 1195 1213 1287 1551 1871 Bassisse E M 87 1872 Batchelor L D 418 Austria 1 650 666 725 Bates G H 1475 1061 1171 1541 1753 1777 Baum R O 212 Averianov S F 616 1022 Baum U 1127 1846 Avis J H 1023 Baumonn H 1604 |
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| Aull G H 354 Barrakette A E 1854 Australia 1 137 172 364 Barrett L A G 1334 366 367 377 405 440 Barron R A 70 1224 469 474 475 478 692 Barrows S B 194 770 809 825 840 842 Bartels L C 367 845 868 894 905 910 Bartam R 368 977 992 1038 1069 1130 Bartram R 368 1195 1213 1287 1551 1871 Basse N 1691-1693 1872 Bastisse E M 87 Austria 1 650 666 725 Bates G H 1475 Averianov S F 616 1022 Baum R O 212 Averianov I H 1022 Baum U 1127 1846 |
| Australia 1 137 172 364 Barrett L A G 1334 469 474 475 478 692 Barrows S B 194 770 809 825 840 842 Bartels L C 367 845 868 894 905 910 Bartram R 368 977 992 1038 1069 1130 Basse N 1691–1693 1195 1213 1287 1551 1871 Bastisse E M 87 1872 Austria 1 650 666 725 Bates G H 1475 Averianov S F 616 1022 Baum U 1127 1846 |
| 469 474 475 478 692 Barrows S B 194 770 809 825 840 842 Bartels L C 367 845 868 894 905 910 Bartram R 368 977 992 1038 1069 1130 Basse N 1691-1693 1195 1213 1287 1551 1871 Bastisse E M 87 1872 Batchelor L D 418 Austria 1 650 666 725 Bates G H 1475 1061 1171 1541 1753 1777 Baum R O 212 Avis T H 1022 Baum U 1127 1846 |
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| 1872 Bastisse E M 87 1872 Batchelor L D 418 Austria 1 650 666 725 Bates G H 1475 1061 1171 1541 1753 1777 Baum R O 212 Averianov S F 616 1022 Baum U 1127 1846 |
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| 1061 1171 1541 1753 1777 Baum R O 212 Averianov S F 616 1022 Baum U 1127 1846 |
| Avris T H 616 1022 Baum U 1127 1846 |
| Avis T U 1022 Daum 0 1121 1040 |
| |
| Avocados 113 1493 1536 1539 Baver L D 148 Ayers F P 1328 Baver L D 248 Baver L D |
| Ayers H D 365 Bayous SEE Bogs and swamps Bayous SEE Bogs and swamps Bazlen K A 1695 |
| Aylen D 1329 Beach W E 1335 |
| Ayres Q C 2 21 617 Bear F E 884 |
| Beasley R P 816 1325 Beauchamp C E 1476 1477 |
| Backfilling 592 664 744 Beauchamp K H 817 1027 1028 |
| 800 1114 Bechuanaland 636 |
| by hand 1203 Beck W D 917 equipment 1361 1459 Bed drains 664 893 |
| Gt Brit 1361 1459 Bed drains 664 893 Midwestern States 817 |
| Greece 1724 North Carolina 930 |
| New Zealand 1095 1175 1361 Trinidad 898 |
| research 134 Wisconsin 909 Sweden 1016 Redell G.D. 71 |
| Utah 1185 Beekom C W C van 72 |
| Backstrom C C 1330 Beenhouwer O 129 |
| Baily P J 366 Belium 618 663 776 1708 Baily P J 366 Belium 618 663 776 195 |
| Baird W W 1303 Bell JE 1029 |
| Baked-earth drains 457 1065 Bell R 1225 |
| Baker D M 206 345 Bender 621 Baker F J 1792 Bendixen T W 31 |
| Baker F J 1792 Bendixen T W 31 Baker M N 193 Bennett H 369 370 1576 1578 |
| Baker R W 1024 Bennett H H 73 74 1577 |

| | | Item | | | <u>Item</u> |
|--|---|---|--|---|--|
| Bennett R R | 243 | 269 | Bogs and swamps Gt Brit 633 64 | -Cont. | 1801 |
| Bennison E W Berg C van den | | $\begin{array}{c} 196 \\ 72 \end{array}$ | 1808 1830 | 1134 | 1001 |
| Bergeson E C | | 395 | Iceland | | 697 |
| Bergsma J | | 1030 | India | | 1299 |
| Bernard M | | 1323 | Indonesia | | 1870 |
| Berries | | 1416 | Ireland 520 113 | | 1828 |
| Berrios A T | | 918 | " | 3 1779 | 050 |
| Beskov I Kh | | 1031 | Kenya | 934 | 852 1245 |
| Bestor H A | | 1579 | Louisiana 1603 A | 304 | 1440 |
| Bethany Conservation Experiment Station (M | ·) | 309 | Maritime Province | s | 1315 |
| Bianchi W | .0.) | 424 | Michigan | , 5 | 552 |
| Bibliographies 27 | 61 | 1737 | Midwestern States | | 673 |
| Bidwell D L | - | 240 | Nebraska | | 1054 |
| Bigorgue O | | 1304 | Netherlands | | 1728 |
| Bijls A 1 | 1305 | 1696 | | 9 600 | 601 |
| Billberg A | | 919 | 606 609 129 | | 1415 |
| Bingham C H | | 1032 | 1436 1443 145 | 1214 | 1334 |
| Bird J A | | 197 | New Zealand 1354 | 1214 | 1334 |
| Bisal F | | 1226 686 | Nigeria | 577 | 584 |
| Bishop A A Bisson C S | | 198 | Norway 55 | | 942 |
| Bistrain P | | 1664 | 965 1725 | | |
| Bixby F S | | 371 | Ohio | | 973 |
| | 1033 | 1468 | Oregon | | 1623 |
| Blake G R | | 884 | Panama | 202 | 576 |
| Blanch G T | | 392 | Rhodesia | 636 | 753 |
| | 400 | 001 | 0 - 41 4 | 0.417 | 1005 |
| Blaney H F | 199 | 384 | Scotland | 647 | 1805 |
| Blaney H F Blasting SEE Ditch blas | | | South Carolina | | 646 |
| Blaney H F Blasting SEE Ditch blas Blein Zarazaga F | sting | 1306 | South Carolina Southeastern State | | 646 1294 |
| Blaney H F Blasting SEE Ditch blas Blein Zarazaga F Blind drains | sting | 1306 1198 | South Carolina Southeastern State Spain | S | 646 |
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| Blaney H F Blasting SEE Ditch blast Blein Zarazaga F Blind drains Blondel L Blood J W Bloodworth M E Bloom A Bobst H G Boddy H 574 1 | sting 741 372 | 1306 1198 1835 1793 373 622 818 1581 | South Carolina Southeastern State Spain Sweden 49 1686 1727 Switzerland Tanganyika Tennessee Valley Texas | s 3 742 | 646 1294 1722 1076 1180 636 590 1550 |
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| Blaney H F Blasting SEE Ditch blast Blein Zarazaga F Blind drains Blondel L Blood J W Bloodworth M E Bloom A Bobst H G Boddy H 574 1 Boer H E Boer T A de Bogs and swamps 611 612 731 805 998 1413 1 Africa Arkansas Australia 366 1 Bechuanaland | 741 372 1580 72 546 800 1417 | 1306 1198 1835 1793 373 622 818 1581 1697 623 578 803 1434 636 603A 1871 636 | South Carolina Southeastern State Spain Sweden 49 1686 1727 Switzerland Tanganyika Tennessee Valley Texas U S S R 39 51 534 565 58 745 777 78 1352 1402 140 1531 1767 Wales Washington Bogue M B Bol'shakov A F | 3 742 1 515 7 719 7 789 3 1442 | 646 1294 1722 1076 1180 636 590 1550 533 726 1102 1479 1314 997 311 374 |
| Blaney H F Blasting SEE Ditch blast Blein Zarazaga F Blind drains Blondel L Blood J W Bloodworth M E Bloom A Bobst H G Boddy H 574 1 Boer H E Boer T A de Bogs and swamps 611 612 731 805 998 1413 1 Africa Arkansas Australia 366 1 Bechuanaland California | 741 372 1580 72 546 800 1417 1195 | 1306 1198 1835 1793 373 622 818 1581 1697 623 578 803 1434 636 603A 1871 636 1055 | South Carolina Southeastern State Spain Sweden 49 1686 1727 Switzerland Tanganyika Tennessee Valley Texas U S S R 39 51 534 565 58 745 777 78 1352 1402 140 1531 1767 Wales Washington Bogue M B Bol'shakov A F Boning rods | 3 742 1 515 7 719 7 789 3 1442 | 646 1294 1722 1076 1180 636 590 1550 533 726 1102 1479 1314 997 311 374 1464 |
| Blaney H F Blasting SEE Ditch blast Blein Zarazaga F Blind drains Blondel L Blood J W Bloodworth M E Bloom A Bobst H G Boddy H 574 1 Boer H E Boer T A de Bogs and swamps 611 612 731 805 998 1413 1 Africa Arkansas Australia 366 1 Bechuanaland California Canada 541 | 741 372 1580 72 546 800 1417 | 1306 1198 1835 1793 373 622 818 1581 1697 623 578 803 1434 636 603A 1871 636 1055 1244 | South Carolina Southeastern State Spain Sweden 49 1686 1727 Switzerland Tanganyika Tennessee Valley Texas U S S R 39 51 534 565 58 745 777 78 1352 1402 140 1531 1767 Wales Washington Bogue M B Bol'shakov A F Boning rods Boonenburg K | 3 742 1 515 7 719 7 789 3 1442 | 646 1294 1722 1076 1180 636 590 1550 533 726 1102 1479 1314 997 311 374 1464 1227 |
| Blaney H F Blasting SEE Ditch blast Blein Zarazaga F Blind drains Blondel L Blood J W Bloodworth M E Bloom A Bobst H G Boddy H 574 1 Boer H E Boer T A de Bogs and swamps 611 612 731 805 998 1413 1 Africa Arkansas Australia 366 1 Bechuanaland California Canada 541 Chile | 741 372 1580 72 546 800 1417 1195 593 573 | 1306 1198 1835 1793 373 622 818 1581 1697 623 578 803 1434 636 603 A 1871 636 1055 1244 794 | South Carolina Southeastern State Spain Sweden 49 1686 1727 Switzerland Tanganyika Tennessee Valley Texas U S S R 39 51 534 565 58 745 777 78 1352 1402 140 1531 1767 Wales Washington Bogue M B Bol'shakov A F Boning rods Boonenburg K Borch M | 3 742 1 515 7 719 7 789 3 1442 647 | 646 1294 1722 1076 1180 636 590 1550 533 726 1102 1479 1314 997 311 374 1464 1227 940 |
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| Blaney H F Blasting SEE Ditch blast Blein Zarazaga F Blind drains Blondel L Blood J W Bloodworth M E Bloom A Bobst H G Boddy H 574 1 Boer H E Boer T A de Bogs and swamps 611 612 731 805 998 1413 1 Africa Arkansas Australia 366 1 Bechuanaland California Canada 541 Chile Delaware Denmark | sting 741 372 1580 72 546 800 1417 1195 593 573 83 737 | 1306 1198 1835 1793 373 622 818 1581 1697 623 578 803 1434 636 603 A 1871 636 1055 1244 794 | South Carolina Southeastern State Spain Sweden 49 1686 1727 Switzerland Tanganyika Tennessee Valley Texas U S S R 39 51 534 565 58 745 777 78 1352 1402 140 1531 1767 Wales Washington Bogue M B Bol'shakov A F Boning rods Boonenburg K Borch M Borden J W Bores SEE Vertical bored | 3 742 1 515 7 719 7 789 3 1442 647 | 1180 636 590 1550 533 726 1102 1479 1314 997 311 374 1464 1227 940 819 |
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| | Item | Item |
|--|---|--|
| Bouma H | 1338 | Buchele W F 822 |
| Boumans J H | 32 | Buerkle A F 922 |
| Bourget F | 1339 | Buie T S 823 |
| Bourgoin Marshes | | Bulldozers 1421 |
| (France) 1703 | | Gt Brit 732 1349 |
| Bourque L | 625 | Netherlands 1365 |
| Boush Creek Drainage proj | ect | New Zealand 1362 Quebec 1441 |
| (Va.). | 1626 | Quebec 1441 U S S R 1396 |
| Bouwer H 33 1035 | 1036 1037 | Burky C R 923 |
| Bouwman L H Bowden-Smith E C | 626 | Burleigh H P 203 |
| Bowler D G 627 1038 | | Burma 1859 |
| Box drains 521 785 | | Burnet G 924 |
| Bozanski A | 162 | Burns B E 1582 |
| Bradley J A | 206 | Burress C G 1032 |
| Bradshaw G B 38 382 | | Burt M 1041 |
| Bragee A | 920 | Burton C J 925 |
| Brakman project (Netherla | | Busby C E 312 313 |
| 1754 | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | Bushnell D H 314 |
| Brant E H | 628 | Busquet J C 1228 |
| Bravo River Valley projec | t | Bussells F R 926 |
| (Mexico) | 1665 | Butler C 1229 |
| Brazil 15 359 441 | 728 | |
| 833 957 1156 1676 | | Cabezas R R 1669 |
| Breed J | 1698 | Cady R C 141 |
| Breeding S D 201 202 | | Calaminus U 1042 |
| Brenner | 1340 | Caldwell J D 1667 |
| Brenner W W | 375 | Caldwell L M 1534 |
| Bretting A E | 34 | California 198 211 215 219 |
| Brick drains | | 232 234 248 258 259 |
| Bridges T W | 244 | 275— 277 283 286 288 |
| Briggs R C | 248 | 289 290 291 292 299 325 326 340 344 361 |
| Brink W | 820 | 325 326 340 344 361 369 383- 385 389 397 |
| British Columbia 184 | 342 | 406 415 443 450 452 |
| 1136 | 1670 | 457 468 476 482 483 |
| British Guiana | 1678 | 574 593 608 614 756 |
| British Standards Institute British West Indies | 1039 899 | 801 1055 1169 1172 1223 |
| Broadhurst W L 202 | | 1258 1302 1493 1536 1564 |
| Brosna Catchment Drainag | | 1581 1583 1625 1652 |
| project (Ireland) | 1810 | California Div of Water Re- |
| Brouwer A R H | 1848 | sources 299 |
| Brown G | 821 | California University 443 |
| Browning G M 99 | | Camargo F C de 1676 |
| Bruns V F | 921 | Camargue project (France) 1689 |
| Bruscalupi G | 1699 | Cambodia 1860 |
| Brush drains | | Cameron A E 376 |
| Denmark | 649 | Campbell F B 827 |
| Egypt | 702 | Campbell G A 575 |
| Gt Brit | 8 | Campbell M 795 |
| India | 446 | Campbell R D 1230 1231 |
| Netherlands | 1212 | Canada 242 541 573 625 652 1244 1658 |
| New Zealand 662 699 | 711 | * |
| 712 769 | OPE | SEE ALSO names of Provinces |
| North Africa | 675 | Canada Dept of Agriculture Prairie Farm Rehabilitation |
| Scotland | 521 | Br 1658 |
| Bryan L L Bryson J L | 279 1040 | Canalini G 629 |
| DI ABOUT A TI | 1040 | |

| | | Item | | | | Item |
|----------------------------------|-------------|-------------|----------------------------|---------------|-------|-------------|
| Canals and ditches | 21 | 74 | Canals and ditch | es | Cont. | |
| 78 85 42 | 28 644 | 672 | Gt Brit 8 | 17 | 700 | 701 |
| 744 782 79 | 91 | 0.1.0 | 729 | | 400 | 050 |
| Australia | 700 | 910 | India Indiana | | 433 | 956 923 |
| Brazil | 72 8 | 957 899 | Italy | 873 | 982 | 1776 |
| Brit West Indies California | | 574 | linings 365 | 592 | 605 | 990 |
| Camornia | | 652 | brick | 002 | 000 | 607 |
| | 93 958 | 975 | concrete | 582 | 599 | 602 |
| costs | 55 550 | 1413 | 607 610 | 855 | 918 | 990 |
| Delaware | | 937 | 1302 1684 | | | |
| Finland | | 556 | Panama | | | 576 |
| Gt Brit | | 1001 | Peru | | | 1684 |
| New Jersey | | 609 | Puerto Rico | | | 918 |
| Nicaragua | | 1673 | research | | | 46 |
| North Carolina | | 929 | USSR vegetative | 491 | 587 | 1005 607 |
| Ohio | | 937 1006 | 781 859 | 918 | 952 | 958 |
| USSR | alaanan | | 988 1005 | 310 | 302 | 330 |
| SEE ALSO Ditch construction 4 | 08 587 | 589 | Madagascar | | | 927 |
| | 94 741 | 791 | maintenance and | l repa | ir | 18 |
| 869 907 | | | 671 694 | $71^{\circ}3$ | 781 | 791 |
| Australia | 367 | 894 | 795 869 | 939 | 945 | 958 |
| Brazil | | 957 | 963 1560 | | | |
| California | | 801 | Australia | | | 894 |
| Canada | | 652 | Belgium | | | 1708 |
| Delaware | | 1617 | California | | 027 | 801 |
| Florida | 1310 | 1438 | Delaware Denmark | | 937 | 1617 691 |
| France | | 1704 547 | equipment | 609 | 1375 | 1467 |
| Germany | | 922 | Finland | 000 | 1010 | 556 |
| Indiana | | 852 | Florida | | | 1587 |
| Kenya Maryland | | 1617 | France | | 1704 | 1708 |
| New Jersey | 606 | 609 | Georgia | | | 610 |
| Tennessee Valle | | 581 | Germany | | | 547 |
| Virginia | | 1626 | Gt Brit | 643 | 1049 | 1467 |
| SEE ALSO Ditcl | hing | | 1793 1803 | 1814 | | 1000 |
| | 03 619 | 922 | Great Plains | | | 1002 |
| deepening | 929 | 1006 | Iceland India | | | 953 947 |
| | 61 1693 | 1713 | Iowa | | | 959 |
| depth and spacing | g 42 | 563 | Italy | | | 1401 |
| 750 898 in peat and muc | k goile | 534 | Kansas | | 991 | 1002 |
| research | 42 728 | 916 | Louisiana | 887 | 917 | 970 |
| | 08 652 | 671 | Maryland | | | 1617 |
| | 60 999 | | Mississippi V | /alley | | 595 |
| California | | 801 | Netherlands | 0.01 | 936 | 1708 |
| handbooks | | 1003 | New Jersey | 601 | 606 | 609 |
| India | | 896 | Nicaragua North Carolir | . 0 | | 1673 929 |
| Ohio | | 1131 | Ohio | ıa | | 929 |
| Sweden | | 955 1839 | Puerto Rico | | | 918 |
| Egypt erosion 5 | 587 589 | 915 | Rhode Island | | | 603 |
| | 353 910 | 937 | Sweden | | | 548 |
| 958 | 010 | 001 | Mexico | | | 1666 |
| Netherlands | | 189 | Missouri | | | 915 |
| Florida 4 | 488 648 | | Netherlands | 111 | 750 | 863 |
| grading | 826 | 1399 | 1008 1757 | | | |
| | | | | | | |

| | - , | | |
|---|-------------|-------------------------------------|--------------|
| Garata and ditabas Con | <u>Item</u> | Carolana 1501 1050 1055 | Item |
| Canals and ditchesConnetworks 912 96 | | Ceylon 1561 1850 1855 1862 | 1991 |
| networks 912 96 New Mexico | 1573 | Chambers T B | 3 |
| New Zealand | 1867 | Channels SEE Canals and | J |
| Puerto Rico | 966 | ditches | |
| Scotland | 665 | Chapman J R | 1341 |
| size 671 72 | | Chapman P W | 1585 |
| slope 587 589 74 | 1 956 | Chapple L A | 377 |
| 960 | | Charles J R | 206 |
| South Carolina | 820 | Charles River Basin proje | ct |
| specifications | 592 | (Mass.) | 1565 |
| Sweden 56 | | Chatskii P V | 1479 |
| Syria | 1848 | Chen R | 1207 |
| Tennessee Valley | 581 898 | Chen Ts Sh | 1307 |
| Trinidad | 1000 | Childers N F Childs E C 35 75-77 | 1480 1044 |
| types USSR 53 | | 1045 1342 | 1044 |
| Utah | 411 | Chile 794 1083 | 1685 |
| weed control 599 78 | | Chimbote project (Peru) | 1684 |
| 921 984 993 | | China 1 | |
| chemical 93 | 9 945 | Chiodi A | 1481 |
| Columbia | 1010 | Chowdhury S | 1482 |
| Delaware | 937 | Christiansen J E 36 | 258 |
| Egypt | 1839 | 361 378 429 1046 | |
| India | 947 | Chwatt L J 577 | |
| Louisiana | 970 | Ciolina F 630 927 1836 | |
| Ohio . | 937 | Citrus 376 476 675 | 677 |
| widening | 929 | 692 1551 1568 | 1 5 0 0 |
| Yugoslavia | 1732 | Clarenbach F A | 1586 |
| SEE ALSO Diversion dit | cnes; | Clark C O | 1323 |
| Laterals; Trenches | 1700 | Clark M W 78 631 826 Clark O M | 895 354 |
| Candida A F di Canterbury Chamber of | 1100 | Clark G M | |
| Commerce | 1043 | Clark W M | 1325 |
| Carah W M | 1583 | Clarke J L | 578 |
| Carnes A 48 | | Clarke T | 1343 |
| Carnwath project (Scotland | | Classen A G | 1233 |
| Carpenter J Č | 487 | Clay C | 1234 |
| Carpenter R W | 1584 | Clay drains 8 | |
| Carr W A C | 1794 | Clay soils 35 696 796 | 1027 |
| Carroll M B Jr | 1260 | 1058 1296 | 001 |
| Carter A N | 576 | Germany | 621 |
| Caryl N R | 315 | Gt Brit 8 76 | |
| Casson P B | 825 679 | Idaho | 1215 1091 |
| Catch basins | 019 | Minnesota | 7.2.7.7 |
| Catchments Gt Brit | 1801 | Netherlands 189 New Zealand 815 | |
| Ireland | 1810 | Philippines | 864 |
| Cedergren H R | 1312 | research 100 1096 | |
| Central and South Florida | | Australia | 137 |
| Flood Control District | 1596 | Union of South Africa | 1167 |
| Central Piedmont Soil and | | USSR | 710 |
| Water Conservation Stati | | Washington | 1215 |
| (N. C.) | 226 | Claypan soils 169 794 | |
| Central States | 223 | Clayton B S 488 489 | |
| Central Valley project (Ca | 1111.) | Clements I B | 138 |
| 211 482 | 1202 | Clover 537 | 1521 379 |
| Cereal crops | 1202 | Clyde | 019 |

| Item | Item |
|-------------------------------------|--|
| Clyde G D 4 | Cook G C 744 |
| Coachella Valley (Calif.) Co- | Cook H L 827 |
| operative Drainge Investiga- | Cools R H A 1701 |
| tion 452 | Cooper T 633 1048 |
| Cobble drains 446 990 | Copais Lake (Greece) 1705 |
| Coconuts 480 | Copley T L 828 829 |
| Code W E 204 205 | Corfitzen W E 1838 |
| Coeytaux A 1837 | Cormack R M M 830 1484 |
| Coffee 967 | Corn 930 1532 1535 1544 |
| Coffey J H 1235 | 1557 |
| Coffey P J 1668 | Corn Belt 175 1655 |
| Cole G 1795 | Corniani project (Italy) 1761 |
| Cole R O 1450 | Costa Rica 1570 1671 |
| Coleman N H 1363 | Costs 5 21 24 318 399 |
| Coleman R 1483 | 466 800 1486 1527 1567 |
| Coleman W H 1588 | 1594 1648 1653 |
| Collins E V 822 | Algeria 1835 |
| Collis-George N 75 | Australia 440 842 1213 |
| Colman E A 37 79 | Belgium 618 |
| Colombia 458 684 1010 1682 | California 415 801 |
| Colombo South Drainage | Ceylon 1861 |
| Scheme (Ceylon) 1861 | Cuba 799 |
| Colorado 204 205 249 301 | Denmark 736 |
| 344 370 444 1108 1578 | Dominican Republic 1667 |
| Colorado River Basin 362 465 | Finland 1112 |
| Colorado Water Conservation | France 1516 |
| Board 249 | Gt Brit 628 786 1160 |
| Comacchio Valley project | Greece 1705 |
| (Italy) 1711 | Iceland 697 |
| Complex drainage 766 | Italy 788 |
| Compound drainage 658 1211 | Japan 1526 |
| Conant V 579 | Louisiana 1548 |
| Conkling H 206 316 345 | Netherlands 768 1552 1754 |
| Connecticut 1355 | 1768 |
| Conover C S 207 | New Zealand 9 627 1099 |
| Conservation 1221 1519 1594 | Scotland 1805 |
| 1654 | Switzerland 549 |
| Contactgroep Opvoering | Texas 1606 |
| Productiviteit 632 | Virginia 1558 |
| Contour drainage 7 71 126 | Washington 1558 |
| 760 772 822 823 | Wyoming 387 |
| Australia 842 | SEE ALSO UNDER specific |
| British West Indies 899 | subjects |
| claypan soils 169 | Cote R R 634 |
| Corn Belt 175 | Cotton 371 |
| India 834 | Coulson H J W 324 |
| Italy 866 | Cowley E W 362 |
| Nyasaland 897 | Cox M B 831 832 |
| Rhodesia 830 1329 | Craig A L 1290 |
| Southeastern States 828 | Crandall L 279-281 |
| Tasmania 856 | Crandell H A 1344 |
| Trinidad 898 | Cranfield T H 80 |
| Union of South Africa 865 | Crawford A 1236 |
| 900 Controlled drainage 502 | Crivellari D 1702 Crocker R L 405 |
| Controlled drainage 502 | |
| Florida 1587 Indiana 494 508 517 | Crompton E 81 Crosby I B 206 |
| peat and muck soils 530 | Crosby I B 206 Cross-drains 251 463 649 |
| poat and much soms 330 | C1035-41 atms 201 400 049 |

| | Thomas | | Thomas |
|------------------------|-------------|-----------------------------|------------|
| Cross drains Cont | Item | Dordo I E 401 | Item |
| Cross-drainsCont. | | Davis J F 491 | |
| 817 893 966 | 1203 | Davis J H | 492 |
| Crossbars | | Davis P W | 834 |
| Cuba P | 833 | Davison B | 84 |
| Cuba 799 1476 1477 | | Davison J R | 1551 |
| | 1459 859 | Day C W R | 541 247 |
| | 992 | Day J R | |
| Australia | 574 | Day P R | 85 |
| California | 983 | Dean A J | 1705 |
| concrete 580 | | Debenham F | 636 |
| corrugated | 1188 | Debler E B 380 | 418 |
| design 580 923 971 | 1004 | Deemter J J van 637 | |
| 1192 | 00.6 | Definition | 1525 |
| India | 896 | De La Valette J | 1706 |
| Louisiana | 614 | Delaware 83 109 916 | 937 |
| Nicaragua | 1673 | 1397 1615 1617 1624 | |
| wooden | 938 | Delaware Agricultural Expe | |
| Cuthbertson J A | 1049 | ment Station | 83 |
| Cutler W A | 1116 | Delgado Marquez R | 1672 |
| | 400 | Deloffre G 86 1707 | 1708 |
| Dachnowski-Stokes A P | 490 | Demolon A_ | 87 |
| Dahl N J | 82 | Denisenko T A | 1052 |
| Dahlbeck N | 1485 | Denks | 638 |
| Dahlgren N | 1050 | Denmark 34 59 649 | 691 |
| Daigh F C | 83 | 709 736 737 751 | 804 |
| Dairy farms 627 | 992 | 1106 1261 1376 1389 | |
| Dale O C | 208 | 1513 1691-1693 1713 | 1733 |
| Dalin A | 1345 | 1749 1788 | |
| Dalrymple T 209 | 210 | Desilting basins | 873 |
| Damodar Valley project | | Desplanque C | 1308 |
| (India) | 1847 | Devereux R E | 88 |
| Dams 13 25 759 772 | | Devon Valley project (Scotl | and) |
| Ceylon | 1850 | 1820 | |
| construction | 1313 | DeVries L L | 1346 |
| costs | 1313 | Dewhirst J F | 5 |
| Denmark | 1749 | Dhawan C L | 69 |
| earthen 846 | 1312 | Dibbits H A M C | 1709 |
| France | 1740 | Dickey P | 639 |
| | 1847 | Dickinson P | 211 |
| Indo-China | 1304 | Diebold C H | 381 |
| Iowa | 1324 | Dijkstra J | 640 |
| Israel | 1854 | Dikes | 782 |
| Missouri | 1325 | British Guiana | 1678 |
| Norway | 1265 | California | 1223 |
| research | 1318 | construction | 1308 |
| Sahara Desert | 1842 | Denmark 649 | |
| Spain | 1306 | Florida 648 | 677 |
| Syria | 1848 | Gt Brit 130 1797 1803 | 1827 |
| | 1313 | history | 1803 |
| Danike G N | 1659 | India | 834 |
| Darby H C | 1796 | Malaya | 1309 |
| Darcy's law 182 | 229 | Maritime Provinces | 1303 |
| David A 1703 | 1704 | 1308 1315 | |
| Davidson J M | 50 | Netherlands 863 902 | 1251 |
| Davis C | 316 | 1317 1322 1697 1698 | 1701 |
| Davis C V | 635 | 1750 | |
| Davis E H | 1486 | Nigeria | 584 |
| Davis H E | 581 | repair 1317 | 1697 |
| | | | |

| | Item | | Item |
|--|--------------|--------------------------------------|--------------|
| DikesCont. | 4000 | DitchersCont. | |
| Spain | 1306 | for bogs and swamps | |
| U S S R 1316 | | Germany | 1445 |
| Wales | 1314 | | 1415 |
| Washington 639 Diseker E G 929 | 1319 930 | 1436 1457 | 1051 |
| = | 1710 | New Zealand 1334 | |
| Diserens A Dismal Swamp (N. J.) | 609 | USSR | 745 |
| Dismal Swamp (Va.) 1589 | | France | 1126 |
| Ditch blasting 546 760 | 926 | Germany Gt Brit 732 1351 1372 | 1453 1468 |
| 931 948 962 963 | 1486 | Gt Brit 732 1351 1372 horse-drawn | 1338 |
| Alabama | 914 | Iceland | 1359 |
| alluvial soils | 1871 | Italy 1401 | |
| Australia 977 | 1871 | mechanical | 1389 |
| bogs and swamps 523 | 546 | | 1390 |
| 973 997 998 1871 | | France 561 1339 1377 | |
| costs | 1007 | Germany 1340 1406 | 1408 |
| for mosquito control 596 | 614 | 1428 1466 | |
| forests 553 554 558 | 569 | Gt Brit 1405 | |
| 571 572 | 0.00 | Italy | 1348 |
| Iowa 964 | 989 | Netherlands 1338 1393 | |
| irrigated soils | 391 934 | New Zealand | 1448 |
| Louisiana 614 methods | 1012 | Spain | 1433 |
| Mississippi | 986 | Sweden 961 | |
| North Carolina 929 | 930 | Netherlands 1251 1338 1378 1783 | 1365 |
| Norway 558 569 571 | 572 | New Jersey 1414 | 1435 |
| 968 1775 | • • • | New Zealand 1362 1386 | |
| Ohio 932 | 973 | Ontario | 1429 |
| Oregon 391 | 749 | Rhodesia | 1329 |
| peat and muck soils | 1871 | Scotland | 1367 |
| Pennsylvania | 1087 | Sweden 1326 | |
| Solomon Islands | 1866 | types | 1416 |
| Sweden 553 554 919 | | ŬSSR | 1396 |
| Switzerland | 972 | SEE ALSO Trenchers | |
| Utah | 596 | Ditches SEE Canals and dit | tches |
| Washington | 997 | Ditching | |
| West Virginia 523 | 925 | Arizona | 371 |
| Ditch cleaners | 1344 | by hand 423 | |
| construction 1374 1375 | 1392 | Canada | 541 |
| 1449 costs 1337 1375 | 1414 | costs 408 610 1413 | 1432 |
| for bogs and swamps | 1413 | 1468 | 1196 |
| 1414 1415 1417 | 1410 | France | 1126 610 |
| for clay soils | 1373 | Georgia Gt Brit | 641 |
| Germany | 974 | Greece | 1724 |
| | 1419 | mechanical 920 | |
| 1467 | | Nebraska | 423 |
| Italy | 1401 | Netherlands 995 1751 | |
| mechanical 974 1388 | 1398 | Norway 569 | |
| 1448 1467 | | Sweden 943 | 1432 |
| Netherlands | 1373 | SEE ALSO Trenching | |
| New Jersey 609 1414 | 1415 | Dittmer H L | 932 |
| 1435 1456 New Zealand 1447 | 1440 | Diversion ditches 25 826 | 859 |
| New Zealand 1447 Ditchers 926 1344 1363 | 1448 1418 | 907 908 946 | 400 |
| Connecticut | 1355 | Djurle O | 493 |
| costs 1355 1414 | 1434 | Dobson A F | 1143 494 |
| 1000 1111 | 1101 | Doggett D | 777 |

| D 11 T D | | Item | | | Item |
|-------------------------|-------------|-------|--------------------|--------|-------------|
| Doggett J F | | 835 | Drained areasCon | t. | 405 |
| Dolfin V | | 1699 | Wisconsin | | 485 |
| Dolgov S I | | 1178 | Drainpipes | | |
| Doll E H | | 841 | for acid soils | | 1039 |
| Domenighetti C | | 1348 | materials | | 1193 |
| Domingo W R | | 89 | quality | | 1014 |
| Dominican Republic | | 1667 | perforated 1047 | 1169 | 1181 |
| Dominy J N | | 1349 | research | | 1106 |
| Donellan M | | 1810 | rust 524 | 1106 | 1219 |
| Donnan W W 38 | 68 | 382 | size | | 1110 |
| 383 384 1350 | | | Drains | | 668 |
| Donovan D E | | 933 | Australia | | 440 |
| Doran W E | | 1798 | Austria | | 650 |
| Dorer R E | | 582 | capacity | | 712 |
| Dottridge R B | | 641 | construction | | 26 |
| Dougall H W | 90 | 91 | Belgium | | 663 |
| Douglass M J | - | 1799 | Maritime Provinc | es | 1308 |
| Dovell J E | | 1590 | Denmark | | 649 |
| Dowd M J | | 385 | depth and spacing | 32 | 162 |
| Dowlen W R | | 934 | 408 471 | - | |
| Downing C G E | | 319 | Australia | 172 | 425 |
| Downing J M | 642 | 836 | Belgium | | 663 |
| Draghicchio F | 042 | 1711 | Denmark | | 709 |
| Drain gauges | | | determination 478 | 681 | 1086 |
| | | 165 | 1710 | 001 | 1000 |
| Drainage basins 1653 | | 1646 | Finland | | 1111 |
| California | | 917.0 | | 755 | 1710 |
| | | 278 | | 100 | |
| Ceylon | | 1850 | irrigated soils | | 478 |
| Idaho | 1 400 | 10 | Malaya | 17 | 480 |
| management | 1492 | 1850 | Netherlands | 17 | 8 797 |
| Drainage districts | 2 | 6 | New Zealand | | 783 |
| 16 18 348 | 356 | | Portugal | 105 | 739 |
| Arkansas |] | 1603A | research 121 | | 178 |
| Colorado | 4 8 6 6 | 1578 | 179 180 431 | | 4.40 |
| Florida 1579 1585 | 1590 | 1609 | sandy soils | 140 | 143 |
| Kansas | | 1613 | USSR | | 478 |
| legislation | | | Virginia | 0.40 | 180 |
| Florida | | 1649 | design | 649 | 1710 |
| Illinois | | 320 | Gt Brit | 643 | 1816 |
| Utah | | 329 | joints | | 440 |
| Louisiana | 1 | .603A | maintenance and re | | 408 |
| Maryland | | 1584 | 642 650 695 | 1392 | |
| Minnesota | | 1582 | metal | | 1047 |
| Mississippi | 1595 | 1608 | New Mexico | | 1573 |
| Mississippi Delta | | 1603 | New Zealand | 712 | 783 |
| New Mexico | 370 | 1573 | size 77 440 | 739 | 763 |
| Tennessee | | 1572 | slope | 739 | 783 |
| Texas | | 1606 | types 21 26 | 431 | 732 |
| Utah | 435 | 1619 | Brazil | | 72 8 |
| SEE ALSO names of | drain | age | Cuba | | 799 |
| districts | | | Netherlands | | 1211 |
| | — 24 | 330 | Sweden | | 1016 |
| | 1221 | 1470 | SEE ALSO kinds of | drains | |
| 1566 1657 | | | Draintile | 2 | 21 |
| Maryland | | 1557 | capacity | | 1103 |
| Mexico | | 1664 | characteristics | 1032 | 1138 |
| Midwestern States | | 1611 | clay 456 1032 | | |
| Mississippi Delta | | 323 | 1139 1147 1149 | | |
| • • | | | | | |

| | <u>Item</u> | | | Item |
|---|-------------|---------------------------|-----------|--------------------|
| DraintileCont. | 4045 | DrainwaterCont | | |
| concrete 364 702 1032 | | analysisCont. | • | 150 |
| 1116 1140 1145 1147 tests 1138 1139 1142 | | Norway | | 150 149 |
| 1150 | 1140 | Venezuela chemistry | | 230 |
| costs | 1539 | discharge | | 1211 |
| density | 1155 | for irrigation | 401 | 1486 |
| durability 1141 1145 | | Australia | 101 | 475 |
| 1149 1170 | | California | | 483 |
| expansion | 1147 | Florida | | 648 |
| for acid soils 1141 1145 | 1146 | New Zealand | | 1236 |
| 1170 | | Rumania | | 1279 |
| for alkali soils 1138 | 1141 | USSR | 706 | 889 |
| 1148 | 4440 | India | | 69 |
| for mineral soils 1145 | 1146 | measurement | | 1090 |
| for peat and muck soils | 1145 | Nevada | 60 | 167 167 |
| Gt Brit 1157 | 1159 | quality salinity 67 69 | 69 460 | 475 |
| history | 1157 | Drake R R | 7 -100 | 212 |
| inspection | 1199 | Dredges and dredgin | o | 1364 |
| loading | 1207 | 1392 1814 1820 | | 1001 |
| | 1148 | Dreibelbis F R 50 | | - 94 |
| | 1211 | 105 | | |
| mortar 1145 | 1150 | Drill barge | | 1438 |
| Netherlands | 1211 | Driskell B N | | 495 |
| perforated | 1184 | Drummond G B | | 206 |
| porosity 1047 1066 | 1128 | Dubakh A D | | 542 |
| properties | 6 | Dubeikovskií I I | | 1352 |
| quality 664 738 1032 1085 1103 1128 1155 | 1066 | Dubkov S N Duffy M | | 1353 |
| 1196 1199 | 1187 | Duny M Dumm L D | | 496 386 |
| research | 1047 | Duncan A A | | 1354 |
| | 1149 | Dunnewald T J | 387 | 388 |
| resistance to heat | 1147 | Durand W F | | 935 |
| resistance to moisture | 1147 | Dushinske R L | | 1488 |
| resistance to sulfates | 1138 | Dutch Moorland Recl | lamatio | n |
| 1142 1150 | | Society | | 640 |
| selection 7 754 760 | 1028 | Duym J | | 936 |
| 1032 1085 1116 1155 | 1560 | Dykes J C | | 317 |
| Canada | 652 | | | |
| Denmark | 804 | Eads R B | | 1866 |
| Finland Netherlands | 1115 | Eakin T E | | 246 |
| Oregon | 1151 749 | Eames H F | 1592 | 1593 |
| Quebec | 1210 | | 257 | 821 |
| shape | 664 | 837 1517 | | 0 |
| size 664 785 800 | 1085 | Ebert F | | 1713 |
| 1211 | | Eckel E B | | 225 |
| | -1020 | Economic Cooperation | on Adm | in |
| 1103 1116 1199 | | 720 | 000 | 1055 |
| strength 1066 1128 | 1133 | Economic effects | 668 | 1657 |
| 1140 1155 | 705 | Austria Brazil | | $\frac{1541}{728}$ |
| Tasmania tests 1139 1147 1149 | 785 1150 | Florida | | 529 |
| SEE ALSO Drainpipes | 1130 | France | | 1516 |
| Drainwater | 6 | Minnesota | | 1582 |
| analysis 87 94 128 | 138 | Norway | | 1496 |
| 1244 | | Washington | | 393 |
| | | | | |

| | | Item | | Itom |
|-------------------------------|-------|------|---------------------------------|------|
| Ecuador | | 1679 | Effects on cropsCont. | Item |
| | G A | 95 | peat and muck soils | 497 |
| Edminster T W 7 | 64 | 90 | Southern States | 1506 |
| 96 837 1056 1 | 394 | 213 | Sweden 1077 | |
| Edmonston A D | | | | 1264 |
| Edwards H C | | 644 | Turkey USSR 506 509 | 537 |
| Edwards H G | 0.0 | 1595 | | 221 |
| Effects 6 16 | 26 | 408 | 1479 | 1500 |
| | 760 | 800 | Wales 734 | 1529 |
| 1470 1471 | | | Wisconsin | 909 |
| Australia | | 842 | Effects on farm wells | 1524 |
| Ceylon | | 1861 | Effects on fish | 1562 |
| France | | 1525 | Effects on floods | |
| Gt Brit | | 1234 | Gt Brit | 1530 |
| Idaho | | 1514 | Effects on health 803 | |
| India | | 20 | Caribbean region | 1570 |
| Midwestern States | | 1507 | Italy | 1481 |
| Minnesota | | 1582 | Peru | 1684 |
| Netherlands | | 1217 | Effects on land values | 1588 |
| | 699 | 1144 | 1614 | |
| North Carolina | 000 | 562 | Effects on plant disease | 567 |
| Oregon | | 1474 | 1478 1482 1536 1540 | |
| | 514 | 1606 | Effects on soil nutrients | 71 |
| Virginia | 017 | 1558 | 94 128 144 1472 | |
| Washington | | 1319 | Corn Belt | 175 |
| Effects on orong 169 | 200 | | Norway | 150 |
| | 399 | | Venezuela | 149 |
| 822 1221 1480 1 | | | Effects on soils 83 | |
| | | 1527 | 186 1472 1483 1498 | |
| 1540 1542 1553-1 | 555 | 1560 | | |
| 1567 | | | Finland 545 | |
| | 770 | 1551 | Florida | 1537 |
| Austria | | 725 | Gt Brit 700 1475 | |
| | 424 | 1493 | India | 20 |
| 1536 | | | Minnesota | 1543 |
| Ceylon | | 1561 | Netherlands 764 | |
| Colorado | | 1108 | Norway 82 1496 | |
| Cuba 1 | 476 | 1477 | Sweden | 1495 |
| Denmark | 804 | 1513 | USSR 1321 | 1531 |
| Finland | 539 | 1545 | Effects on wildlife 1471 | 1488 |
| Florida | | 1568 | 1512 1547 | |
| France | | 1491 | Southern States | 566 |
| Germany | | 1549 | Sweden | 1485 |
| Gt Brit 729 734 1 | 528 | | Texas | 1550 |
| Gulf Coast States | .020 | 1500 | Egaaens project (Denmark) | |
| India | | 1482 | 1691 | |
| | 535 | 1544 | Eggers H W T | 1057 |
| irrigated lands | 000 | 461 | Egypt 1 470 645 | 702 |
| Kentucky | | 1534 | 1067 1834 1839 | |
| Louisiana | | 1548 | Egypt Dept of Public Works | 645 |
| | 557 | 1584 | 1839 | |
| | 331 | | Eijsvoogel W F | 1714 |
| Michigan Midwestern States | | 1501 | Eldred (Ill.) Drainage and | |
| | | 1507 | Levee District | 1230 |
| Minnesota | | 526 | Electro-osmosis 1058 | |
| Mississippi Valley | 477.0 | 1519 | research | 1143 |
| Netherlands 764 1 | 478 | 1919 | Elephant Butte Irrigation | 1110 |
| 1538 1552 | | 000 | District (Now May) | 207 |
| North Carolina | | 930 | District (New Mex.) Ellerbe C M | 646 |
| Norway | | 501 | E0 E | |
| Ohio | | 1532 | Elliott I L 535 | 000 |
| | | | | |

| | | | Item | | Item |
|-------------------------------|---------|--------|--------------|------------------------------------|--------------------|
| Ellis N K | | | 497 | ErosionCont. | Item |
| Ellison W | | | 647 | New York | 102 |
| Ellison W D | | | 937 | Norway | 1562 |
| El Salvador | 1570 | 1669 | | Escritt L B | 1801 |
| Elston J | | | 1355 | Estes H | 1598 |
| Eltisley Lord Elveve J T | | | 1356 498 | Estonia 1758 17 Etcheverry B A | 759 1769 |
| Elwell G | | | 1596 | Europe | 1782 |
| Elwell H M | | | 838 | Evans C B | 1242 |
| Emerson A W | 839 | 1357 | | | 48 98 |
| Emerson W O | | | 389 | Evans L S | 939 |
| Engelhard J | | | 1715 | Evdokimova V I | 1060 |
| Engelhardt J H | | | 1059 | | 88 492 |
| Engelund F Engineers Joint | Coun | .:1 | 97 | 498 529 648 6 1320 1438 1576 15 | 77 1242 |
| National Water | Dolic | u Dan | -1 | 1587 1590 1591 15 | |
| 318 | FOIIC | y Fain | 31 | | 32 1649 |
| Enstone R B | | 1358 | 1800 | 1650 | 0_ 1010 |
| Equipment | 632 | | 819 | Everglades Drainage Dis | strict |
| 1326-1468 | | | | Ĭ579 1585 1590 16 | 09 |
| Australia | | | 678 | Everglades Experiment | |
| Belgium | | | 663 | Station | 1290 |
| Denmark | | 649 | | Ewan J W | 1802 |
| for bogs and s | wamps | 5 | 1402 | | 14 1418 74 1375 |
| Germany | | | 1380 | construction 13 | 1375 |
| Gt Brit | | | 1351 | | 43 1349 |
| Greece | | | 1759 | Ireland | 1135 |
| Ireland | | | 496 | Netherlands | 1365 |
| Latvia | | | 1331 | New Zealand 10 | 98 1448 |
| mechanical | | | | USSR | 1178 |
| costs | | | 1328 | Exmoor Marshes (Engla | nd) |
| France | 1050 | 1005 | 1412 | 1808 | 2 948 |
| Gt Brit Netherlands | 1330 | 1387 | | Explosives in mosquito control | 2 948 592 |
| New Jersey | | | 1404 1328 | Iowa | 959 |
| New Zealand | | | 1361 | Pennsylvania | 1602 |
| Sweden | | | 1455 | Sweden | 553 |
| USSR | 1353 | 1442 | 1465 | tests | 962 |
| New Zealand | 9 | 627 | 815 | SEE ALSO Ditch blastin | |
| 1865 | | | | Eylands A G 13 | 59 1716 |
| Quebec | | | 1441 | | |
| Scotland | 7.45 | 1015 | 665 | Farm ponds 592 7 | 01 708 |
| USSR 706 1403 | 745 | 1345 | 1402 | 760 858 860 | 01 100 |
| Washington | | | 1368 | | 92 914 |
| SEE ALSO kin | ds of e | aninn | | SEE ALSO Forests | |
| and UNDER s | pecific | drai | nage | Farmyards | 1072 |
| practices | | | | Farrell B H | 1867 |
| Erosion 7 | 78 | 106 | 110 | Fascine drains SEE Brus | sh |
| 153 888 | | | | drains | 1027 |
| control | 126 | 145 | 174 | Fasken G B Feilberg A 6 | 49 940 |
| 727 813 | 859 | | 00.4 | | 49 940 |
| India | | | 834 | - 8 | 50 1061 |
| research | | | 880 175 | | 12 519 |
| Corn Belt Mississippi | | | 1497 | 647 1232 1239 12 | 40 1243 |
| Missouri | | | 915 | 1285 1300 1475 15 | 28 1792 |
| | | | | | |

| F (F 1 1) C (| Item | | Item |
|---|--|---------------------------------|-------------------|
| Fens (England)Cont. 1797 1798 1803 180 | 1796 06 1807 | Flood controlCont. legislation | 355 |
| 1819 1821—1823 183 | | Louisiana | 3 505 |
| Ferguson D S | 1309 | Midwestern States | 1629 |
| | 51 652 | Minnesota | 337 |
| 1062 Fernandez de L G A | 653 | Mississippi Delta Nebraska | 1603 969 |
| Ferrara project (Italy) | 1760 | New England States | 1622 |
| Ferris J G | 214 | New Mexico | 1573 |
| Ferron | 1717 | New York | 1622 |
| Fertilizers ' | $\begin{array}{c} 1176 \\ 39 \end{array}$ | | 574 1597 |
| Fialkovskii P G Field J E | 316 | Ohio Oklahoma | 1288 862 |
| Field crops | 1518 | Oregon | 1623 |
| SEE ALSO names of spe | | Pakistan | 1845 |
| crops | 4404 | Portugal | 1738 |
| Fife C V | 1101 | Texas | 1233 |
| Fiji Islands Fill Lake (Denmark) | $\frac{1869}{1733}$ | Trinidad U S S R | 944 1316 |
| Filman C C | 1244 | Uruguay | 1680 |
| | 32 346 | | 93 310 |
| 348 1640 | 4.000 | Arkansas | 298 |
| Florida Miggiaginni Dolta | $\begin{array}{c} 1632 \\ 323 \end{array}$ | | 290 293 223 |
| Mississippi Delta South Carolina | 354 | Central States Denmark | 1788 |
| Tennessee | 1642 | | 22 257 |
| | 36 1619 | Gt Brit 15 | 10 1793 |
| | 48 539 | Great Plains | 1002 |
| | 57 559 15 1379 | Hawaii | 293 298 1002 |
| 698 1109-1112 113 1430 1508 1545 173 | | Kansas 2 Minnesota | 98 1002 293 |
| Finska Mosskulturförenin | | Missouri | 298 |
| | 528 | Missouri River Basin | 294 |
| Firkins B J | 1544 | | 93 298 |
| Firth D H | 519 | | 1745 |
| Fishel V C Fitton A H | $\begin{array}{c} 141 \\ 1802 \end{array}$ | Nevada New England States | 293 221 |
| Fitzhugh E A | 390 | New Mexico | 209 |
| Flanagan J E | 1669 | New York | 239 |
| Fleming H K | 66 | North Atlantic States | 297 |
| Fletcher P W Flodkvist H | 114 1489 | North Dakota | 293 |
| | 13 18 | Oklahoma Oregon 2 | 298 56 293 |
| 22 25 126 17 | 73 174 | Pennsylvania | 239 |
| 194 1618 1641 164 | | | 93 295 |
| Austria | 666 | South Dakota | 293 |
| California Ceylon | 1652 1862 | Southeastern States Texas 2 | 296 01 210 |
| costs | 343 | Washington 2 | 256 |
| Denmark | 1691 | Winnipeg River Basin | 293 |
| Florida 648 1310 132 | 20 1438 | SEE ALSO Inundated so | oils |
| 1601 Franco | 1740 | | 88 489 |
| France Gt Brit 1280 1814 181 | | 492 498 6 677 1091 13 | 02 648 10 1438 |
| 1822 | 1020 | 1537 1568 15 | |
| Hungary | 746 | 1585 1587 15 | |
| India 467 184 | | 1596 1601 16 | 09 1620 |
| Iraq 185 | 56 1863 | 1627 1632 16 | 49 1650 |
| | | | |

| Item | Ttom |
|--|--|
| Florida Agricultural Experiment | |
| Station 488 489 1609 | |
| | |
| Florida Board of Conservation | Wisconsin 157 |
| Div of Water Survey and Re- | Forman J 1803 |
| search 1310 | |
| Florida Everglades Drainage | Fort Hays Conservation Experi- |
| District Act of 1941 1649 | |
| Floten C G 391 | Foss H 655 |
| Flow of water 637 859 1011 | Foster G M 656 |
| 1051 | Fouquet C 1739 |
| calculation 771 | France 561 615 681 714 |
| in canals and ditches 18 | |
| 115 935 949 956 950 | |
| 990 994 1009 | 1491 1516 1525 1688 1689 |
| measurement 981 | dela dell'idea Tell Tell |
| in drains 75 | TAIL TAIL TAIL TAIL TAIL |
| formulas 763 | alle alle the terms of the term |
| in grassed waterways 868 | 4-04 |
| 881 883 891 979 987 | |
| in laterals 1489 | |
| | |
| in mole drains 1100 | |
| in soils 35 115 164 454 | |
| in subsurface drains 1052 | |
| in tile drains 18 97 175 | |
| 940 1090 1197 1350 | Free G R 99 |
| into drains 100 123 1118 | |
| 1119-1122 | French drains 753 1166 |
| research 115 | |
| tests 1082 | 760 1207 1208 |
| Flumes 399 980 981 1318 | Freyburger E 843 1600 |
| Fluorides 138 | Fridstrom A E 1063 |
| Folsom O H 1360 | Frodsham Marshes (Gt Brit) |
| Fong K L 654 | 1794 |
| Food for Freedom program | Fruit SEE Citrus; Orchards; |
| 1556 | Vineyards |
| Foote M V 840 | Fugetta P 1699 |
| Forbes H 206 215 288 345 | Fuhriman W U 392 |
| Forbes U A 324 | Fujisaki M 1849 |
| Forests 546 567 | Fullerton W H 1245 |
| Australia 825 | Furneaux B S 1064 1490 |
| Canada 541 573 | Furrows and furrowing 829 |
| Finland 545 550 556 557 | Australia 770 842 |
| 559 | British West Indies 899 |
| France 561 1740 | California 1536 |
| | |
| Germany 547 Italy 1702 | Kenya 716 852 |
| | |
| | Latvia 1331 |
| | Latvia 1331 Netherlands 111 |
| Michigan 552 | Latvia 1331 Netherlands 111 New Zealand 769 |
| Michigan 552 North Carolina 543 562 | Latvia 1331 Netherlands 111 New Zealand 769 U S S R 913 |
| Michigan 552 North Carolina 543 562 Northern States 525 | Latvia 1331 Netherlands 111 New Zealand 769 |
| Michigan 552 North Carolina 543 562 Northern States 525 Norway 555 558 568 572 | Latvia 1331 Netherlands 111 New Zealand 769 U S S R 913 Fussell G E 660 |
| Michigan 552 North Carolina 543 562 Northern States 525 Norway 555 558 568- 572 Ontario 157 | Latvia 1331 Netherlands 111 New Zealand 769 U S S R 913 Fussell G E 660 Gain E W 8 1804 |
| Michigan 552 North Carolina 543 562 Northern States 525 Norway 555 558 568-572 Ontario 157 South Carolina 543 | Latvia 1331 Netherlands 111 New Zealand 769 U S S R 913 Fussell G E 660 Gain E W 8 1804 Gaines H F 393 |
| Michigan 552 North Carolina 543 562 Northern States 525 Norway 555 558 568-572 Ontario 157 South Carolina 543 Southern States 566 | Latvia 1331 Netherlands 111 New Zealand 769 U S S R 913 Fussell G E 660 Gain E W 8 1804 Gaines H F 393 Gaiser R N 543 |
| Michigan 552 North Carolina 543 562 Northern States 525 Norway 555 558 568 572 Ontario 157 South Carolina 543 Southern States 566 Sweden 513 548 553 554 | Latvia 1331 Netherlands 111 New Zealand 769 U S S R 913 Fussell G E 660 Gain E W 8 1804 Gaines H F 393 Gaiser R N 543 Gale H S 259 303 |
| Michigan 552 North Carolina 543 562 Northern States 525 Norway 555 558 568—572 Ontario 157 South Carolina 543 Southern States 566 Sweden 513 548 553 554 563 564 | Latvia 1331 Netherlands 111 New Zealand 769 U S S R 913 Fussell G E 660 Gain E W 8 1804 Gaines H F 393 Gaiser R N 543 Gale H S 259 303 Galletti A C 1065 |
| Michigan 552 North Carolina 543 562 Northern States 525 Norway 555 558 568 572 Ontario 157 South Carolina 543 Southern States 566 Sweden 513 548 553 554 | Latvia 1331 Netherlands 111 New Zealand 769 U S S R 913 Fussell G E 660 Gain E W 8 1804 Gaines H F 393 Gaiser R N 543 Gale H S 259 303 |

| | Item | | | | Item |
|-----------------------|------------|------------------|------------|-------|------|
| Garboua M | 1067 | Gottlieb W H | | 1248 | 1250 |
| Garcia Atance J | 1719 | Goudie A G | | 1210 | 692 |
| Gardens SEE Small fa | | Gourley H J F | | | 316 |
| gardens | I IIID and | Gowla Reclamati | on nr | niect | 010 |
| Gardner C H | 1068 | (Ireland) | .011 P1 | Oject | 1828 |
| Gardner H H | 843 | Grading and leve | ling | 624 | 727 |
| Gardner R | 394 | 760 819 | | | |
| Gardner W 40 | | Australia | 000 | 367 | 678 |
| 1247 | 100 1-10 | Canada | | | 652 |
| Gardner W H | 454 | Colorado | | | 370 |
| Garstka W U | 41 | Eastern States | | | 837 |
| Gascogne Moors (Fra | | equipment | 885 | 887 | |
| Gaskell R E | 119 134 | Louisiana | | 837 | 1548 |
| Gasparetto A | 1699 | New Mexico | | ••• | 370 |
| Gasparetto F | 1699 | Quebec | | | 1210 |
| Gay C B | 42 | Wisconsin | | | 1630 |
| Gayford G W | 1069 | Grain | | | 1545 |
| Geddes J A | 395 | Grande Covian R | | 1722 | |
| Gee H C | 1601 | Grant A | | | 1805 |
| Gee W L | 1363 | Grant Township | Drain | age D | is- |
| Geiszler G N | 844 | trict (Kans) | | U | 1613 |
| Geitman B G | 499 661 | Grassed waterwa | ays | 7 | 664 |
| George N C | 101 | 813 818 | 836 | 839 | 860 |
| George W O | 216 - 218 | 878 888 | 836 952 | 987 | |
| Georgia 352 486 | 610 1225 | Australia | 840 | 868 | 910 |
| 1633 | | Brazil | | | 833 |
| Georgia State Drainag | e Law 352 | Canada | | | 652 |
| Germany 547 621 | 638 682 | construction | 760 | 835 | 841 |
| 703 704 752 | 761 762 | 843 846 | 849 | 851 | 853 |
| 974 996 1042 | 1058 1070 | 854 861 | 868 | | |
| 1089 1113 1124 | | design 841 | 861 | 868 | 874 |
| 1193 1194 1340 | 1364 1380 | 946 | | | |
| 1395 1406 1408 | 1428 1445 | fertilizing | 835 | 843 | 854 |
| Germany Reichsminis | terum für | 895 908 | | | |
| Ernährung und Landv | rirtschaft | Guinea | | | 871 |
| | 1070 | Kansas | | | 861 |
| Geytenbeek P E | 845 | location | 835 | 868 | 875 |
| Ghab project (Syria) | 1848 | maintenance | 760 | 824 | 840 |
| Ghetti A | 1737 | 841 843 | 854 | 875 | 895 |
| Ghisleni P L | 1720 | 904 | | | |
| Gies R W | 583 | Michigan | | | 491 |
| Gilroy A B | 584 | mulching | 813 | 843 | 854 |
| Girardin | 1491 | Nebraska | | | 861 |
| Glanville E B | 662 | New Zealand | 627 | 662 | 815 |
| Glentworth R | 43 | North Carolina | | | 835 |
| Gley soils SEE Bogs a | and | Nyasaland | | | 897 |
| swamps | | Ohio | | | 1532 |
| Glotov M N | 1071 | peat and muck | soils | | 491 |
| Godinache J | 663 | research | | | 988 |
| Godinez Noriega M | 1665 | Missouri | | 882 | 890 |
| Gokhale V K | 947 | Oklahoma | 831 | 832 | 838 |
| Goliakov N M | 500 | 883 891 | | 0(= | 001 |
| Goncalves P A | 941 | South Carolina | | 827 | 881 |
| Gonzalez R A | 396 | 882 891 | 987 | 000 | 0.00 |
| Goodman A M | 664 | retardance | 882 | 883 | 979 |
| Goodwin K R | 1409 | Rhodesia | | | 830 |
| Goodwin-Wilson R A | 1244 | South Australia | | | 845 |
| Gorrie R M | 1492 1850 | width | | | 895 |
| | | | | | |

| | | | <u>Ite.n</u> | | | | <u>Item</u> |
|------------------------------|--------------|---------|----------------|------------------------|-----------------|------------|------------------------|
| Grasslands | 92 | 428 | 696 | Ground waterCo | | 218 | 540 |
| 1000 Australia | | 842 | 905 | | 157 191 | 192 | 225 |
| California | | 012 | 415 | 273 274 | 101 | 102 | 220 |
| Eastern States | | | 821 | California | 198 | 215 | 232 |
| Finland | | | 528 | 234 237 | 258 | 259 | 275 |
| Gt Brit | 81 | 130 | 721 | | 283 | 286 | 288 |
| Ireland | | | 1824 | | 397 | 443 | 1223 |
| Maritime Prov | | | 1315 | characteristics | 100 | 0.4 P | 214 |
| Netherlands | 623 | | 1212 | | 198 204 | 217 205 | 230 |
| New Zealand | 815 | 1038 | $1098 \\ 1474$ | | 578 | 405 | 245 |
| Oregon Switzerland | | 705 | 775 | | 196 | 255 | 283 |
| Gravel drains | 8 | 788 | | 285 300 | | | -00 |
| 1112 | U | 100 | 1000 | consumption | | 199 | 255 |
| Gravity drains | 410 | 425 | 442 | control | | 316 | 321 |
| 449 | | | | | 105 | 203 | 276 |
| Gray H E | | | 33 | for irrigation | | 203 | 205 |
| Gt Brit 8 | 11 | 17 | 27 | hydraulics | 36 | 46 | 55 |
| 76 80 | 81 | 108 | 112 | _ | 237 | 250 | 262 |
| 130 151 | 154 | 155 | 324 | | 488 | 408 | 517 |
| 333 626 | 628 | 633 | 641 | 1220 1278 | | 0.00 | 004 |
| 643 647 | 660 | | - 701 | Idaho 10 | 55 | | - 281 |
| 721 729 | 732- | | 798 | legal aspects | | 316 | 321 327 |
| | 1001 1045 | | 1046 1049 | legislation Arizona | | 313 | 344 |
| | 1045 | 1157 | 1162 | | 325 | 326 | 340 |
| 1222 1239- | | | | 344 | 020 | 520 | 340 |
| 1280 1282 | | | | Colorado | | | 344 |
| 1332 1343 | | | 1356 | Idaho | | | 326 |
| 1370-1372 | 1382 | | | Nevada | | | 344 |
| | | | 1440 | New Mexico | 322 | 325 | 326 |
| | 1459 | 1462 | 1463 | 344 | | | |
| | | | 1503 | Texas | | 325 | 326 |
| 1510 1528- | | | | Utah | | 325 | 344 |
| 1793-1804 | | | | Western States | | 328 | 338 |
| | 1826 | 1827 | 1829 | 345 | | 0.0 | 500 |
| 1830-1833 Gt Brit Dept of | Acrion | 14 | for | measurement | | 33 | 236 |
| Scotland | Agricu | illure | 665 | Mexico Nevada | 167 | 246 | 13 ² 398 |
| Gt Brit Ministry | of Am | ni ou l | | New Mexico | 101 | 207 | 301 |
| Grant Aid Sche | | ricuri | 1799 | North Dakota | | 201 | 253 |
| Gt Brit Ministry | of Ag | ricult | | Oklahoma | | | 301 |
| and Fisheries | 01 118 | | 1072 | Oregon | | 220 | 260 |
| Gt Brit War Agr | icultu | ral E | xecu- | peat and muck so | oils | _ | 517 |
| tive Committee | | | | pumping | | 1258 | 1469 |
| Land Drainage | Dept | | 1800 | quality | | | 300 |
| Great Lakes Sta | | | | | 236 | ∠37 | <i>4</i> 69 |
| Great Plains | 284 | 1002 | 1655 | 286 284 | | | |
| Greece 1705 | 17.4 | 1759 | | research | 0.0 | 40- | 36 |
| Greene M T | | | 1251 | salinity 418 | 488 | 465 | 1223 |
| Greenhalgh W H Greenland | | | 481 1662 | situation and out | | ≥36 | 254 |
| Greenfand Gregor H F | | | 397 | sources 193 2 686 | 415 | 430 | 300 |
| Griffiths J A | | | 1660 | Southwestern Sta | tes | | ∠03 |
| Ground water | 128 | 195 | 196 | | 105 | 160 | 206 |
| 242 277 | 304 | 312 | 1013 | 9 - | ² 78 | 200 | _00 |
| 1539 | | | | | 283 | 291 | 292 |
| | | | | | | | |

| | | Item | | | | <u>Item</u> |
|-----------------------------|-------------------|---|------------------------------|--------|-------|-------------|
| Ground waterCont. | | | HandbooksCon | t. | | |
| storagecont. | | 6.00 | Denmark | | | 804 |
| Western States | 000 | 206 | Mississippi Del | ıta | | 1603 |
| Texas 190 202 | $\frac{208}{243}$ | $\begin{array}{c} 216 \\ 244 \end{array}$ | USSR | TD ~ | | 719 |
| 217 218 238 247 267— 269 | 300 | 303 | SEE ALSO UND | ER S | pecui | C |
| 247 267— 269 304—307 | 300 | 303 | subjects | (Tana | n) | 1857 |
| Utah 233 241 | 282 | 481 | Hane-Ko project Hanks R J | (Japa | .11) | 103 |
| 686 | | | Hannah H W | | | 320 |
| Washington | 252 | 261 | Hannaman D A | | | 1624 |
| Western States | 38 | 159 | Hanraets J M J | | | 1365 |
| 197 255 287 | | | Hansen V E | | 224 | |
| Wyoming | | 266 | Hanson E G | | 329 | 1619 |
| SEE ALSO Water ta | ble | | Happ S C | | | 1497 |
| Grout A R | | 1073 | Harbord W L | | | 1081 |
| Grout R | | 1602 | Hardin E A | | | 1181 |
| Grover N C | 221- | - 223 | Harding S T | | | 321 |
| Gruber J W | | 1851 | Harding S W | | | 1082 |
| Grubinger H | | 666 | Hardman G | | | 398 |
| Gryonne Valley proje | ct (Swi | itzer- | Hardman J A | | | 1381 |
| land) | | 549 | Hardpan soils | | 858 | |
| Guatemala | | 1570 | Hardy F | | | 944 |
| Guinea | | 871 | Hargrave J | | | 669 |
| Gulf States | | 1500 | Hargreaves G H | | | 1670 |
| Gullies | 25 | 859 | Harildstad E | | | 670 |
| control 7 839 | 904 | 1318 | Harker D | = 0.11 | -4- | 1311 |
| Nyasaland | | 1844 | Harker D H | 502 | 517 | 671 |
| Spain | | 1306 | 1114 | | -00 | 504 |
| Gustafson A F | | 102 | Harmer P M | | 503 | |
| Gut R C | | 544 | Harper H J | | 104 | |
| Gutberlet F | | 1364 | Harrell M A | | | 225 |
| Guyton W F | 700 | 306 | Harris C D | | 1000 | 322 |
| Gypsum 419 | 796 | 884 | Harris L E | | 1806 | |
| 11 A E | | 1059 | Harris R B | | | 345 491 |
| Haarer A E | (Motho | 1852 | Harrison C M | | | 1252 |
| Haarlem Sea project | (Merne | 1774 | Harrison G R | 323 | 505 | 1499 |
| lands) Haas A R C | | 1493 | Harrison R W 1603-1605 | 323 | 303 | 1499 |
| Habbaniyah Lake (Ira | a) | 1856 | Harrold L L | 105_ | - 107 | 226 |
| 1863 | .4) | 1000 | Hart J T | 100- | - 101 | 1414 |
| Habib J | | 681 | Hart R A | 399 | 400 | |
| Hadjinicolaou J | | 1724 | Harvey N | 000 | 1084 | |
| Haegermark F | | 1074 | Hastings W W | | 217 | |
| Hagem K | | 1075 | Haswell J R | 672 | | |
| Hagerup H 501 | 942 | 1725 | 1086 1087 | | | |
| Hahn J H de | | 1677 | Haugen O | | | 1366 |
| Haiti | 1570 | 1670 | Hauger R L | | 1500 | 1606 |
| Hakansson A | 1076 | 1726 | Haverlee A H | | | 945 |
| Haley L | | 1494 | Нау А К | | | 586 |
| Hall L S | | 316 | Hay R C | | | 904 |
| Hall T F | | 585 | Hay | 537 | 1554 | 1557 |
| Hallgren G | 943 | | Haynes A R | | | 1809 |
| Hallin S | 1496 | | Haynes J L | | | 126 |
| Hamblyn C J | 1078 | -1080 | Hays J B | | | 1854 |
| Hamid K B | | 1853 | Hays O E | | 401 | 227 |
| Hamid M A | 0.47 | 667 | Hayward H E | /T | | - 403 |
| Hamilton C L | | - 851 760 | Hazorea project | (Isra | er) | 1127 |
| Handbooks 668 744 | 759 | 100 | 1846 | | | |

| | Item | <u>Item</u> |
|------------------------------|-------|--|
| Headwalls | 1114 | HistoryCont. |
| Heathcote W R | 108 | Iraq 1851 1863 |
| Hedge cutters | 1452 | Ireland 1824 |
| | 701 | Italy 11 1737 1779 1781 |
| Heesterman J E | 1678 | Manitoba 1660 |
| Heikurainen L | 545 | Mexico 1664 |
| Heimpel L G | 1088 | Minnesota 1582 |
| Hellinga F 1253 | 1728 | Micciccinni 1505 1603 1604 |
| Helseth T P | 639 | Netherlands 1695 1696 1700 |
| Henderson G R | 852 | 1701 1735 1744 1751 1765 |
| | - 589 | 1770 1781 1782 1786 |
| Henderson County (Ill) Drain | | New Zealand 1100 |
| District | 1238 | North Dakota 1574 |
| Hendrick J | 44 | Sweden 1076 |
| Hendricks H A J | 1677 | Tennessee 1642 |
| Hendrix W E | 1572 | Virginia 1589 |
| | 853 | Wales 11 1314 |
| Herrera L | 1840 | Western States 810 |
| | 1089 | SEE ALSO UNDER specific |
| Hershberger M F | 31 | subjects |
| Hess A D | 590 | Hobbs H W 109 |
| Hester J B | 45 | Hobday S R 324 |
| Heuser J F | 304 | Hock O W 1091 |
| Hewes L 673 674 | | Hockensmith R D 110 |
| Heyndrickx G A | 1090 | Hoene J V 546 |
| Hibon J | 675 | Hoenshel P 677 |
| Hickman W D | 1215 | Hoglund C R 1501 |
| | 946 | Holbrook W 404 |
| Hidinger L L | 1608 | Holmes W E 103 |
| Hidveghy L | 1254 | Honduras 1675 |
| Higgins F H | 1368 | Hooghoudt S B 111 112 1092 |
| Hill R A | 206 | Hooper W T 1255 |
| Hilly regions 946 | 1323 | Hoover M D 114 |
| drainability | 1036 | Hopewell H G 9 1093-1095 |
| Gt Brit 633 | 786 | 1100 |
| India | 1847 | Hopfen 1369 |
| Iowa | 125 | Hore E R 1096 |
| Netherlands | 757 | Horn 1662 |
| Scotland | 1426 | Horner G M 228 |
| Hissink D J | 676 | Horner W W 1323 |
| History 11 14 26 | 193 | Horth C J 678 |
| 668 1504 1616 1656 | 100 | Horton R E 193 |
| Argentina | 1683 | Horton R K 1684 |
| Balearic Islands | 656 | Howald R 1097 |
| Brazil | 15 | Howe O W 462 |
| California | 1652 | Hubbert M K 229 |
| Egypt | 702 | Hubble G D 405 |
| Europe | 1782 | Huberty M R 113 198 230 |
| Florida 1576 1590 1609 | 1627 | 100 100 100 |
| 1632 1649 | | 235 406 466 1539 1569 Hudson A W 9 680 1098 |
| France | 1525 | 1099-1101 1868 |
| Gt Brit 8 11 17 | 27 | Huff L C 231 |
| 626 660 733 1157 | 1162 | Hugues L 681 |
| 1234 1781 1796-1798 | 1802 | Huisman L H 1373 |
| 1803 1806 1807 1819 | 1831 | Huleh Lake (Israel) 1854 |
| Greece | 1724 | Hungary 746 877 1254 1.56 |
| India 20 | 718 | 1276 1778 |
| Iowa | 1607 | Hunter H 732 |
| | 1001 | 100 |

| | | | Item | | | | Item |
|---------------------------------|--------------|-----------|--------------|-----------------------|-----------|------------------|--------------|
| Hursh C R | | | 114 | Inundated soils | Cont | • | 1700 |
| Husemann C Hutchins W A | 316 | 3:5- | 682 - 328 | Denmark France | | 1707 | 1788 1708 |
| Hutchinson D E | 310 | 020- | 854 | Gt Brit 80 | 669 | 1793 | 1795 |
| Hydraulics | 19 | 25 | 34 | 1830 1832 | 000 | 1100 | 1100 |
| 57 158 | 637 | 668 | 743 | Japan | | | 1849 |
| 759 851 | 999 | 1409 | | Kansas | | | 991 |
| handbooks | | | 635 | Madagascar | 70 | con | 1843 |
| SEE ALSO Flo | w of w 25 | | 100 | Netherlands | 72 | 623 | 1305 |
| Hydrology 191—310 | 985 | 62 | 190 | 1708 1745 Texas | 1750 | 1751 | 1784 1233 |
| 191-310 | 900 | | | USSR | | 156 | 1321 |
| IAngol A M | 506 | 683 | 1102 | Iowa 125 | 140 | 161 | 185 |
| Iceland 697 | | 1359 | | 264 270 | 924 | 956 | 959 |
| Idaho 10 | 55 | 279- | - 281 | 989 1184 | 1209 | 1324 | 1535 |
| | 1514 | | | 1544 1607 | | | |
| Idaho State Plan | | Board | 10 | Iraq | 1851 | 1856 | 1863 |
| Iglesias Benoit | Н | | 684 | Ireland 496 | 510 | 520 | 1134 |
| Ignatenok F B | | | 685 1256 | 1135 1791 1828 | 1810 | 1824 | 1825 |
| Ihrig D Illinois 118 | 176 | 320 | 1230 | Irmay S | | | 115 |
| | | 1260 | | Irrigated soils | 4 | 6 | 21 |
| Illinois Univers | | | | 26 35 | | - 483 | 604 |
| Agriculture Ex | | | | 800 1197 | | 1470 | 1566 |
| | | | 1103 | 1636 | | | |
| Imperial Irriga | tion Di | strict | | Arizona | | | 371 |
| (Calif) | | | 385 | Australia | 364 | 366 | 367 |
| India 1 | 20 | 69 | 168 | 377 405 | 425 | 440 | 469 |
| 251 433 | 438 | 446 | 463 | 474 1195 | | 250 | 441 |
| 467 613 956 1299 | 834 1482 | 896 | 947 1847 | Brazil | E C | 359 258 | 441 361 |
| 1852 1858 | 1864 | 1569 | 1041 | California 369 383 | 56 384 | 389 | 397 |
| Indian Grave (Il | | nage T | Dis- | 415 424 | | 450 | 452 |
| trict | .I)DIUI | nage 1 | 1260 | 457 476 | 482 | 483 | 608 |
| Indiana 494 | 502 | 507 | 508 | 1625 1652 | | | |
| 517 718 | 922 | 1190 | 1218 | Canada | | | 1658 |
| 1252 1600 | 1633 | | | Colombia | | | 458 |
| Indiana Drainag | ge Cont | tracto | rs | Colorado | | | 370 |
| Association | | | 1190 | India 433 | 438 | 446 | 467 |
| Indo-China | | | 1304 | Montana | | 363 | 388 |
| Indonesia | 17 | 17.4 | 1870 | Nevada | | 398 | 427 |
| Infiltration 164 802 | 7 | 74 | 99 | New Mexico | 201 | 370 | 459 445 |
| 164 802 estimates | | | 129 | Oregon Puerto Rico | 391 | 426 396 | 1672 |
| peat and muck | renile | | 538 | research | 79 | 379 | 402 |
| rates | SOLIS | | 98 | 454 | 10 | 010 | 102 |
| research | | 49 | 111 | USSR | | | 51 |
| Ingerson I M | | | 232 | Utah | | | 477 |
| Inglis C C | | | 947 | Western Sta | tes | | 38 |
| Inlets 399 | 664 | 713 | 744 | Rhodesia | | | 416 |
| 749 1673 | | | | Saskatchewan | | 437 | 1659 |
| Institute of Mal | ters of | Explo | | Sierra Leone | G1 : | | 90 |
| sives | nim c | | 948 | Southwestern | States | | 444 |
| Interception dra | | . Docc | 1130 | Texas | | 372 | 459 420 |
| International Bastruction and I | | | | USSR 478 | | 374 | 440 |
| Inundated soils | SEVETO | иеш 86 | | Utah 392 | 407 | 409 | 411 |
| Belgium | | 00 | 1708 | 481 | 101 | 100 | 111 |
| 201514111 | | | 1.00 | 101 | | | |

| Irrigated soilsCont. Washington 368 393 Western States 382 430 432 445 1517 Wyoming 388 Isere Valley project (France) | 1558 419 436 (e) 1712 | Jones G P 593 Jones H I 1108 Jones J P 952 Jones L A 12 117 330 331 332 694 695 1504 1505—1507 1587 1609 1656 |
|---|-------------------------------------|--|
| Isler D A 1374 Ismail H M Israel 879 1127 1846 Israelsen O W 11 46 329 407-413 435 686 1246 1257 1258 1278 1619 | 1375 949 1854 234 442 | 1813 Jones L S 138 Jones W R 1259 Jonge L J A 696 Jonge P de 1378 Jongedyk H A 507 Jonsson A L 697 953 Jonsson P 954 |
| 1348 1401 1431 1481 | 866 1065 1690 1719 1761 | Jourdan L 1729 Jungstedt B O 548 955 Jute 1676 Junsela T 82 524 698 1109-1111 1379 1508 |
| IUnevich D P Izzard C F Jack H W | 687 950 1869 | Kahawita R 416 Kaitera P 1112 1115 1509 Kalbermatten J de 549 Kalweit H 1380 |
| Jackson A E Jacobsen J Jacobson H G M Jacobson P Jacoby C E 688 | | Kannenberg H 1113 Kansas 212 298 301 326 861 991 1002 1613 Karla Lake (Greece) 1773 Karstens G A 1114 |
| Jacoby H Jahn G Jakobsen J M 691 1106 Jakovlev B I Jamison V C | 690 547 1376 116 47 | Kazmann R G 206 Keach (Ill) Drainage and Levee District 1231 Keen B A 1510 Keilholz F J 1511 |
| Japan 784 872 1189 1526 1849 1857 Jarrett G 951 Jarvis C S | 1411 1812 206 | Kelley O J 58 1381 Kelley W P 418 419 Kellogg F H 1312 Keltikangas V 550 |
| Jarvis M W Jelies H Jennings D S Jensen H | 692 1338 1381 1106 | Kemp W S 699 Kendall R G 700 701 1382 1383 1384 Kenn River project (England) |
| Jensen M C Jepson H G Jessup L T Jobbins D M | 55 855 414 591 | 1812 Kenney F R 1512 Kent River project (England) |
| Joffe J S 693 1107 Johnson E A G 1377 Johnson H A 599 | 1502 1503 607 | Kentucky 486 1534 1633 Kentucky Agricultural Experi- ment Station |
| Johnson H P Johnston C N Joint Committee of the Nati Malaria Committee and the | e San- | Western Kentucky Substation 1534 Kenya 716 852 Kerr H A 908 |
| itary Engineering Div of the Malaria Society of Civil Engers Jones B J Jones G H | ne ngi- 592 415 236 | Kershaw C J 856 Keso L 1115 1730 Khairy A 702 Khanna R K 956 Khoperskii I S 1313 |

| Kidder E H | 118 | 175 | 1096 | Land useCont. | | Item |
|------------------------------|--------|--------|---------------------|--------------------------|------|-------------|
| 1116 | 110 | 113 | 1090 | Southeastern States | | 486 |
| Kiehl E J | | | 957 | Landon I K | | |
| Kielman J A | | | 1697 | Lane D A | | 861 237 |
| King A S | | | 749 | Lang J W | 238 | 305 |
| King B | | | 1610 | Langbein W B | 239 | 1323 |
| King J A | | | 1117 | Langley B C | | 240 |
| Kinkham D | 40 | | 119 | Laos | | 1860 |
| 120-125 | 1118- | -1122 | | Lapides Y | 0.5 | 1127 |
| Kirwald E | _ | | 703 | Laplace equation 52 | 95 | 164 |
| Klestrup-Hanse | n F | | 1513 | Larroque J | 1000 | 1734 |
| Klingebiel A A | | | 176 | Larsen C V S | 1389 | 1390 421 |
| Klingenhoff W | | | $704 \\ 1260$ | Larson C A | 1128 | 1263 |
| Klingner W H Klute A | | | 164 | Larson C L Larson J E | 1140 | 1129 |
| Knapp G S | | 316 | | Larsson H | | 1391 |
| Knifing | | 310 | 472 | | 887 | 1073 |
| Knight E W | | | 167 | | 001 | 1548 |
| Knoblauch H C | | | 127 | depth and spacing | 180 | 425 |
| Knoppien P | | | 62 | 474 671 1489 | | |
| Knox County (Inc | d) Soi | l Cons | serva- | maintenance | | 1548 |
| tion District | , | | 1600 | plastic | | 1184 |
| Kobayashi T | | | 1857 | Latham E | | 1819 |
| Koblet R | | | 705 | Latvia 551 | 1015 | 1331 |
| Koenig N | | | 1612 | Laue W C | | 959 |
| Köhler | | | 551 | Law F | | 960 |
| Kohler K O | | | 1514 | Leaching 28 86 | | 378 |
| Kohnke H 49 | 50 | 71 | | 418 449 1120 | 1177 | 1700 |
| Kolenchenko D | /r 505 | | 509 | Bonneville Basin | 400 | 465 |
| Kollmorgen W N | | , | 1603A 1731 | California | 406 | 450 |
| Kondratavichus Koslow V S | V I | | 707 | Colorado Nevada | | 370 427 |
| Kostiakov A M | 51 | 420 | 706 | New Mexico | | 370 |
| Kotilainen M J | 01 | 120 | 557 | research 406 | 448 | 451 |
| Kovacevic P | | | 1732 | Sierra Leone | 110 | 90 |
| Krekow E A | | | 958 | Utah | 448 | 451 |
| Kreuger W C | | 693 | 1107 | Washington | | 421 |
| Krijger P D | | | 857 | Wyoming | | 387 |
| Krimgold D B | 51 | 129 | 708 | Leavitt E T | | 862 |
| 858-860 | | | | Lebarron R K | | 552 |
| Kristensen K J | | | 709 | Le Compte S B | | 144 |
| Krivonosov I M | | 710 | 1123 | Lee A T M | | 1567 |
| Kroff W J | | | 1188 | Legal aspects | 337 | 353 |
| Kunkel F | | | 299 | Leggette R M | 141 | 241 |
| Kupper | | | $\frac{1124}{1125}$ | Legislation 18 21 | | 317 |
| Kuum IU | | 1961 | | 318 331 332 | | 347 |
| Kuvas K | | 1261 | 1733 | 348- 350 355 | 356 | 1632 |
| Lafferty O W | 594 | 1262 | 1415 | 1641 | | 342 |
| Lagos U J A | 001 | 1202 | 1671 | Canada Florida | | 1632 |
| Lalloy | | | 1126 | France | | 723 |
| Lambe T W | | | 1312 | Georgia | | 352 |
| Lambert J M | | | 130 | Gt Brit 8 | 324 | 333 |
| Lamont N 711 | 712 | 1385 | 1386 | Illinois | 311 | 320 |
| Land use 92 | 93 | 106 | 1499 | Maryland | | 336 |
| 1511 1641 | | | | Michigan | | 346 |
| Pakistan | | | 667 | Minnesota | | 335 |
| Saskatchewan | | | 437 | Mississippi Delta | | 1603 |
| | | | | | | |

| | Item | Item |
|-------------------------------|-------------|---|
| Legislation Cont. | | LouisianaCont. 1091 1245 |
| New Mexico | 353 | 1522 1548 1603A 1605 1633 |
| North Dakota 339 | | Louisiana Agricultural Experi- |
| Ontario | 319 | ment Station 887 |
| Pennsylvania | 1085 | Lourdin L 1516 |
| Scotland | 334 | Love S K 263 – 265 |
| South Carolina | 354 | Lovely W G 822 |
| Virginia | 1589 333 | Lowdermilk W C 14 133 863 |
| Wales Legumes 491 537 | | Lowry S J 1534 Lubkov A I 511 |
| Legumes 491 537 Legwen W A | 1392 | Lubkov A I 511 Ludvik G F 590 |
| Lehmann E W | 713 | Ludwig B H 596 |
| Lelydorp project (Surinam) | | Luebke H N 1131 |
| Lembke W D | 131 | Lugo Lopez M A 966 967 |
| Lenert L G | 1392 | Luk'îanchikov S N 1396 |
| Leopold L B | 13 | Lukkala O J 512 556 557 |
| Le Prince J A 595 | 607 | Lumby Strand project (Denmark) |
| Le Ry J | 714 | 1713 |
| Leur F H de | 1393 | Lund B 1265 |
| Leusen H J van | 1735 | Lunden B 968 |
| Levees 782 1259 | 1323 | Lundgreen W 969 |
| California | 215 | Lundgreen W K 423 |
| construction 1310 | | Luthin J N 52 53 85 134 |
| Florida 1310 1320 | | 135 136 424 |
| Indo-China | 1304 | Lynch E E 1397 |
| | 1245 | Lynes W S 1117 1132 |
| Netherlands | 1305 | Lyon A V 137 425 |
| New Zealand Levi E | 1867 132 | Lyra I de A 15 |
| Levine G | 33 | Lysimeters 28 37 60 87 93 94 105 144 |
| Leville G | 1130 | |
| | 422 | bibliography 50 construction 50 |
| Lie O | 510 | design 41 65 |
| Liere W J van 1264 | | Gt Brit 154 |
| Lillard J H 96 1056 | | India 168 |
| Lindberg K 553 554 | 715 | installation |
| 919 961 | | peat and muck soils 146 518 |
| Lindenbergh D J | 1394 | research 50 |
| Linsley R K | 242 | Iowa 161 |
| Lint H C | 127 | Norway 150 |
| Lithuania | 1772 | Scotland 44 |
| Livestock 78 | 1098 | Lytle S A 495 |
| 0 | 963 | Lytle W F 118 |
| | 268 | |
| | 1814 | Maartmann K 558 |
| Løddesøl A | 555 | McAllister L 426 |
| Lodo M | 1679 | McAtee W L 1512 |
| Loam soils 9 Loebell R | 692 1395 | Macaulay Institute for Soil Re- |
| Loeltz O | 0.45 | search (Scotland) 43 |
| Loeltz O J | 245 246 | McChesney A J 1589 |
| Loess soils | 1058 | McClung V O 1133 McClymonds A E 1613 |
| Logsdon W T | 964 | McClymonds A E 1613 McColly H F 744 |
| Loiseau J | 1410 | McCornick J A 427 |
| Lømsland D | 965 | McCrory S H 1517 |
| Lonsdale J T | 247 | McCubbin G A 1661 |
| Louisiana 142 308 505 | 614 | McCulloch R 1134 1135 |
| 887 917 934 941 | 970 | McDougal O J 854 |
| | | 0 |

| McGeorge W G | <u>Item</u> 1266 | Maryland Univer | | | Item |
|--|--|--|--------|--------------------------|---|
| McGlashan H D MacGregor D R MacIntyre W H Mackie J W McKinnon A D | 248 1820 138 1399 1614 | College of Agri Home Econom Marzolo F Masclee J A Mason F R | | re and | 336 1737 140 480 |
| McLaughlin T G McLaughlin W W McLean J L McMillan J A MacPherson H N MacQueen P O | 249 428 1859 1821 1136 1181 | Mason H G Massachusetts Materials Matsepuro M Matsepuro M E Matson H | 668 | 755 515 514 970 | 1402 1618 |
| McQuown R | 1589 | Maughan J H | 329 | 411 | 435 |
| Madagascar Maddock T Magistad O C Magoon E H Maher C Maierhofer C R Maillard J Maits B Malaya Malfatti D | 1836 1843 403 429 1570 716 430 432 1860 1615 480 1309 1699 | Mavis F T Mayer I D Mayer R Mayo K L Mayo N Mazzei E Mechanization Belgium costs | | 507 | 971 718 1738 1144 1620 866 1444 618 |
| Malhotra S L Malmtrom C Malygin V S Mamisao J P Manitoba Manly G W Mansfield G R | 433 513 1137 864 342 1660 434 223 1138—1142 | Netherlands Denmark France Gt Brit Netherlands New Zealand | | 1365 1334 | 750 1389 1377 732 1735 1448 830 1455 |
| 1145 1146 1149 | | USSR 511 | 514 | 515 | 533 |
| 1519—1521 1616 Mantello Reclamation (Italy) Mapham A L Maraschi G Marchesaiz project (F | 1690 865 1401 Trance) | 560 1352 Meinzner O E Mer R Mercer W B Merrick C P Merrill L P | 141 | 250 | 345 1739 1794 1621 142 |
| Manillannat I | 1734 717 | Messines J | | 1740 | 1741 -1744 |
| Marillonnet L Marimpietri L Marin O Maritime Provinces 1308 1315 | 139 1699 342 1303 | Mesu F P Metsanheimo U Meuwissen P G Mexico 132 1663-1666 | 876 | | 559 1745 |
| Markwick A H D Marschall F Marschner F J | 1143 705 1589 | Michael S A Michigan 214 503 504 | 552 | 491 1501 | 212 502 |
| Marshall plan Austria | 1753 | Michigan Dept of | Con | servat | 214 |
| Martin H B Martine P Martinez M B Martinez Bula F | 966 967 1680 | Michigan State C Muck Experim Michigan State S Committee | ent Fa | arm onserv | 491 vation 875 |
| Marvin V Maryland 109 336 | 1267 1268 916 1557 | Middle Rio Gran | de Dr | ainag | e 1573 |
| Maryland 109 336 1575 1584 1592 1621 1624 | 1593 1617 | District (New M Midwestern State 817 1507 | es | 673 1629 | 674 |

| * | | T4 |
|------------------------------------|-----------------------|------|
| Item | Mitaball B D | Item |
| Milhollin R M 867 | Mitchell R D | 1674 |
| Miller A W 868 | M'Laren J | 516 |
| Miller C K 436 | Mohrman K J M | 1151 |
| Miller D B 1138 | Moldboard plows 1363 | |
| Miller D G 1140 1141 1145 | Mole drainage 632 | |
| 1146-1150 1524 | Australia 678 770 | 809 |
| Miller G J 16 | Austria | 1171 |
| Miller R D 135 | bogs and swamps | |
| Miller W F 973 | Australia 366 | 1195 |
| Miller W McN 1220 | Germany | 1445 |
| Milligan C H 1269 | Gt Brit | 1794 |
| Mills D R 1405 | Ireland | 1134 |
| Milner R 869 | New Jersey | 1443 |
| Minas Gerais Escola Superior | New Zealand | 1214 |
| de Agricultura 728 | Rhodesia | 753 |
| Mineral soils | Sweden | 1076 |
| Finland 1112 | USSR | 1123 |
| 1100 | California | 756 |
| | clay soils 1091 | |
| Peru 807 USSR 661-687 1123 1201 | costs | 1183 |
| | Australia 1195 | |
| 1352 1789 Minnesota 335 337 526 | | |
| | 2 | |
| 901 1091 1543 1582 | Gt Brit 1160 1161 | |
| Minnesota Agricultural Experi- | Ireland | 1135 |
| ment Station 525 | New Zealand 1043 | 1078 |
| Minnesota Legislative Interim | 1079 1081 1144 1174 | 1000 |
| Commission 337 | Sweden | 1076 |
| Minnesota University Dept of | Denmark | 804 |
| Agricultural Engineering 1138 | Egypt | 702 |
| Minolts 1406—1408 | equipment | 1385 |
| Minolts L R 974 | Austria | 1171 |
| Minshall N E 708 858 | France | 1126 |
| Minsk Belaruskaia Akademia | Gt Brit 1026 1048 | 1160 |
| Navuk Institut Melioratsii Vod- | 1161 1349 1398 1468 | |
| nogo i Bolotnogo Khoziaistva | Iceland | 1359 |
| 719 | New Zealand | 1078 |
| Minsmere Level project (Eng- | Sweden | 1076 |
| land) 1830 | Union of South Africa | 1167 |
| Miramontes F C 1270 | USSR 1439 | 1460 |
| Mission Française d'Outre- | Finland | 1109 |
| Mer 720 | Florida | 677 |
| Mississippi 486 986 1047 | France | 1126 |
| 1497 1563 1595 1598 1608 | Germany 1042 | 1113 |
| Mississippi Agricultural Experi- | Gt Brit 17 700 701 | 729 |
| ment Station | 732 733 1026 1048 | 1049 |
| Black Belt Br 1563 | 1064 1068 1158 1160 | 1162 |
| Mississippi Delta 16 323 495 | 1349 1529 1799 1804 | |
| 1483 1603 1604 1643 1655 | history | |
| Mississippi Valley 227 595 | New Zealand | 1100 |
| 1519 1524 1628 | Sweden | 1076 |
| Missouri 186 298 309 631 | Ireland | 1824 |
| 816 882 890 915 1237 | irrigated soils | 471 |
| 1248 1318 1325 1588 | Australia 366 | 1195 |
| Missouri Society of Professional | Israel | 1127 |
| Engineers 1635 | Kenya | 716 |
| Missouri Valley Loess Region | Louisiana 1091 | 1548 |
| Conservation Experiment Sta- | mineral soils | 1201 |
| tion (Iowa) 270 | Minnesota | 1091 |
| 2011 (20114) | 11111100000 | 1001 |

| | <u>Item</u> | | Item |
|--------------------------|-------------|----------------------------|-------|
| Mole drainageCont. | | Mole plowsCont. | |
| Netherlands | 1092 | construction 1327 | 1461 |
| New Zealand 9 484 | | Denmark 649 | 1376 |
| 536 · 627 699 711 | 712 | | |
| 769 1038 1078 1079 | | ~ | 1342 |
| | 1144 | Germany | 1124 |
| 1152 | | Gt Brit 151 633 732 | 1159 |
| Norway | 1075 | 1161 1343 1349 1356 | 1387 |
| Oregon | 749 | 1388 1400 1420 1423 | |
| peat and muck soils 538 | 696 | in mosquito control | 1397 |
| Florida 488 | 1091 | maintenance | 1100 |
| New Zealand 484 | 535 | Netherlands | 1378 |
| | 555 | | |
| 536 | 4404 | New Jersey | 1443 |
| USSR 506 537 | | New Zealand 536 1079 | 1094 |
| research | 1183 | 1144 1174 1327 1361 | |
| Georgia | 42 | Sweden 1017 1050 1378 | 1424 |
| Gt Brit | 151 | types | 1100 |
| Iowa | 1184 | Ú S S R 1427 | 1461 |
| New Zealand 1093 1094 | | Molen W H van der 72 | 143 |
| | | Molinelli J C | 870 |
| saline-alkali soils 1177 | | | |
| Scotland | 665 | Mollenkopf J F | 975 |
| Sweden | 1050 | Monhemius L | 1271 |
| Switzerland | 1097 | Monnier G | 871 |
| Union of South Africa | 1167 | Monson O W 1272 | 1273 |
| USSR 1034 1071 1177 | 1178 | Montana 363 | 388 |
| 1201 1202 | 1110 | Montana Agricultural Exper | |
| Wales | 1529 | Station | 388 |
| | | | |
| Mole drains 7 664 | 672 | Mookerjee D | 251 |
| Austria | 1171 | Moon C L | 167 |
| construction | | Moore R E | 1409 |
| Germany | 1124 | Moorhouse S | 721 |
| | 1081 | Morecambe Bay project (Gt | |
| USSR | 1439 | Brit) | 1829 |
| depth and spacing 1043 | | Morel C 722 723 1410 | 1525 |
| 1100 1174 | 1044 | 1746—1748 | 1020 |
| | 1105 | | 1702 |
| bogs and swamps | 1195 | Morestel Marshes (France) | |
| New Zealand 1043 | | Morgan A M | 266 |
| 1080 1081 1100 1101 | 1144 | Morgan J H | 1314 |
| 1174 | | Morgan M F | 144 |
| Union of South Africa | 1167 | Mori S | 1411 |
| Florida | 1587 | Morishima S | 1189 |
| Gt Brit 8 701 1033 | 1045 | Morocco 1 | 1837 |
| 1064 1161 1370 | 1010 | Morris R | 497 |
| | 1170 | Morris R E | 517 |
| Louisiana | 1179 | | |
| maintenance 730 | 1064 | Morris W | 1154 |
| Netherlands | 1212 | Morrow R R | 567 |
| New Jersey | 1443 | Mors project (Denmark) | 1692 |
| New Zealand 1043 1080 | 1100 | Mortensen T | 1749 |
| 1144 1174 | | Mosquito control 61 574- | - 614 |
| size 1080 1100 | 1174 | 805 1392 1417 | |
| slope 1100 | 1153 | California 574 593 | 608 |
| | | 614 1625 | 000 |
| strength and durability | 1033 | | 1570 |
| 1045 1144 1153 1420 | 1443 | Caribbean region | 1570 |
| strengthening 1060 | 1384 | Connecticut | 1355 |
| Union of South Africa | 1167 | Delaware 83 | 1397 |
| USSR 706 1031 1102 | 1176 | Dominican Republic | 1667 |
| 1440 | _ | El Salvador | 1674 |
| Wales | 1033 | equipment | 1437 |
| Mole plows 1333 1347 | 1384 | Florida | 602 |
| 1446 1452 | 1004 | Georgia | 610 |
| 1110 1104 | | W 001 5 1 4 | |
| | | | |

| | | <u>Item</u> | | | | | <u>Item</u> |
|-----------------------------|---------|-------------|---------------------|--------------|---------------------|------------|--------------|
| Mosquito controlCon | nt. | 4 70 4 | Nebraska- | | | | 1054 |
| Greece | | 1724 | Nebraska | Agric | uiturai | Colle | |
| India | 1/01 | 613 | Modorland | ceho l | Hoidon | anntea | 854 |
| Italy | 1481 | 1761 614 | Nederland | sche | netaen | liaaist | 640 |
| Louisiana Massachusetts | | 1565 | pij Needs | 22 | 461 | 471 | 472 |
| Mississippi Valley | | 595 | 808 | 811 | 1469 | 1470 | 1487 |
| New Jersey 583 | 600 | 601 | 1494 | | 1505 | 1511 | 1517 |
| 606 609 1262 | 1274 | 1414 | 1518 | 7 2 7 | 1533 | 1546 | 1558 |
| 1415 1416 1456 | 1457 | | 1560 | 1567 | | | |
| New York | 583 | 1418 | British V | West I | ndies | | 899 |
| Nicaragua | 1668 | 1673 | Californ | ia | | | 389 |
| Nigeria | 577 | 584 | Ceylon | | | | 1561 |
| Ontario | | 586 | Gt Brit | | | 729 | 1510 |
| Panama | | 576 | Louisian | | | | 1522 |
| Peru | | 1684 | Netherla | | | | 797 |
| research | | E00 | New Mex | | | | 1559 |
| Portugal Phodo Island | | 598 | New Zea Quebec | land | | | 1868 1210 |
| Rhode Island | | 603 1866 | Texas | | | | 1559 |
| Solomon Islands Spain | | 1721 | Utah | | | | 1619 |
| Tennessee | | 580 | Washing | ton | | | 639 |
| Tennessee Valley | 581 | 585 | Neetzel J | | | | 552 |
| 590 | | | Nefedov V | D | | | 726 |
| Trinidad | | 575 | Neller J F | } | 146 | 488 | 518 |
| Utah | | 596 | Nelson L | В | | 147 | 727 |
| Virginia | 582 | 1626 | Nelson W | | | | 148 |
| Moss H C | | 437 | Nene Rive | r proj | ject (G | t Brit | |
| Motooka T | | 1526 | Nery J M | | | 0.0 | 728 |
| Motsereliia A V | | 724 | Netherlan | | 1 1 2 0 | 62 | 72 |
| Mozambique Baslamas | Hon n | 1838 | 89 188 | 111 189 | $\frac{120}{623}$ | 143 640 | 178 657 |
| Mozambique Reclamatect | tion p | 1838 | 658 | 676 | 717 | 747 | 750 |
| Muckenhirn R J | 147 | | 757 | 764- | | 773 | 776 |
| Muguet M | | 1412 | 797 | 802 | 857 | 863 | 902 |
| Muirheid B F | | 1155 | 936 | 995 | 1008 | 1023 | 1030 |
| Muksch L | | 725 | 1037 | | 1092 | 1151 | 1168 |
| Mulhern T D | 1413- | -1418 | 1211 | 1212 | 1216 | 1217 | 1227 |
| Muncey J A | | 1514 | | 1251 | 1253 | 1271 | 1305 |
| Munns E N | | 1750 | 1317 | | 1338 | | 1373 |
| Murayama S J | 1070 | 1156 | | 1393 | 1394 | 1404 | 1407 |
| Murdock H E Musgrave G W | 1272 | 1273 99 | | 1515 1700 | $\frac{1538}{1701}$ | | 1695 1709 |
| Myers L E | | 597 | 1714 | 1718 | 1723 | _ | 1729 |
| Mycrs H E | | 001 | 1735 | | -1745 | 1750- | |
| Nadler H A | | 1672 | 1754 | 1755 | | | 1765 |
| Naffziger L M | | 228 | 1766 | | | 1774 | 1781 |
| Najera Angulo L | | 598 | 1782- | -1786 | 1790 | 1823 | |
| Nakashima T | | 872 | Netherlan | ds Co | mmiss | ie voo | r |
| Nangal project (India) | | 433 | een Onde | | | | |
| Naphan E A | | 427 | Landbouv | vkundi | ge Mo | gelijk | |
| Narasimha A Natal | | 1861 | heden | | | | 1681 |
| National Institute of A | ani a-1 | 620 | Netherlan | as Cu | ltuurte | chnis | |
| tural Engineering | gricul | 1419 | Dienst Netherlan | dc. D: - | nontin | don W | 1752 |
| Neal J H | 145 | 754 | germeer | | | | |
| Neal O R | | 161 | ken | 11001 | , Jobi pi | JAGET W | 1752 |
| Nebraska 298 423 | 861 | 969 | Neudecke | r J | | | 1753 |

| Nevada 167 | 246 344 | <u>Item</u> 398 | Northern Ireland Land | Impr | |
|----------------------------------|------------------------|--------------------|---------------------------------------|-----------|--------------|
| 427 Nevada State Er | oinear | 246 | ment Scheme Northern Ireland Minis | strv o | 1824 f |
| New Brunswick | igineer | 342 | Agriculture | Stry O. | 1824 |
| New England-N | | ter- | Northern States | | 525 |
| Agency Commi | | 1622 | Norton R A | | 1209 |
| New England Sta New Jersey | 109 579 | 1 1622 | Norway 150 501 568 572 655 | | 558 920 |
| 600 601 | 606 609 | | | 1075 | 1265 |
| | 1262 1274 | 1298 | 1366 1496 1562 | 1725 | 1775 |
| 1328 1414 | | | Nova Scotia | | 342 |
| 1436 1443 | 1456 145' | | Noyes J R | | 1757 |
| New Mexico 322 325 | 207 209 326 344 | | Nuts Nyasaland | 897 | 1564 1844 |
| 459 1559 | 1573 | ± 303 | Nye S S | 091 | 303 |
| New York 33 | 102 239 | 9 583 | 1., 0 2 2 | | |
| 625 1418 | 1622 1633 | | Oats | | 1563 |
| New Zealand 9 | 484 53 | | O'Brien H R | 250 | 1532 |
| 627 662 712 769 | 680 699 783 814 | | Observation wells Ochoa A E | 258 | 443 149 |
| 1029 1038 | 1043 105 | | O'Connor R | | 520 |
| 1079-1081 | 1093-109 | | Odelien M | | 150 |
| 1099-1101 | | | Odle M | | 738 |
| 1175 1214 | | | Ogg W G 521 | 522 | 1533 |
| 1354 1361 1447 1448 | 1362 1386 1865 186' | | Ohio 41 49 92 625 932 937 | 94 973 | 148 1131 |
| Newcomb R C | 1000 100 | 252 | 1221 1267 1288 | 1532 | 1131 |
| Newhouse F | | 1822 | Ohlson N E 1326 | | 1425 |
| Nicaragua | 166 | | O'Kelly E P | | 1825 |
| Nichol G E | 45 54 | 1527 | Oklahoma 104 142 | 272 | 298 |
| Nicholson H H | 17 519 1157—116 | | 301 831 832 883 891 1003 | 838 | 862 |
| 1528-1530 | 1823 | 0 1440 | Oklahoma Agricultura | | eri- |
| Nielsen K M | 10-0 | 736 | ment Station | - Zp | 1003 |
| Nielsen V | | 737 | Olafson E A | | 1277 |
| Nigeria | 57 | | Oldham E T | | 977 |
| Nikitin A A Nitrates | | 1756 181 | Oliva A Oliveira e Sousa E S | a, | 873 739 |
| Nitrogen | | 1166 | Ollier C | 1 | 1763 |
| Nitsenko A A | | 1531 | Olney A J | | 1534 |
| Noce G dalla | | 976 | Olsen J T | 1164 | 1826 |
| Noren D | | 302 | O'Neal A M | 0.4.0 | 173 |
| North Africa North Carolina | 226 26 | 675 5 486 | Ontario 157 319 651 1062 1266 | | 586 1429 |
| 543 562 | 835 92 | | 1661 | 1209 | 1423 |
| North Dakota | 253 27 | 1 339 | Open-ditch drainage | 2 | 6 |
| 844 1574 | 1597 159 | 9 1614 | 7 18 139 | 408 | 624 |
| 1633 | Own Chatan | 0.0 04 - | 664 671 754 | 759 | 800 |
| North Dakota L | aws statute | es etc 339 | 808 893 999 Alabama | | 914 |
| North Dakota St | tate Planni | | alluvial soils | 662 | 1623 |
| Board | | 253 | Australia 770 | 894 | 992 |
| Northeastern S | tates 29 | 7 778 | bogs and swamps | | 612 |
| 1655 | achien Con | COPTO | Delaware | | 1704 |
| Northern Appal tion Experimen | nt Station | 200 | France Iceland | | 1704 697 |
| Northern Indian | na Muck Ex | | Louisiana | | 1245 |
| ment Farm | 50 | 7 508 | New Jersey | | 606 |
| | | | | | |

| | <u>Item</u> | Item |
|-------------------------|-------------|---------------------------------|
| Open-ditch drainage | | Open-ditch drainageCont. |
| bogs and swamps-Cont. | | peat and muck soilsCont. |
| Norway 555 942 | 965 | Florida 488 |
| Oregon | 1623 | New Zealand 484 |
| Rhodesia | 753 | Scotland 521 |
| Brazil | 957 | USSR 500 |
| California | 756 | Puerto Rico 967 |
| Canada 573 | 652 | research 119 |
| Ceylon | 1855 399 | Finland 1545 Utah 442 |
| costs | 690 | saline-alkali soils 401 417 |
| Florida | 768 | 429 |
| Netherlands | 436 | Gt Brit 1793 |
| Wyoming dairy farms | 992 | Netherlands 676 902 |
| Delaware 916 | 1617 | USSR 500 |
| Denmark 736 | 804 | Scotland 521 1426 |
| design | 1293 | small farms and gardens 622 |
| Egypt | 702 | 736 901 |
| Finland | 698 | Spain 1433 |
| for mosquito control | 598 | Sweden 659 |
| Louisiana | 614 | Switzerland 544 549 996 |
| Mississippi Valley | 595 | Tasmania 785 |
| Nicaragua | 1668 | Texas 867 |
| Tennessee Valley | 590 | Trinidad 944 |
| forests | 546 | USSR 706 |
| Germany | 547 | Utah 686 |
| Latvia | 551 | Orchards 361 1164 1480 1518 |
| Norway 555 | 570 | 1539 1564 |
| Sweden | 563 | Australia 678 1069 1130 |
| France 722 | 1741 | 1551 |
| Germany | 996 | California 483 1564 |
| Gt Brit 108 733 1799 | 1820 | Netherlands 747 1478 1538 |
| Gulf States | 1500 | 1552 |
| Idaho | 55 | New Zealand 699 |
| India 20 | 446 | North Africa 675 |
| irrigated soils 399 453 | 471 | Sweden 1063 |
| Arizona | 371 | Tasmania 785 Washington 368 |
| Montana | 363 | Oregon 220 231 256 260 |
| Nebraska | 423 | 391 426 445 749 1129 |
| Puerto Rico 396 | 1672 | 1474 1623 |
| Wyoming | 436 | Oregon Agricultural College 445 |
| Italy 788 976 | 982 | Oregon State Planning Board |
| Louisiana | 941 | 1623 |
| Madagascar | 927 | Orlov P M 560 |
| Maryland 916 1592 | 1617 | Osmun J V 1274 |
| Minnesota | 901 | Otto W S 1624 |
| Netherlands 120 188 | 764 | Outlets 74 360 594 644 |
| 767 773 1251 1253 | 1701 | 664 671 727 740 744 |
| 1757 1784 | | 759 782 800 888 1028 |
| New Jersey 693 | 916 | 1085 1117 1165 1198 1286 |
| New Zealand 9 662 | 712 | 1560 |
| 769 783 | | Australia 440 |
| North Africa | 675 | California 801 |
| North Carolina | 930 | Canada 652 |
| Oregon | 1623 | clay 1025 |
| peat and muck soils 519 | 696 | cleaning 793 1049 1105 |
| Finland 528 | 539 | concrete 818 983 |

| | | | Item | | | | <u>Item</u> |
|--------------------------|---------|------------|--------------|-----------------------------|--------|-------------|----------------|
| OutletsCont. | | | | Park C F | | | 260 |
| construction | 713 | 760 | 846 | Parker E R | | 0=4 | 1536 |
| 983 1064 | 1385 | 046 | 070 | Parker G G | | 254 | 1537 |
| design | | 946 | 978 755 | Parker W V Parkins A E | | 599 | 607 16 |
| France grassed 7 | 708 | 836 | 846 | Parshall R L | | 980 | 981 |
| 849 855 | 878 | 000 | 010 | Parshall flume | | 980 | 981 |
| British West | | S | 899 | Parsons O J | | | 1275 |
| Missouri | | | 890 | Pasini B | | 982 | 1760 |
| Oklahoma | | | 891 | Pasto Irrigation | proje | ect (Pi | ıerto |
| research | | 890 | 891 | Rico) | | | 1672 |
| South Carolin | ıa | | 891 | Patiala Drainage | | | |
| Gt Brit | | | 700 | tection Scheme | (India | 1) | 1864 |
| India | | | ৭96 1209 | Pattantyus A G | | | 1276 |
| Iowa maintenance a | nd ror | nair | 760 | Patty R L Paukkonen N | | | 152 1430 |
| 795 846 | 851 | 958 | | Paulsen C | | | 255 |
| 1025 1283 | 001 | 000 | 001 | Paulsen C G | | 256 | 257 |
| Denmark | | 691 | 804 | Pearce O W M | | -00 | 1166 |
| Gt Brit | | | 1064 | | | | 1167 |
| metal | | | 1025 | Pearson R W | | | 47 |
| Michigan | | | 504 | Peasro A | | | 1431 |
| New Zealand | 699 | 1078 | 1079 | Peatfield A E | | _ | 983 |
| 1175 | | | 1.100 | Peat and muck s | | 7 | 21 |
| Ontario | | | 1429 | 484 — 540 | 632 | 672 | 696 |
| Oregon | ~~!1~ | | 749 | | 1117 | 1512 | |
| peat and muck protection | 793 | 831 | 525 851 | Australia burning | | | $1871 \\ 1512$ |
| 878 1073 | 1105 | 1197 | 001 | distribution | | | 532 |
| Denmark | 1100 | 110. | 804 | Finland 524 | 528 | 545 | 1112 |
| Iowa | | | 1132 | Florida 146 | 488 | | 498 |
| Netherlands | | | 1697 | | | 1609 | 1632 |
| pump 1263 | 1283 | 1284 | 1286 | Gt Brit | 1475 | 1802 | 1813 |
| size | | 892 | 1013 | Indiana | 494 | 502 | 1252 |
| Southern State | S | | 906 | Ireland | 496 | 510 | 520 |
| Tasmania | | | 785 | Louisiana | | 50 6 | 505 |
| tile | 847 | 051 | 708 | Michigan | | 502- | - 504 |
| types Overholt V | 041 | 851 740 | 1283 1165 | Minnesota Mississippi De | 1+0 | | 526 495 |
| Overy B B | | 140 | 151 | Netherlands | ııa | | 1742 |
| Overy D D | | | 101 | New Zealand | 9 | 484 | 536 |
| Pacific Northwe | st | 228 | 1655 | Northern States | | 101 | 525 |
| Pacific Northwe | st Co | nserva | ition | Norway | | | 501 |
| Experiment Sta | tion (' | Wash) | 228 | Ontario | | | 157 |
| Pai P P | | | 1758 | permeability | | | 535 |
| Pais E A | 005 | 4500 | 523 | research | | 525 | 527 |
| Pakistan 470 | 667 | 1569 | 1845 | Finland | F.O.F. | 500 | 539 |
| 1853 1858 | | | 1595 | Indiana | 507 | 508 | 517 |
| Palmer L | 831 | 07/ | 1535 | Michigan | | | 491 |
| Palmer V J 987 | 001 | 014 | 979 | New Zealand Scotland 510 | 516 | 521 | 535 522 |
| Panama | | 576 | 1570 | subsidence | 310 | 041 | 497 |
| Panarin M N | | 0.0 | 1427 | Finland | | | 512 |
| Pannwitz E | | | 1428 | Florida | | 489 | 1587 |
| Papaniko-Laou | DL | | 1759 | Gt Brit | | | 1475 |
| Paradis A | | | 741 | Indiana | | | 508 |
| Paris R G | | | 440 | Louisiana | | | 505 |
| Parish F J | | | 1429 | Minnesota | | | 1543 |
| | | | | | | | |

| Peat and muck soils Cont | • | Pipe drainage | ·Cont. | | |
|---|--|---|---|--|--|
| subsidenceCont. | | Egypt | | | 702 |
| Southeastern States | 486 | Finland | | 524 | 1110 |
| Sweden | 493 | Germany | | 1193 | 1194 |
| USSR | 534 | Gt Brit 700 | 701 | 1039 | 1794 |
| Sweden | 513 | Italy | | | 788 |
| types | 532 | Mexico | 0.00 | 006 | 1200 |
| USSR 499 500 506 | | Netherlands | 676 | 802 | 1023 |
| 511 514 515 531 | 533 | 1168 1212 | 1698 | | 000 |
| 534 537 706 1461 | 523 | peat and muck | | | 696 |
| West Virginia | 490 | Sweden 1014 | 1110 | 1219 | 1686 |
| Western States Wisconsin 157 485 | | Pipe drains depth and space | ina | 82 | 1110 |
| Pecos River Joint Investiga | | 1193 | ing | 04 | 1110 |
| 459 | 1559 | joints | 1014 | 1194 | 1219 |
| Peele T C | 153 | maintenance | 1011 | 691 | 1023 |
| Penders J M A | 1762 | slope | | 001 | 1219 |
| Penman H L 154 | | Piper A M | | 259- | - 262 |
| Pennsylvania 66 239 | | Pitman E P | | 200 | 600 |
| 1085 1087 1602 | 10.0 | Pitzen T A | | | 713 |
| Penny J M | 441 | Plaisance G | | | 561 |
| Percolation 92 96 | | Plastic drains | | | 1183 |
| 237 733 763 | | Plows | 850 | 1369 | 1452 |
| rates 31 147 | 153 | Australia | | | 825 |
| research 84 | 93 | Gt Brit | | 1049 | 1371 |
| Perekhrest S M | 156 | Netherlands | 1251 | 1378 | 1393 |
| Perez Diaz D | 876 | 1404 1751 | 1783 | | |
| Persson S | 1432 | New Jersey | | | 1457 |
| Peru 807 | | Norway | | | 1366 |
| Peterson A H | 1247 | Scotland | | | 1426 |
| Peterson D F | 1277 | Sweden | | 1326 | 1391 |
| | | | | | |
| Peterson D F Jr 410 442 | 448 | Union of South | Afric | a | 900 |
| 451 1257 1278 | | USSR | | | 913 |
| 451 1257 1278 Peterson H B | 471 | USSR SEE ALSO Mol | | | 913 |
| 451 1257 1278 Peterson H B Peterson R K | 471 56 | U S S R SEE ALSO Mol Mole plows | ldboar | d plow | 913 /s; |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F | 471 56 540 | USSR SEE ALSO Mol Mole plows Po Valley proje | ldboar ct (Ita | d plow | 913 /s; 1736 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B | 471 56 540 742 | U S S R SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje | ldboar ct (Ita | d plow | 913 75; 1736 1624 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines | 471 56 540 742 864 | U S S R SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J | ldboar ct (Ita | d plow | 913 7s; 1736 1624 444 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A | 471 56 540 742 864 743 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O | ldboar ct (Ita | d plow | 913 75; 1736 1624 444 1279 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J | 471 56 540 742 864 743 744 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree | ldboar ct (Ita | d plow ly) S) | 913 75; 1736 1624 444 1279 748 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 | 471 56 540 742 864 743 744 45 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M | ldboar ct (Ita | d plow | 913 75; 1736 1624 444 1279 748 1764 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates Piatin M V | 471 56 540 742 864 743 744 45 745 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M Polak B | ldboar ct (Ita | d plow ly) S) | 913 75; 1736 1624 444 1279 748 1764 1870 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates Piatin M V Pichler J 746 | 471 56 540 742 864 743 744 45 745 877 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M Polak B Poland J F | ldboar ct (Ita | d plow ly) S) | 913 75; 1736 1624 444 1279 748 1764 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W | 471 56 540 742 864 743 744 45 745 877 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M Polak B Poland J F Polders | ldboar ct (Ita | d plow ly) S) | 913 78; 1736 1624 444 1279 748 1764 1870 288 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S | 471 56 540 742 864 743 745 745 877 18 157 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana | ldboar ct (Ita | d plow ly) S) | 913 78; 1736 1624 444 1279 748 1764 1870 288 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 | 471 56 540 742 864 743 744 45 745 877 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit | ldboar ct (Ita | d plow ly) S) | 913 78; 1736 1624 444 1279 748 1764 1870 288 1678 1827 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 | 471 56 540 742 864 743 745 745 877 18 157 53 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan | ldboar ct (Ita ct (U | rd plow ly) S) | 913 7S; 1736 1624 444 1279 748 1764 1827 1678 1827 1857 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 Pijls F W G 747 1168 | 471 56 540 742 864 743 744 45 745 877 18 157 53 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands | ldboar ct (Ita ct (U | rd plow ly) S) 1763 | 913 75; 1736 1624 444 1279 748 1764 1870 288 1678 1827 1857 188 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 Pijls F W G 747 1168 Pillsbury A F 56 258 | 471 56 540 742 864 743 744 45 745 877 18 157 53 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands 717 750 | ldboar ct (Ita ct (U 89 764 | rd plow ly) S) 1763 | 913 75; 1736 1624 444 1279 748 1764 1870 288 1678 1827 1857 188 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 Pijls F W G 747 1168 Pillsbury A F 56 258 443 450 1539 | 471 56 540 742 864 743 744 45 745 877 18 157 53 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands 717 750 1251 1697 | 89 764 1698 | rd plow ly) S) 1763 120 802 1701 | 913 75; 1736 1624 444 1279 748 1764 1870 288 1678 1827 1857 188 1227 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 Pijls F W G 747 1168 Pillsbury A F 56 258 443 450 1539 Pineapple | 471 56 540 742 864 743 744 45 745 877 18 157 53 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands 717 750 | ldboar ct (Ita ct (U 89 764 | rd plow ly) S) 1763 | 913 75; 1736 1624 444 1279 748 1764 1870 288 1678 1827 1857 188 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 Pijls F W G 747 1168 Pillsbury A F 56 258 443 450 1539 Pineapple Pipe drainage | 471 56 540 742 864 743 744 45 745 877 18 157 53 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands 717 750 1251 1697 1728 1735 | 89 764 1698 | rd plow ly) S) 1763 120 802 1701 | 913 75; 1736 1624 444 1279 748 1764 1870 288 1678 1827 1857 1857 1723 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 Pijls F W G 747 1168 Pillsbury A F 56 258 443 450 1539 Pineapple | 471 56 540 742 864 743 744 45 745 877 18 157 53 1538 406 1482 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poe E J Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands 717 750 1251 1697 1728 1735 1784 | 89 764 1698 | rd plow ly) S) 1763 120 802 1701 | 913 75; 1736 1624 444 4279 748 1764 1870 288 1678 1827 1857 1857 1723 1755 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 Pijls F W G 747 1168 Pillsbury A F 56 258 443 450 1539 Pineapple Pipe drainage Australia | 471 56 540 742 864 743 744 45 745 877 18 157 53 1538 406 1482 1287 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Pocomoke proje Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands 717 750 1251 1697 1728 1735 1784 Sierra Leona Pole drains Polesje Swamps | 89 764 1698 1743 | 1763 120 802 1701 1752 446 S R) | 913 75; 1736 1624 444 1279 748 1764 1870 288 1678 1827 1723 1755 90 783 1767 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 Pigls F W G 747 1168 Pillsbury A F 56 258 443 450 1539 Pineapple Pipe drainage Australia Austria costs Germany | 471 56 540 742 864 743 744 45 745 877 18 157 53 1538 406 1482 1287 1061 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Poce E J Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands 717 750 1251 1697 1728 1735 1784 Sierra Leona Pole drains Polesje Swamps Policies 318 | 89 764 1698 1743 20 (US | 1763 120 802 1701 1752 | 913 75; 1736 1624 444 1279 748 1764 1870 288 1678 1827 1723 1755 90 783 1767 1645 |
| 451 1257 1278 Peterson H B Peterson R K Peterson S F Pettersson B Philippines Phillips F A Phipps L J Phosphates 43 Piatin M V Pichler J 746 Pickels G W Pierce R S Piezometers 36 48 55 258 442 Pijls F W G 747 1168 Pillsbury A F 56 258 443 450 1539 Pineapple Pipe drainage Australia Austria costs | 471 56 540 742 864 743 744 45 745 877 18 157 53 1538 406 1482 1287 1061 | USSR SEE ALSO Mol Mole plows Po Valley proje Pocomoke proje Pocomoke proje Poebing O Poiree Poiree M Polak B Poland J F Polders Brit Guiana Gt Brit Japan Netherlands 717 750 1251 1697 1728 1735 1784 Sierra Leona Pole drains Polesje Swamps | 89 764 1698 1743 20 (US | 1763 120 802 1701 1752 446 S R) | 913 75; 1736 1624 444 1279 748 1764 1870 288 1678 1827 1723 1755 90 783 1767 |

| | | Ttom | | | | Thomas |
|--------------------------------|-------|---------------------|------------------------------|-------|-------|--------------|
| Pontine Marshes (Ital | v) | <u>Item</u> 1706 | ProgramsCon | nt | | Item |
| 1719 1776 1779 | 3) | 1100 | Washington | | | 1580 |
| Portugal 598 | 739 | 1738 | Wisconsin | | | 1630 |
| Post F A | | 92 | Yugoslavia | | | 1732 |
| Potatoes | | 1241 | Puerto Rico | 396 | 903 | 918 |
| Pothole drainage | 844 | | 966 967 | 1570 | 1612 | 1672 |
| Potter W D 54 | 263 | - 265 | Pump drainage | 7 | 408 | 694 |
| Powell T | | 1842 | 759 1293 | | | |
| Powers G E | - 40 | 601 | alluvial soils | | 662 | 1623 |
| Powers W L 445 | | | Australia | | | 425 |
| Pozo Rodriguez P del | L | 1682 | bogs and swam | ıps | | 1044 |
| Pratelli G Price M | | 158 603 | Canada | | | 1244 |
| Price M | | 906 | Denmark Gt Brit | | 8 | 1261 1794 |
| Price W A | | 159 | India | | 0 | 1299 |
| Programs 5 16 | 22 | 24 | Israel | | | 1854 |
| | 1487 | | New Jersey | 1262 | 1274 | 1298 |
| | 1616 | | Oregon | | | 1623 |
| 1628 1634-1640 | 1646 | 1651 | Southeastern | State | s | 1294 |
| 1653 1654 1657 | | | British Guiana | | | 1678 |
| California 593 | 608 | 1581 | costs | | | 1257 |
| 1625 | | | Australia | | | 1287 |
| Canada | | 1658 | New Jersey | | | 1274 |
| Corn Belt | | 1655 | Ontario | | 4.000 | 1289 |
| Costa Rica | | 1671 | Denmark | | 1692 | 1693 |
| Delaware | 1750 | 1615 | Egypt | | | 1839 |
| Estonia | 1758 | 1769 1771 | Florida France | | | 1242 1712 |
| Germany Gt Brit 1529 1530 | | | Gt Brit | 1990 | 1300 | 1827 |
| 1800 1822 1826 | 1639 | 1199 | handbooks | 1200 | 1300 | 1301 |
| Great Lakes States | | 1655 | history | | | 1001 |
| Great Plains | | 1655 | Gt Brit | | | 1806 |
| Ireland 1810 | 1824 | | India | | | 1858 |
| Louisiana | | 1605 | Indiana | | | 1252 |
| Manitoba | | 1660 | irrigated soils | | 453 | 471 |
| Maryland 1584 | 1592 | 1593 | California | | 482 | 1302 |
| 1621 | | | India | | | 467 |
| Midwestern States | 4500 | 1611 | Puerto Rico | | 405 | 1672 |
| Mississippi | 1598 | | Utah | | 407 | 409 1711 |
| Mississippi Delta 1643 1655 | 1603 | 1604 | Italy Netherlands | 902 | 1251 | 1698 |
| Netherlands | | 1714 | 1757 | 002 | 1231 | 1090 |
| New Mexico | | 1573 | New Zealand | | 9 | 662 |
| New Zealand | 1865 | 1868 | Norway | | ŭ | 1265 |
| North Dakota | | 1614 | Oregon | | | 1623 |
| Northeastern States | | 1655 | Pakistan | | | 1858 |
| Norway | | 1775 | peat and muck | soils | 1252 | 1300 |
| Pacific Northwest | | 1655 | research | | | |
| Pennsylvania | | 1602 | Utah | | 410 | 1257 |
| Puerto Rico | 0.5.4 | 1612 | Rumania | ., | 401 | 1279 |
| South Carolina | 354 | 1610 | saline-alkali so 429 1277 | oils | 401 | 417 |
| Southeastern States Texas | 1010 | 1655 | Switzerland | | | 1281 |
| USSR | | 1756 | Turkey | | | 1264 |
| Utah | 435 | 1619 | USSR | | | 706 |
| Virginia | 200 | 1589 | Utah 410 | 686 | 1257 | 1277 |
| Wales 1529 | 1530 | | Pumping plants | 18 | 1292 | 1293 |
| | | | 1297 | | | |

| | <u>Item</u> | <u>Item</u> |
|---|--|--|
| Pumping plantsCont. | | PumpsCont. |
| California | 1223 | selection 1293 |
| design | 1275 | sizes 1286 |
| diesel | 1250 | steam 1271 1282 1806 |
| | 8 1587 | testing 1270 |
| France | 1739 | turbine 1235 1295 1301 |
| Gt Brit 1232 1234 128 | 5 1291 | vertical 1235 1293 |
| 1300 1816 | 4.04 | SEE ALSO Windmills |
| Illinois | 1231 | Purcell M R 1655 |
| Italy | 1776 | Pusic B 1732 |
| maintenance | 1587 | Puustjarvi V 524 |
| Netherlands 1228 125 | | 0 1 049 005 004 1000 |
| Puerto Rico | 1672 | Quebec 342 625 634 1088 |
| Switzerland Texas 123 | 1281 | 1210 1441 |
| | | Quicksand 644 1056 |
| Pumps 7 77 Australia 44 | | Do - D 440 |
| axial-flow 1228 123 | | Rae R |
| 1293-1295 1298 130 | | Raggio J L 19 Rague Botev F 1433 |
| California | 483 | |
| | 4 1272 | Rainey M B 604 Rainfall and runoff compilations |
| | 3-1295 | Appalachian region 200 |
| 1301 1806 | 31293 | Iowa 264 270 |
| costs 123 | 4 1268 | Kansas 212 |
| Denmark 64 | | |
| diesel 1230 1238 124 | 3 1245 | North Carolina 226 265 |
| 1249 1251 1271 128 | | Oklahoma 272 |
| costs 1237 124 | | Pacific Northwest 228 |
| discharge 125 | | Texas 240 308 |
| 2120112180 | | |
| electric 1239 1240 125 | 1 1252 | Upper Mississippi Valley 227 |
| electric 1239 1240 125 1267 1299 1806 | 1 1252 | Upper Mississippi Valley 227 Washington 263 |
| 1267 1299 1806 | • | Washington 263 |
| 1267 1299 1806 costs | 1268 | Washington 263 Rakover Y 879 |
| 1267 1299 1806 costs installation | 1268 1268 | Washington 263 |
| 1267 1299 1806 costs installation Florida 64 | 1268 1268 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 |
| 1267 1299 1806 costs installation | 1268 1268 1268 8 677 1236 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 | 1268 1268 8 677 1236 4 1239 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 | 1268 1268 8 677 1236 4 1239 5 1280 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 256 Rao K M G 20 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 6 1276 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 256 Rao K M G 20 Rapp J R 266 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 | 1268 1268 8 677 1236 4 1239 5 1280 11 1806 1290 6 1276 9 1260 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 256 Rant Z S E 256 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 256 Rantz S E 256 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 1249 India Indiana | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 256 Rantz S E 256 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 1249 India Indiana installation 1260 | 1268 1268 1268 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1299 1252 1287 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rantz S E 256 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 1266 | 1268 1268 1268 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 3 1287 1245 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rantz S E 256 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 1266 Louisiana maintenance | 1268 1268 1268 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 3 1287 1245 601 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rantz S E 256 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experi- |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124' India Indiana installation 1266 Louisiana maintenance Missouri 123 | 1268 1268 1268 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 8 1287 1245 601 7 1248 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rap SEE Grasslands 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 1266 Louisiana maintenance Missouri 123 mixed-flow 1293—1298 | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 1287 1245 601 7 1248 5 1301 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rap J R 266 Ras M G 20 Rapp J R 266 Ras mussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 126 Louisiana maintenance Missouri 123 Netherlands 1228 125 | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 1287 1245 601 7 1248 5 1301 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands Rantz S E 256 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 126 Louisiana maintenance Missouri 123 mixed-flow 1293—1291 Netherlands 1228 125 | 1268 1268 677 1236 4 1239 5 1280 11 1806 1290 1276 9 1260 1299 1252 3 1287 1245 601 7 1248 5 1301 1 1271 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rantz S E 256 Rao K M G 20 Rapp J R 266 Ras mussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 Ree W O 883 987 988 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 126 Louisiana maintenance Missouri 1233—1291 Netherlands 1228 125 1697 New Jersey 601 609 | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 1287 1245 601 7 1248 5 1301 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rantz S E 256 Rao K M G 20 Rapp J R 266 Ras mussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 Ree W O 883 987 988 Reed I F 47 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 1266 Louisiana maintenance Missouri 123 mixed-flow 1293—1298 Netherlands 1228 125 1697 New Jersey 601 609 1298 | 1268 1268 1268 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 3 1287 1245 601 7 1248 5 1301 1 1271 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rantz S E 256 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 Ree W O 883 987 988 Reed I F 47 Reed drains 788 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 126 Louisiana maintenance Missouri 123 mixed-flow 1293—1298 New Jersey 601 609 1298 New Zealand | 1268 1268 1268 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1295 2 1287 1245 601 7 1248 5 1301 1 1271 1262 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Raps J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 Ree W O 883 987 988 Reed I F 47 Reed drains 788 Reedy J 1766 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 126 Louisiana maintenance Missouri 123 mixed-flow 1293—129 Netherlands 1228 125 1697 New Jersey 601 609 1298 New Zealand Ohio 126 | 1268 1268 1268 1268 677 1236 4 1239 5 1280 1 1806 1290 1299 1260 1299 1245 601 7 1248 5 1301 1 1271 1262 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 20 Ranges SEE Grasslands 20 Rap J R 266 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 Ree W O 883 987 988 Reed I F 47 Reed drains 788 Reedy J 1766 Reeve R C 28 46 55 56 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 126 Louisiana maintenance Missouri 123 mixed-flow 1293—1298 New Jersey 601 609 1298 New Zealand Ohio 126 | 1268 1268 1268 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 3 1287 1245 601 7 1248 5 1301 1 1271 1262 1288 1886 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Rap J R 266 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 Ree W O 883 987 988 Reed I F 47 Reed drains 788 Reedy J 1766 Reeve R C 28 46 55 410 447-451 1277 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 126 Louisiana maintenance Missouri 123 mixed-flow 1293—1298 New Jersey 1298 New Jersey 601 609 1298 New Zealand Ohio 1266 oil Ontario | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 8 1287 1245 601 7 1248 5 1301 1 1271 1262 1286 7 1288 1806 1266 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Raps J R 266 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 Ree W O 883 987 988 Reed I F 47 Reed drains 788 Reedy J 1766 Reeve R C 28 46 55 410 447-451 1277 Regel C 1767 |
| 1267 1299 1806 costs installation Florida 64 gasoline Gt Brit 1222 123 1240 1241 1243 125 1282 1285 1797 180 helical Hungary 1254 125 Illinois 1230 1238 124 India Indiana installation 126 Louisiana maintenance Missouri 123 mixed-flow 1293—1298 New Jersey 601 609 1298 New Zealand Ohio 126 | 1268 1268 8 677 1236 4 1239 5 1280 1 1806 1290 6 1276 9 1260 1299 1252 8 1287 1245 601 7 1248 5 1301 1 1271 1262 1286 7 1288 1806 1266 | Washington 263 Rakover Y 879 Ramalingham A V 1861 1862 Ramsauer B 1171 1541 Ramser C E 880-882 984 985 985 Ranges SEE Grasslands 20 Raps J R 266 Rao K M G 20 Rapp J R 266 Rasmussen P B 751 Ray C M 986 Rea D H 923 Reclamation Act of 1939 347 Rector N H 605 Red Plains Conservation Experiment Station (Okla) 272 Red River Valley of the North 1574 Ree W O 883 987 988 Reed I F 47 Reed drains 788 Reedy J 1766 Reeve R C 28 46 55 410 447-451 1277 Regel C 1767 |

| Danut I D | | | Item 1827 | | | Item |
|----------------------------|-------|---------|--------------|----------------------------------|---------|--------------|
| Rempt J D Research 28 | 30 | 33. | - 65 | Rogers H | | 457 |
| 727 | 50 | 00 | 00 | Romero M Rondeau L | | 458 755 |
| Brazil | | | 728 | Rorden J W | | 885 |
| California | | | 756 | Rose L E | | 104 |
| Denmark | | 34 | 59 | Rose N A | | 306 |
| Louisiana | | | 1548 | Rosenhead L | | 84 |
| needs | | 58 | 1470 33 | Rosenthal E J B van | | 1768 |
| New York Utah | 442 | 449 | 686 | Ross P E | 1510 | 372 |
| Virginia | 772 | 110 | 64 | Rost C O Rostovtsev M I | 1519 | 1520 |
| SEE ALSO UN | DER s | specifi | | Roth W J | | 1769 343 |
| subjects | | | | Rounds M B | | 1536 |
| Reshetkina N | | | 1173 | | 1494 | 1518 |
| Rhode Island | | | 603 | Rowlette M | | 1828 |
| Rhodesia 416 | 636 | 753 | 830 | Roy P E | | 1441 |
| 1329 1484 | | | 1540 | Rubidoux Laboratory | | |
| Rice Brazil | | 441 | 1676 | Regional Salinity La | iborato | ry |
| Ceylon | | 771 | 1561 | (Riverside, Calif) | | 1460 |
| Fiji Islands | | | 1869 | Rudich S I Rule G K | | 1460 1576 |
| Japan | | | 1857 | Rumania | | 1279 |
| Louisiana | | | 941 | Runoff 7 74 78 | 92 | 105 |
| Madagascar | | | 1843 | 106 126 128 | 129 | |
| Senegal | | | 1841 | 145 153 174 | | 733 |
| Richards E V | 57 | 160 | 1863 161 | 859 882 888 | | 000 |
| Richards L A 453 | 31 | 100 | 101 | California | 291 | 292 |
| Richards S J | | | 127 | Corn Belt Mexico | | 175 132 |
| Richardson H W | r | | 1438 | Missouri | | 631 |
| Richter R C | | | 1223 | rates | 858 | 892 |
| Riddolls A W | | 1174 | 1175 | Delaware | 000 | 109 |
| Ridiger V | 1170 | 1176 | 1177 | Maryland | | 109 |
| Ridiger V R | 1178 | 1439 | 1440 185 | New Jersey | | 109 |
| Riecken F F Riedel D | | | 752 | records | | 54 |
| Riegel R M | | | 1312 | research | | 708 845 |
| Riggs H C | | | 256 | South Australia Texas 190 202 | 217 | 867 |
| Rinehart J C | | | 884 | USSR | 211 | 1031 |
| Rio Grande Dra | inage | | ct | SEE ALSO Rainfall | and ru | |
| (Colo) | | 370 | | compilations | | |
| Rivers | | 951 | 1824 989 | Russell E W | | 163 |
| Roach H L Roads 487 | 741 | 931 | 950 | Russell M B 161 | 164 | 527 |
| Roads 487 1131 1192 | 111 | 501 | 500 | 1544 | | 105.0 |
| Robbins C | | | 1218 | Ruth P W Ryan D M | | 1626 1286 |
| Roberts J A | | 342 | 1315 | Ryan D W | | 1200 |
| Roberts R H | | | 753 | Sabinskii G B | | 1442 |
| Robertson I M | | 521 | 522 | Sahara Desert | | 1842 |
| Robertson J L | | | 607 | Sahni P N | | 165 |
| Robins J S | | | 454 138 | St Albans M | | 1666 |
| Robinson B Robinson C W | | | 362 | Saline-alkali soils | 67 | 86 |
| Robinson E C | | | 1625 | 91 378 379 401— 402 412 | | 400 |
| Robinson T W | | 259 | 260 | 401— 402 412 418 419 429 | | 460 |
| Roe H B 21 | 455 | 525 | 526 | 461 466 479 | 100 | 100 |
| 724 1283 | 1284 | 1542 | 1543 | Australia 377 | 405 | 469 |
| Rogers F | | | 456 | California361 406 | | 468 |
| | | | | | | |

| | | | Item | | | | Item |
|---------------------------|---------|-------|--------------|-----------------------------|--------|------|--------------|
| Saline-alkali so | oilsC | ont. | | Schofield R K | | | 154 |
| Colorado Rive | er Basi | in | 362 | Schoklitsch A | | | 759 |
| 465 | | | 4=0= | Schroeder E W | | | 1446 |
| Florida | | | 1537 | Schroeder G | | | 1182 |
| France | cco | 1705 | 1689 1830 | Schukall G | | | 1770 |
| Gt Brit 80 | 669 | 1795 | | Schuylenborgh J | | 1110 | 796 |
| India | | 69 | 1858 1690 | Schwab G O 7 1184 | 100 | 1119 | 1183 |
| Italy Montana | | | 388 | Schwarz K | | 761 | 1771 |
| Netherlands | 72 | 623 | 676 | Schweicher F | | 101 | 762 |
| 902 1700 | | 020 | 010 | Scoates D | | | 2 |
| Nevada | 2120 | | 427 | Scobey F C | | | 990 |
| New Jersey | | | 606 | Scofield C S | 167 | 418 | 459 |
| New Mexico | | | 459 | 460-462 | 472 | | |
| New Zealand | | | 1867 | Scoops 609 | 1330 | 1344 | 1456 |
| Pakistan | | 470 | 1858 | Scotland 43 | 44 | 334 | 510 |
| permeability | | | 394 | 516 521 | | 647 | 665 |
| research | | | | 1367 1426 | 1805 | 1820 | 4440 |
| USSR | 440 | 451 | 51 | Scott D F | | 1447 | 1448 |
| Utah 448 | 449 | 451 | 477 | Scott H A | | | 1627 |
| 1277 | | | 416 | Scranton L L | | 1965 | 744 |
| Rhodesia Senegal | | | 1841 | Scrapers | | 1365 | 1456 1185 |
| Texas 372 | 373 | 431 | 459 | Searle K D | 577 | 626 | 1801 |
| Tonga | 010 | 101 | 1873 | Seawalls Sedimentation | 25 | 104 | 812 |
| USSR 374 | 464 | 500 | 912 | 862 924 | | 101 | 012 |
| 1173 1177 | | | | in canals and o | | 385 | 556 |
| Washington | | | 421 | 587 589 | 949 | 956 | 985 |
| Western State | es | | 432 | 1374 | | | |
| Wyoming | | 387 | 388 | Seepage 67 | 188 | 754 | 764 |
| Saloheimo L | | 528 | 1545 | 1108 | | | |
| Salter R M | 58 | 1546 | 1547 | into drains | 70 | 121- | |
| Salwen N | | 563 | 564 | of irrigation w | | 46 | |
| Salzmann R | | | 705 | 379 380 | 382 | 385 | 468 |
| Sammis R H | | | 1443 | 1302 | 0.5 | 105 | 270 |
| Sand drains | | | 600 713 | research 46 | 85 | 125 | 379 1186 |
| Sand traps Sandy soils | 140 | 594 | 978 | Seidemann J Selby W E | | | 991 |
| 1027 | 140 | 994 | 310 | Semple W J | | | 992 |
| Netherlands | 143 | 764 | 1216 | Semple w 5 | | | 168 |
| research | 110 | .01 | 144 | Senegal | | | 1841 |
| Gt Brit | | | 101 | Senegal Delta p | roiect | | 1841 |
| Santalin K V | | | 565 | Serdechnyi A | - J | | 1345 |
| Sardo Q | | | 886 | Setinsky V | | | 763 |
| Saskatchewan | 342 | 437 | 1659 | Settling basins | | 826 | 924 |
| Saveson I L | 756 | 887 | 893 | Severson H | | | 529 |
| 1179 1444 | | | 004 | Shafer F F 530 | 1187 | 1623 | 1629 |
| Sayre A N | 267- | - 269 | 304 | Shafer G E | | | 1188 |
| Schagen F van | | | 757 | Shannon W L | | | 1312 |
| Scharz K | | | 1694 1549 | Sharma K R | | | 463 |
| Scherotzki Schiff L | | | 888 | Sharpe C F S | | | 993 889 |
| Schildnecht H | | 758 | 1180 | Shaumiàn V A Shearer M N | | | 1449 |
| Schlaudt E A | | 166 | 566 | Shelaev A | | | 464 |
| Schlick W J | | | 1207 | Sheridan C M | | | 1630 |
| Schmitt E A | | | 1181 | Sherman L K | | | 1323 |
| Schnittger H G | | | 1445 | Shipman R C | | | 1450 |
| Schoenleber L | H | | 270 | Shoji H | | 1189 | 1411 |
| | | | | | | | |

| | Thoma | | , | TA |
|-----------------------------|---------------------|------------------------|--|-------------|
| Showell I I | <u>Item</u> 1287 | Smith N M | | tem |
| Showell J L Shrag V I 39 | 1316 | Smith N M Smith R M | 110 | 1871 903 |
| Shrag V I 39 Shulits S | 759 | Smits H | | 696 |
| Sieben W H | 764 | Smits J | | 1552 |
| Sierra Leone | 90 | Snohomish County (Wa | | |
| Silt SEE Sedimentation | 90 | Utility District 1 | .SII) Pu | 252 |
| Silt basins 652 | 664 | Snow B F | | 345 |
| Silty soils 1058 1143 | 1224 | Snowy Mountain Hydro | -elect | |
| Silvester R | 994 | Scheme (Australia) | | 1872 |
| Simpson H E | 271 | Snyder C G | | 1147 |
| Sine L | 663 | Snyder J H | 275- | |
| Singh R | 1864 | Sod drains | -10 | - 8 |
| Singleton J R | 1550 | Sogamoso Valley proje | ect (Co | |
| Siphons 1004 | | bia) | 000 (00 | 1682 |
| Sipkes C | 995 | Soil borings 32 | 48 | 60 |
| Sisson D R | 1190 | 96 180 376 | | |
| Situation and outlook 1504 | | equipment 390 | 1357 | 1381 |
| 1640 | | for tile drainage | | 1164 |
| Egypt | 645 | Soil conservation 3 | 12 | 73 |
| Finland | 1112 | 74 78 117 | 173 | 617 |
| Gt Brit 17 | 734 | 779 823 985 | | 1577 |
| Midwestern States | 674 | 1638 | | |
| Mississippi Delta | 1604 | Florida | | 1579 |
| Sweden | 715 | Gulf States | | 142 |
| Washington | 639 | Mexico | | 876 |
| Siviero G | 1699 | Nyasaland | | 1844 |
| Skepper A H | 1551 | Utah | | 413 |
| Skerrett R G | 1631 | Soil conservation dist | ricts | 22 |
| Sklerius P TS | 1772 | 1470 1633 1648 | | |
| Skoropanov S G | 531 | Maryland | | 1593 |
| Skov K S | 59 | Mississippi Valley | | 1628 |
| Slab drains 769 | 770 | Soil moisture measur | | 40 |
| Slater C S 31 | 1191 | 129 170 620 | | |
| Slosser J W | 272 | Soil temperature 82 | 95 | 700 |
| Sluices | 4 = 4 0 | Finland | 545 | 1508 |
| Denmark 649 | | Netherlands | | 1217 |
| Gt Brit 626 928 1232 | 1814 | New York | 1977 | 102 |
| Netherlands 1697 | 1701 | Soil tension 47 57 | $\begin{array}{c} 127 \\ 21 \end{array}$ | 135 |
| Nigeria | 577 | Soils 7 | 162 | 759 171 |
| Texas | 1233 | analysis | 102 | 425 |
| Sluis P M van der 765 | 766 | Australia | | 899 |
| Smale A H Small C J | 767 1317 | British West Indies | 99 | 113 |
| Small farms and gardens | 622 | characteristics 95 | 99 | 110 |
| 679 | 022 | drainability 2 107 | 152 | 1205 |
| Denmark | 736 | 1594 | 102 | 1200 |
| Germany | 638 | India | | 438 |
| Gt Brit 1068 | 1072 | South Carolina | | 166 |
| Netherlands 1515 | 1785 | for mole drainage | | 1153 |
| USSR | 1427 | Australia | | 1195 |
| Smit A | 768 | Austria | | 1171 |
| Smith C A | 60 | Gt Brit | 76 | 151 |
| Smith D D 169 890—892 | 1318 | New Zealand | 1101 | 1174 |
| Smith E A | 608 | for open-ditch drain | | |
| Smith E G | 769 | Gt Brit | | 108 |
| Smith G E P 273 274 | 316 | for pump drainage. | 407 | 1242 |
| 344 | | for terracing | 185 | 187 |
| Smith G-H | 16 | for tile drainage | 97 | 1027 |
| Smith L J | 1319 | | | |
| | | | | |

| | <u>Item</u> | I | tem |
|--------------------------|-------------|--|--------------|
| SoilsCont. | | Sopp C W | 206 |
| for tile drainageCont. | 1800 | | 1872 |
| Chile 1187 | | South G P | 411 |
| Chile Gt Brit | 1083 108 | South Carolina 166 354 | 486 |
| Illinois | 176 | 543 646 820 827 882 891 1610 1633 | 881 |
| Iowa | 185 | | 2200 |
| Gt Brit 112 | | South Maroochy Swamp Drain Scheme (Australia) | 1871 |
| India | 20 | South River (Mo) Drainage D | |
| Netherlands 178 188 | | trict 1237 1 | |
| New Zealand | 1101 | Southeastern States 296 | 486 |
| Pennsylvania | 66 | | 1610 |
| permeability 68 79 | 110 | 1655 | |
| 113 119 120 124 | | Southern States 566 880 | 906 |
| 177 182 229 365 | 378 | 1294 1506 1570 | |
| 394 1199 | | Southwell P H | 772 |
| Coastal Plains | 31 | Southwestern States | 203 |
| determination 32 36 | 96 | | 554 |
| 173 1205 1211 Gt Brit | 110 | | 722 |
| Illinois 118 | 112 176 | | 1192 1320 |
| Iowa | 185 | | 290 |
| measurement 33 48 | | Speir W H 1 Spillways 375 831 859 | 860 |
| 75 180 | 00 | 1666 | 000 |
| research 88 98 | 131 | | 130 |
| 148 153 381 1543 | | | 1829 |
| porosity 47 107 119 | | Staf C | 773 |
| profiles 81 153 425 | 696 | Stafford H M 278 | 466 |
| 1101 | | Stampe W | 467 |
| research 87 100 131 | 160 | Stampfli A | 996 |
| 454 1521 | | Standen J H | 774 |
| British Columbia | 184 | | 1453 |
| Gt Brit 154 | 155 | Stauber H | 775 |
| Iowa 161 | 185 | Stauffer R S | 175 |
| Minnesota | 1543 | Stearns H T 279- | |
| Missouri | 186 | Stearns L A 61 | 83 |
| Netherlands Ohio 92 | 111 148 | Steelant L | 776 96 |
| Ohio 92 Scotland | 43 | Steele F 88 Steele J G | 110 |
| Virginia | 88 | | 289 |
| Wisconsin | 103 | Stein C 1193 1 | 194 |
| surveys 108 405 437 | 1264 | | 632 |
| types 93 110 124 | 160 | | 290 |
| 472 916 | | | 673 |
| Australia 172 | 474 | Stevens C P 997 | 998 |
| Gt Brit | 641 | Steward C D | 409 |
| Illinois | 118 | Steward W G 280 | 281 |
| Mississippi Delta | 495 | Stewart C E | 392 |
| New Zealand | 699 | | 185 |
| Sweden | 961 | Stewart K V | 893 |
| Utah Washington | 395 639 | Stipp A C | 345 |
| Wisconsin | 147 | | 454 |
| USSR | 39 | | 418 282 |
| Western States 38 | 159 | Stokes W L Stolp D W | 62 |
| SEE ALSO kinds of soils | 100 | Stone E L | 567 |
| Sokolovskii D L | 771 | Stone drains | 501 |
| Solomon Islands | 1866 | Australia | 770 |
| Somerset Moors (Gt Brit) | 1813 | California | 476 |
| | | | |

| | | Item | | | Item |
|-----------------------------|--------|--------------|---------------------------------|-------------|-------------|
| Stone drainsCont. | 0.40 | 1000 | Subsurface drainage | | |
| Denmark Ct Brit | 649 | 1693 1084 | peat and muck soils | 519 | 521 |
| Gt Brit India | 20 | | 538 539 research | 33 | 1545 |
| New Zealand | 20 | 769 | Sweden | 55 | 1016 |
| Tasmania | | 785 | Turkestan | | 1137 |
| USSR | | 706 | types | 695 | 779 |
| Stony soils | | 33 | USSR | | 565 |
| Storm drains 37 | | 830 | Yugoslavia | | 1732 |
| 897 1844 1855 | 2 | 894 | SEE ALSO kinds of s | subsui | riace |
| Story C G Straatmans W | | 1873 | drainage Subsurface drains | | 644 |
| Strashnikov S N | | 777 | construction | 791 | 1129 |
| Straub L G | | 759 | depth 386 1013 | | 1137 |
| Streams and brooks | 643 | 1824 | durability | | 788 |
| Stringer N E | | 1195 | installation | | 1673 |
| Stripcropping 169 | | 888 | location | 1013 | 1016 |
| Structures 24 668 | 3 772 | 1323 | maintenance | 1016 | 1016 |
| 1618 | 858 | 933 | spacing 386 528 types | 1016 364 | 1137 671 |
| design Gt Brit | 030 | 1801 | SEE ALSO kinds of s | | |
| handbooks 635 | 649 | 759 | drains | Jubbus | ilacc |
| Indo-China | | 1304 | Sudan | | 1 |
| Mexico | | 1200 | Sugar beets 409 | 503 | 1527 |
| Oklahoma | | 862 | Sugarcane | | 1554 |
| Western States | | 38 | Australia | | 894 359 |
| SEE ALSO kinds of | struct | | Brazil | | 756 |
| Stylianidis K Subkov A I | | 1773 533 | California Colombia | | 458 |
| Subsidies | | 1488 | Cuba | 1476 | 1477 |
| Subsurface drainage | 2 | 6 | Louisiana 887 | 1179 | 1548 |
| 18 21 113 | _ | | Natal | | 620 |
| Australia 364 425 | | 664 | Puerto Rico 396 | 966 | 967 |
| 668 727 1196 | 3 1523 | 1540 | 1672 | | 000 |
| British Columbia | | 184 | Trinidad | | 898 1264 |
| Ceylon costs | | 1561 788 | Turkey Union of South Afric | 2 | 1167 |
| Cuba | | 799 | Venezuela | а | 774 |
| design | | 7 | Zululand | | 620 |
| Egypt | | 1067 | Sulzer Brothers | | 1291 |
| Estonia | | 1125 | Sump and bore draina | | 1021 |
| Finland 3 | 698 | 1545 | | 1229 | 1286 |
| Florida | -1 507 | 488 | Supplemental drainage | e 678 | 1198 619 |
| for mosquito contr 1668 | 01 597 | 605 | Surface drainage 632 664 668 | 727 | 740 |
| forests | | 565 | 819 885 893 | 1198 | 1523 |
| France 1712 | 2 1740 | 1741 | Australia 425 440 | 678 | 809 |
| Gt Brit 633 | 641 | 1084 | bogs and swamps | 611 | 852 |
| India | | 20 | 1261 | | 4=04 |
| irrigated soils | 386 | 444 | Ceylon | | 1561 |
| Italy | | 788 | costs | | 887 |
| Japan New Japan | | 1189 | Louisiana Cuba | | 799 |
| New Jersey New Zealand | | 693 783 | Denmark | | 1261 |
| Nicaragua | 1668 | 1673 | Egypt | | 1067 |
| Norway | 1000 | 1496 | for mosquito control | 597 | 611 |
| Ontario | | 1062 | France | | 1740 |
| Oregon | | 1129 | Gt Brit | 641 | 951 |
| | | | | | |

| Hungary 118 | | <u>Item</u> | | | | Item |
|--|---------------------------|-------------|----------------|--------|--------|------|
| Illinois | Surface drainageCont. | 077 | | en fo | r Mas | |
| India | | | | | 544 | |
| Israel | | | Switzerland | | | |
| Haly | | | | | | |
| Semant S | | | | | | 1097 |
| Manitoba 1660 Midwestern States 817 Mississippi 1660 Midwestern States Syndicat Intercommunal des Eaux du Val d'Azergues Mississippi 1608 Metherlands 857 New Zealand 711 712 814 Ontario 857 Syria 1848 Systems 668 Ges Syria 670 Syria 1848 Systems 668 Ges Syria 670 Syria 670 Syria 1848 Systems 668 Ges Syria 670 Siria 67 | | | | 1100 | 1201 | 783 |
| Mississippi 1608 Netherlands 1608 Netherlands 171 12 814 Ontario Ontario Ordinards 1539 peat and muck soils 738 research Georgia 42 Puerto Rico 966 small farms and gardens 679 South Carolina 820 Texas 790 types 695 779 U S R SEE ALSO kinds of surface drainage Surface inlets 1073 1114 1164 1175 1197 1209 Surinam 1677 1681 1714 Surveys and surveying 689 907 Australia 364 10wa 1132 Minnesota 901 Mississippi 1608 New Zealand 907 Texas 790 1606 Sutton J G 22 778 - 782 999 1000 1197 - 1199 1292 - 1295 Suxman L de 1774 Swamp Land Act of 1850 (U S) 1649 Swamp Land Act of 1850 (U S) 649 Swamp Land Act of 1850 (U S) 649 Swamp SEE Bogs and swamps Sweden 493 513 548 553 554 633 564 659 715 742 919 943 954 955 961 1014 1016 1017 1050 1063 1074 1076 1077 1110 1219 1326 1330 1378 1391 1424 1425 1432 1445 1455 1473 1485 1495 1686 1687 Western States 380 1636 U S R Western States 380 1636 U S R Western States 380 1636 U S R Western States 380 U S R U S S R U S S R U S S R U S S R U S S R U S S R U S S R U S S R U S S R U S S R U S S R U S S R U S S R U S S R U S A | | | | m miir | al des | |
| Mississippi 1608 (France) 1739 New Zealand 711 712 814 Syria 1848 Ontario 651 Systems [668 Ontario 653 Australia 425 440 Ocorpia 42 Balearic Islands 656 Georgia 42 Colombia 684 Puerto Rico 966 small farms and gardens 679 South Carolina 820 Texas 790 types 695 779 types 684 440 syria | Midwestern States | 817 | | | | |
| New Zealand 711 712 814 Systems 668 668 Contarto 651 Australia 425 440 668 Australia 425 440 668 Early Franchisco 656 Early 656 Early Franchisco 657 Franchisco 656 Early Franchisco 657 Franchisco 658 Franchisco 658 Franchisco 658 Franchisco 658 Franchisco 658 Franchisco 658 Franchisco 657 Franchisc | Mississippi | 1608 | / | | | 1739 |
| Ontario 651 Australia 425 440 orchards 1539 Balearic Islands 656 peat and muck soils 538 research 618 Balearic Islands 656 Georgia 42 Colombia 684 678 Puerto Rico 966 small farms and gardens 679 712 791 1619 Texas 790 types 695 779 695 779 712 791 1619 684 Texas 790 40 types 695 779 69 740 743 792 1165 1409 Surface drains 730 760 814 Malaya 480 6ermany 169 765 153 181 447 Malaya 480 447 Malaya 480 740 743 792 1165 149 New Zealand 712 791 1615 1179 169 New Zealand 712 781 1179 181 | | 857 | | | | |
| Decide a contract of the part of the par | | | Systems | | | 668 |
| Peat and muck soils 538 Fesearch Brazil 728 | | | | | 425 | |
| Tesearch | | | | ls | | |
| Georgia | <u> </u> | 538 | | | | |
| Puerto Rico 966 small farms and gardens 679 South Carolina 820 Texas 790 types 695 779 U.S.S.R. 706 SEE ALSO kinds of surface drainage Strace drains 730 760 814 SEE ALSO kinds of surface drains 1073 1114 1164 1175 1197 1209 Surinam 1677 1681 1714 Surveys and surveying 689 800 907 Australia 364 Iowa 1132 Minnesota 901 Mississippi 1608 New Zealand 780 Minesota 901 Mississippi 1608 New Zealand 780 Minesota 901 Mississispi 1608 New Zealand 780 Minesota 901 Mississippi 1608 New Zealand 780 Minesota 901 Mines | <u> </u> | 49 | | | | |
| Small farms and gardens 679 South Carolina 820 Texas 790 types 695 779 types 695 779 U S R 706 SEE ALSO kinds of surface drainage Surface drains 730 760 814 SEE ALSO kinds of surface drains Surface inlets 1073 1114 1164 1175 1197 1209 Surinam 1677 1681 1714 Surveys and surveying 689 800 907 Australia 364 Howa 1132 Minnesota 901 Mississippi 1608 New Zealand 901 Mississippi 1608 Sutton J G 22 778 - 782 999 1000 1197 - 1199 1292 - 1295 1553 1554 1633 - 1641 Swamps and Overflow Land Grant Act of 1850 (U S) 1649 Swamp Land Act of 1850 (U S) 1649 Swamp Land Act of 1850 (U S) 1649 Swamp Land Act of 1850 (U S) 1649 Swamp SEE Bogs and swamps Sweden 493 513 548 553 961 1014 1016 1017 1050 1063 1074 1076 1077 1110 1219 1326 1330 1378 1391 1424 1425 1432 1455 1473 1485 1495 1686 1687 Western States 380 1636 1616 Western States 380 1616 1616 Western States 380 | | | | 440 | 171 | |
| South Carolina Record Texas Te | | | | | 411 | 099 |
| Texas | | 2.12 | | | 471 | 684 |
| types 695 779 U S S R 706 US S R 706 US S R 706 US S R 706 SEE ALSO kinds of surface drainage | | | | | | |
| U S S R 706 SEE ALSO kinds of surface drainage 1694 Gt Brit 786 1159 1159 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1197 1209 1175 1175 1197 1209 1175 1175 1197 1209 1175 1175 1197 1209 1175 1 | types 695 | 779 | | | 1100 | |
| SEE ALSO kinds of surface drainage Surface drains 730 760 814 | | | Germany | | | |
| Surface drains 730 760 814 Malaya 480 SEE ALSO kinds of surface drains Malaya 480 Surface inlets 1073 1114 1164 New Zealand 712 Surface inlets 1073 1114 1164 Northeastern States 778 1175 1197 1209 Peru 807 Surveys and surveying 689 800 Southeastern States 789 480 Formal farms 480 Surveys and surveying 689 800 Southeastern States 486 Australia 364 Tasmania 785 Minnesota 901 Wirginia 64 88 New Zealand 901 Wirginia 64 88 New Zealand 901 Wirginia 64 88 New Zealand 901 Wirginia 64 88 Florida 1587 Gt Brit 806 Sutton J G 22 778 – 782 999 104a 104a S | | e | | | 786 | 1159 |
| SEE ALSO kinds of surface drains | | 044 | irrigated soil | S | 381 | |
| New Zealand 712 | | | | | | |
| Surface inlets 1073 1114 1164 Northeastern States 778 1175 1197 1209 Northeastern States 778 Surveys and surveying 689 800 small farms and gardens 109 Australia 364 Iowa 1132 Minnesota 901 Union of South Africa 1041 Mississippi 1608 Virginia 64 88 New Zealand 9 Florida 1587 64 88 Sutton J G 22 778 – 782 999 India 463 1000 1197 – 1199 1292 – 1295 India 463 10wa 1324 1ayout 440 463 1owa 1324 1ayout 440 468 689 780 688 689 780 688 689 780 688 689 780 688 689 780 688 689 780 689 780 689 780 689 780 689 780 689 7 | | e | | | | |
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| Surinam 1677 1681 1714 Peru 807 Surveys and surveying 689 800 Foru 807 Australia 364 Southeastern States 486 Iowa 1132 Union of South Africa 1041 Mississippi 1608 Virginia 64 88 New Zealand 9 Florida 1587 Texas 790 1606 Gt Brit 806 Sutton J G 22 778-782 999 India 463 1000 1197-1199 1292-1295 Iowa 1324 1553 1554 1633-1641 Iowa 1324 Swaan L de 1774 Swamp and Overflow Land Grant 689 780 Swamp SEE Bogs and swamps Gt Brit 669 798 Sweden 493 513 548 553 Sweden 493 513 548 553 Peru 807 Western 807 Western 1063 | | 1104 | | | - | |
| Surveys and surveying 689 800 small farms and gardens 109 Australia 364 Tasmania 785 Iowa 1132 Union of South Africa 1041 Minnesota 901 Utah 1619 Mississippi 1608 Virginia 64 88 New Zealand 9 Florida 1587 Texas 790 1606 Gt Brit 806 Sutton J G 22 778 – 782 999 India 463 1000 1197 –1199 1292 –1295 Iowa 1324 1553 1554 1633 –1641 Iowa 1324 Swadovsky E G 534 Iowa 1324 Swamp Land Act of 1850 (U S) 1649 Gt Brit 689 780 Swamps SEE Bogs and swamps Sweden 185 534 Mexico 1664 Nebraska 969 Oregon 749 Peru 807 104 101 101 101 101 101 | | 1714 | | Soll | S | |
| Southeastern States | | | | nd or | rdone | |
| Australia 364 Iowa 1132 Minnesota 901 Mississippi 1608 New Zealand 9 Texas 790 1606 Sutton J G 22 778-782 999 1553 1554 1633-1641 Svadovsky E G 534 Swaan L de 1774 Swamp and Overflow Land Grant Act of 1850 (U S) Swamps SEE Bogs and swamps Sweden 493 513 548 553 Sweden 493 513 548 553 Sweden 493 513 548 553 Peru 807 1063 1074 1076 1077 1110 1063 1074 1076 1077 1110 11219 1326 1330 1378 1391 1424 1425 1432 1454 1455 1424 1425 1432 1454 1455 1485 1495 1686 1687 Minion of South Africa 1041 Utah Virginia 64 88 Florida 1587 Gt Brit 806 India 463 Iowa 1324 Iayout maintenance and repair 688 India 834 Mexico 1664 Nebraska 969 Oregon 749 Peru 807 US A 399 Utah 1619 Missouri 631 New Zealand 699 712 Ivyes 738 801 1636 I US S R Western States | | | | | | |
| Iowa | Australia | 364 | | 50000 | • | |
| Mississippi 1608 Virginia 64 88 New Zealand 9 Texas 790 1606 Sutton J G 22 778—782 999 1000 1197—1199 1292—1295 1553 1554 1633—1641 Svadovsky E G 534 Swaan L de 1774 Swamp and Overflow Land Grant Act of 1850 (U S) 1649 Swamp Land Act of 1850 (U S) 311 Swamps SEE Bogs and swamps Sweden 493 513 548 553 Sweden 493 513 548 553 Peru 807 1063 1074 1076 1077 1110 1063 1074 1076 1077 1110 11063 1326 1330 1378 1391 1424 1425 1432 1454 1455 1427 1485 1495 1686 1687 Virginia 64 88 Florida 1587 Gt Brit 806 India 463 India 463 Iayout 440 maintenance and repair 688 Mexico 1664 Nebraska 969 Oregon 749 Peru 807 U S A 399 Utah 1619 Missouri 631 New Zealand 699 712 U S S R 616 U S S R Western States | | 1132 | | ı Afri | ca | |
| New Zealand 9 Florida 1587 Texas 790 1606 Gt Brit 806 Sutton J G 22 778 – 782 999 India 463 1000 1197—1199 1292—1295 Iowa 1324 1553 1554 1633—1641 Iowa 1324 Swadovsky E G 534 Iowa 1324 Swamp and Overflow Land Grant Act of 1850 (U S) Gt Brit 689 Swamp Land Act of 1850 (U S) 311 Mexico 1664 Swamps SEE Bogs and swamps Oregon 749 Sweden 493 513 548 553 Peru 807 Florida 1587 Mexico 1664 Nebraska 969 Oregon 749 Peru 807 US A 399 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 1424 1425 1432 1454 1455 US S R 616 1473 1485 1495 1686 168 | | | | | | 1619 |
| Texas 790 1606 Gt Brit 806 Sutton J G 22 778 – 782 999 India 463 1000 1197 –1199 1292 –1295 Iowa 1324 1553 1554 1633 –1641 Iowa 1324 Swaan L de 574 Swamp and Overflow Land Grant Act of 1850 (U S) 1649 Swamp Land Act of 1850 (U S) 311 Swamps SEE Bogs and swamps Sweden 493 513 548 553 Peru 807 554 563 564 659 715 US A 399 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 US S R 1473 1485 1495 1686 1687 Western States | | _ | Virginia | | 64 | 88 |
| Sutton J G 22 778—782 999 | | | | | | |
| 1000 1197—1199 1292—1295 | | _ : : : | | | | |
| 1553 1554 1633—1641 Svadovsky E G 534 Swaan L de 1774 Swamp and Overflow Land Grant Act of 1850 (U S) 1649 Swamp Land Act of 1850 (U S) 311 Swamps SEE Bogs and swamps Sweden 493 513 548 553 Sweden 493 513 548 553 Peru 807 554 563 564 659 715 Yes Peru 807 742 919 943 954 955 T42 919 943 954 955 T43 1063 1074 1076 1077 1110 T53 1063 1074 1076 1077 1110 T54 1076 1077 1110 T55 1076 1077 1110 T57 1076 1077 1110 T58 1076 1077 110 T58 1076 1077 1110 T5 | | | | | | |
| Svadovsky E G 534 maintenance and repair 688 Swaan L de 1774 689 780 Swaam and Overflow Land Grant Act of 1850 (U S) 1649 India 834 Swamp Land Act of 1850 (U S) Mexico 1664 Swamps SEE Bogs and swamps Oregon 749 Sweden 493 513 548 553 Peru 807 742 919 943 954 955 961 1014 1016 1017 1050 1063 1074 1076 1077 1110 1219 1326 1330 1378 1391 1424 1425 1432 1454 1455 US S R 616 Western States 38 | | -1233 | | | | |
| Swaan L de 1774 689 780 Swamp and Overflow Land Grant Act of 1850 (U S) 1649 Gt Brit 669 798 Swamp Land Act of 1850 (U S) Mexico 1664 Swamps SEE Bogs and swamps Mexico 1664 Sweden 493 513 548 553 Peru 807 554 563 564 659 715 U S A 399 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 U S S R 616 1473 1485 1495 1686 1687 Western States 38 | | 534 | | d non | oin | |
| Swamp and Overflow Land Grant Act of 1850 (U S) 1649 India 834 Swamp Land Act of 1850 (U S) 311 Mexico 1664 Swamps SEE Bogs and swamps Oregon 749 Sweden 493 513 548 553 Peru 807 554 563 564 659 715 U S A 399 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 U S S R 616 1473 1485 1495 1686 1687 Western States 38 | Swaan L de | | | u rep | all | 000 |
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| Swamp Land Act of 1850 (U S) Mexico 1664 Swamps SEE Bogs and swamps Oregon 749 Sweden 493 513 548 553 Peru 807 554 563 564 659 715 U S A 399 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 U S S R 616 1473 1485 1495 1686 1687 Western States 38 | Act of 1850 (U S) | 1649 | | | | |
| Swamps SEE Bogs and swamps Oregon 749 Sweden 493 513 548 553 Peru 807 554 563 564 659 715 U S A 399 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 USSR 616 1473 1485 1495 1686 1687 Western States 38 | Swamp Land Act of 1850 (U | | Mexico | | | |
| Sweden 493 513 548 553 Peru 807 554 563 564 659 715 USA 399 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 USSR 616 1473 1485 1495 1686 1687 Western States 38 | | | Nebraska | | | |
| 554 563 564 659 715 USA 399 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 USSR 616 1473 1485 1495 1686 1687 Western States 38 | | nps | | | | |
| 742 919 943 954 955 Utah 1619 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 USSR 616 1473 1485 1495 1686 1687 Western States 38 | | | | | | |
| 961 1014 1016 1017 1050 Missouri 631 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 USSR 616 1473 1485 1495 1686 1687 Western States 38 | | | | | | |
| 1063 1074 1076 1077 1110 New Zealand 699 712 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 USSR 616 1473 1485 1495 1686 1687 Western States 38 | | | | | | |
| 1219 1326 1330 1378 1391 types 738 801 1636 1424 1425 1432 1454 1455 USSR 616 1473 1485 1495 1686 1687 Western States 38 | | | | | 600 | |
| 1424 1425 1432 1454 1455 ŬSSR 616 1473 1485 1495 1686 1687 Western States 38 | | | | 738 | | |
| 1473 1485 1495 1686 1687 Western States 38 | 1424 1425 1432 1454 | | | .00 | 001 | |
| 1726 1727 | | 1687 | | | | |
| | 1726 1727 | | | | | |

| | | T4 | | | | T.1 |
|-----------------|-------------|---------------------|-----------------|--------|---------|-------------|
| Tabasco project | (Movico) | <u>Item</u> 1666 | TexasCont. | 240 | 243 | Item 244 |
| Tabasco project | (MEXICO, | 1200 | | | | |
| Tamayo J L | | | | - 269 | 300 | 301 |
| Tanaka T | | 784 | 303 - 308 | | 326 | 372 |
| Tanganyika | 400 | 636 | 373 431 | 459 | 790 | 867 |
| Tanner C B | 103 | | 1233 1250 | 1514 | 1550 | 1559 |
| Tascher W R | | 895 | 1606 1655 | | | |
| Tasmania | 785 | 856 | Texas Agricultu | ıral E | xperi | nent |
| Tatarinova N K | | 1201 | Station | | 240 | 308 |
| Taylor G H | | 241 | Texas Board of | Wate: | r Engi | neers |
| Taylor S A | | 170 | 190 | 217 | 304- | - 306 |
| Tedrow J C F | 171 | 884 | Theis C V | | | 284 |
| Temple F C | | 896 | Theobald G H | | | 1001 |
| Tennessee 486 | 580 1572 | | Thom W | 609 | 1456 | 1457 |
| Tennessee State | | | Thomas E E | | | 468 |
| mission | r ranning v | 1642 | Thomas H E | | 259 | 285 |
| Tennessee Valle | 177 | 590 | Thomas J E | | 200 | 469 |
| Torresce and to | nno oing ' | 7 | Thomas P H | | | 785 |
| Terraces and te | 78 127 | 142 | | | | |
| | | | Thomas Sir R | | | 470 |
| 145 158 | 727 760 | 823 | Thompson C K | | | 786 |
| 826 859 | 888 906 | 908 | Thompson D G | | | 316 |
| 1498 | | | Thompson F B | | 535 | 536 |
| California | | 756 | Thorne D W | | | 471 |
| Ceylon | | 1850 | Thornton J F | | | 42 |
| claypan soils | | 169 | Thorp J | | | 472 |
| construction | 864 869 | 906 | Thuet P | | | 1780 |
| 1399 1450 | | | Thurmann-Moe | P | 568- | - 572 |
| design | 858 864 | 892 | 1775 | | | |
| equipment | 906 | 1399 | Tibbetts F H | | | 286 |
| Finland | | 698 | Tidal soils SEE | Alluv | rial so | ils |
| grading | 187 | 892 | Tide gates 574 | | | 1855 |
| grassed | | 880 | Tile drainage | 2 | 6 | 22 |
| Guinea | | 871 | 145 376 | 408 | 619 | 624 |
| India | | 251 | 632 694 | | 800 | 805 |
| Iowa | | 185 | 808 846 | 1086 | | 1221 |
| Italy | | 873 | 1286 1542 | 1555 | 1560 | |
| Japan | | 872 | Australia | 377 | 678 | 770 |
| Kenya | | 716 | 809 1021 | | 1551 | |
| maintenance | 824 850 | 911 | benefits 1117 | | 1199 | 1218 |
| | 024 000 | 876 | | | 697 | 753 |
| Mexico | | 816 | bogs and swar | | | 100 |
| Missouri | | | 1054 1123 | 1100 | | 1652 |
| New Zealand | | 1399 | California | | 1536 | _ |
| Nyasaland | | 897 | Canada | | | 652 |
| Ohio | | 869 | Chile | 1000 | 1100 | 1083 |
| Oklahoma | | 862 | clay soils | 1096 | 1190 | 1215 |
| orchards | | 1539 | Colorado | | | 1108 |
| Philippines | | 864 | Corn Belt | | -40 | 175 |
| Puerto Rico | | 903 | costs 399 | 695 | 740 | 754 |
| Sahara Desert | | 1842 | 760 1117 | 1527 | | 4040 |
| Southeastern S | tates 828 | 911 | Australia | | 678 | 1213 |
| Southern States | | 906 | Finland | | | 1112 |
| spacing | 880 | 892 | Germany | | | 1182 |
| Texas | | 867 | Gt Brit | | | 1024 |
| types | 848 | 850 | Ireland | | | 1135 |
| Uruguay | | 870 | Michigan | | | 1501 |
| Wisconsin | | 909 | Netherlands | | 768 | 1151 |
| Terzaghi K | | 1296 | New Zealand | | 1098 | 1099 |
| Texas 142 | 190 201 | 202 | 1175 | | | |
| 208 210 | 216- 218 | 238 | Pakistan | | | 1853 |
| | | | | | | |
| | | | | | | |

| | | | Item | | Item |
|-------------------------|--------------|--------------|---|---------------------------------------|--------------|
| Tile drainage | Cont. | | | Tile drainageCont. | |
| Denmark | | 736 | 804 | researchCont. 131 | 134 |
| Egypt | | 1154 | 1839 | 136 1035 1208 | 4.0 |
| equipment Gt Brit | 1024 | 1154 1048 | 1190 1356 | Georgia | 42 |
| 1398 | 1024 | 1040 | 1990 | Indiana Iowa | 1218 185 |
| Iowa | | | 1209 | Minnesota | 1543 |
| Netherlands | | | 1151 | Netherlands | 1217 |
| Ontario | | | 1429 | New Zealand | 1095 |
| Pakistan | | | 1853 | Sweden | 1077 |
| Finland | | | 1115 | Utah | 407 |
| France | 722 | 1204 | 1739 | Rhodesia | 753 |
| Germany | | | 1395 | saline-alkali soils 377 | 401 |
| grasslands | 400 | -00 | 1098 | 417 429 1793 | 0.05 |
| Gt Brit 17 | 108 | 729 | 732 | Scotland | 665 |
| | 1048 | 1049 | 1064 | small farms and gardens | 622 |
| | 1159 1799 | 1162 1804 | 1163 | 736 1072 Sweden 659 1017 | 1074 |
| hilly regions | 1199 | 1004 | 1036 | Switzerland | 1180 |
| history | | | 1117 | Tasmania | 785 |
| Iceland | | | 697 | Union of South Africa | 1041 |
| Idaho | | | 1215 | USSR 706 | 1123 |
| Illinois | | | 118 | Wales | 1529 |
| Indiana | | 1190 | 1218 | Washington | 1215 |
| Iowa | | | 1209 | SEE ALSO Pipe drainage | |
| irrigated soils | 399 | 453 | 471 | Tile drains 2 672 | 744 |
| 472 1197 | | 004 | 0.77 | capacity 1197 | 1198 |
| Australia California | 369 | 364 383 | $\begin{array}{c} 377 \\ 424 \end{array}$ | cleaning | 781 1028 |
| Utah | 309 | 303 | 409 | construction 713 754 1053 1085 | 1048 |
| Washington | | | 368 | Netherlands | 1211 |
| Kentucky | | | 1534 | costs | 1085 |
| Latvia | | | 1015 | Denmark | 1713 |
| Maryland | | | 1592 | depth and spacing 97 | 740 |
| Nebraska | | | 1054 | 760 1085 1114 1117 | 1165 |
| Netherlands | 120 | 188 | 764 | 1191 1197—1199 1205 | 1207 |
| | 1037 | 1092 | 1211 | 1221 1518 1555 1560 | |
| 1751 | 0 | 007 | 000 | Australia 364 678 | 1130 |
| New Zealand 711 712 | 9 769 | 627 1029 | 699 1038 | Canada | 652 |
| | 1214 | 1029 | 1030 | Chile clay soils 1027 | 1083 1216 |
| North Africa | 1217 | | 675 | Finland | 1115 |
| Norway | | | 1075 | formulas 68 383 | |
| Ontario | | | 651 | 1191 | |
| orchards | | | 1164 | Indiana | 1218 |
| Australia | 678 | 1069 | 1130 | Iowa | 185 |
| Sweden | | | 1063 | Netherlands 773 1059 | 1151 |
| Washington | ., | | 368 | 1211 1217 | 1000 |
| peat and muck | SOIIS | | 1117 | New Zealand | 1029 |
| Michigan New Zealand | | | 504 484 | peat and muck soils 525 research 1206 | |
| Northern Stat | 20 | | 525 | sandy soils 1027 | 1216 |
| Norway | .00 | | 501 | Sweden | 1077 |
| Scotland | | | 521 | design 407 664 713 | 1053 |
| Pennsylvania | | 1073 | 1087 | 1105 1187 1197-1199 | 1293 |
| Quebec | | | 1088 | Germany | 1186 |
| quicksand | En | 0.0 | 1056 | Netherlands | 1211 |
| research | 53 | 98 | 119 | durability | 1084 |
| | | | | | |

| | | | Item | | | | Item |
|----------------------------|---------------|-----------|--------------------|-------------------------------|--------------|-------|--------------|
| Tile drainsCo | ont. | | | Tisdall A L | 172 | 425 | 473 |
| Gt Brit | | 0.0 | 8 | 474 475 | | | 1001 |
| India | | 20 | 446 1187 | Titov N M | 537 | 1460 | 1321 1461 |
| inspection installation | 408 | 738 | 1073 | Tiulenev N A Tiuneev N A | 331 | 1400 | 787 |
| 1165 1207 | 1539 | 100 | 1010 | Tobacco | 828 | 829 | 967 |
| California | 1000 | | 801 | Toe drains | 0=0 | 0-0 | 70 |
| Virginia | | | 1056 | Tolman C F | 287 | 288 | 345 |
| joints | | | 1198 | Tomatoes | | | 1502 |
| location 53 | 407 | 664 | 1035 | Tonelli A | | | 788 |
| 1092 1117 | 1197 | 1198 | 1209 | Tonga | | | 1873 |
| 1560 | nd no | ooin 6 | 407 | Tonkin Gulf pro | gect (. | indo- | 1304 |
| maintenance a 664 713 | 730 | 744 | 781 | China) Topham P | | | 897 |
| 1028 1105 | 1114 | 1165 | 1187 | Tourneur M | | | 1843 |
| 1560 | | | | Trach J | | | 540 |
| California | | | 801 | Tractors | | 371 | 1441 |
| Germany | | | 1186 | Trappel A | | | 1777 |
| Gt Brit | 1064 | 1158 | 1163 | Treadwell E F | 1005 | 4448 | 345 |
| 1793 | | | 1911 | Trenchers | | 1117 | 1335 |
| Netherlands | | | 1211 1056 | 1360 1421 | 1422 | 1452 | 1334 |
| Virginia obstructions | 754 | 781 | 1105 | for bogs and s Gt Brit 786 | | 1343 | 1358 |
| 1164 1170 | 101 | .01 | 1100 | 1458 1463 | 1002 | 1010 | 1000 |
| size 97 | 131 | 678 | 740 | Ireland | | | 1135 |
| 760 1029 | 1117 | 1218 | | Japan | | | 1411 |
| slope 1114 | 1115 | 1211 | 1564 | mechanical | | | |
| types | | 1070 | 1117 | Finland | | | 1379 |
| SEE ALSO Pip | pe ara 664 | ns 744 | 800 | France | 1 0 17 1 | 1907 | 561 1388 |
| Tile laying 1086 1114 | | | 1560 | Gt Brit 1398 1451 | 1371 1459 | | 1300 |
| bogs and swar | | 1200 | 1334 | Netherlands | 1400 | 1102 | 1393 |
| by hand | 1057 | 1203 | 1432 | Norway | | | 1366 |
| Canada | | | 652 | operating co | sts | | 1346 |
| costs | | | 1004 | Sweden | | | 1454 |
| Netherlands | | | 1394 | Netherlands | 4000 | 750 | |
| Sweden | | | 1425 804 | New Zealand | 1098 | 1334 | 1341 |
| Denmark equipment | | 1336 | 1360 | 1361 Oregon | | | 749 |
| France | | 1000 | 1377 | specifications | | | 1383 |
| Germany | | | 1395 | Sweden | | 1326 | 1425 |
| Gt Brit | | 1049 | 1358 | USSR | | | 1125 |
| mechanical | 750 | 1057 | 1366 | Trenches | | 664 | 1013 |
| | 1404 | 1405 | 1432 | Austria | | | 1061 |
| Netherlands | 3 | | 1394 1361 | Netherlands | | | 1701 |
| New Zealand Norway | ı | | 1366 | New Zealand Trenching | | 1198 | 1095 1203 |
| USSR | | | 1427 | Australia | | 1190 | 678 |
| Gt Brit | | 633 | 701 | by hand 1040 | 1075 | 1165 | 1203 |
| Netherlands | | 750 | 1151 | Canada | | | 652 |
| New Zealand | 783 | 1057 | 1175 | costs | | | |
| 1334 | | | 740 | Norway | | | 1075 |
| Oregon | | | $\frac{749}{1210}$ | Sweden | | | 1425 |
| Quebec Sweden | | | 1432 | Gt Brit | | | 1040 1165 |
| Union of South | h Afri | ca | 1041 | mechanical Norway | | | 1075 |
| Utah | | | 1185 | Netherlands | | | 1151 |
| Tinn G | | | 1776 | Norway | | | 1075 |
| | | | | • | | | |

| | Item | Item |
|--|--------------|---|
| TrenchingCont. | 1105 | U S Bur of the Census 23 |
| Utah Trenka E | 1185 1276 | 24 1643 U S Civilian Conservation Corps |
| Trent River project (Gt Bri | | 1637 |
| | 1816 | U S Congress |
| Trinidad 575 898 | 944 | House |
| Trist P J O Trois Rivières project (Hai | 1830 | Committee on Agriculture 346 |
| Trois itivieres project (mai | 1670 | Committee on Irrigation and |
| Troxell H C 278 289- | - 292 | Reclamation 347 |
| Trummer A | 1778 | Senate |
| Truscott J H L | 1244 1202 | Committee on Agriculture |
| Truss P Tsarevskii A | 789 | and Forestry 348 U S Corps of Engineers 1644 |
| Tuinstra U | 1322 | U S Dept of Agriculture 336 |
| Tule Lake (Calif) | 1583 | 348 357 443 445 477 |
| Turkistan | 1137 | 1612 1639 1645 |
| Turkey 1264 | 1569 | Off of the Solicitor 349 |
| Turnbull J 1333 Turner P E 898 | 1556 899 | U S Dept of the Interior 208 |
| Turner W L | 96 | U S Farm Credit Admin 314 |
| Turner W L Jr | 88 | U S Forest Serv |
| Turnor C H | 1779 | Upper Peninsula Experimental |
| Twinn C R | 586 | Forest (Dukes Mich) 552 |
| Udbyneder project (Denmar | (k) | U S Geological Survey 208 214 293 - 295 388 |
| oubyficuer project (Defimal | 1693 | Water Resources Br 296 |
| Uhland R E 173 | 1557 | 297 |
| Uhlen R | 1780 | Water Resources Div 298 |
| Ulich W L | 790 | U S Laws Statutes etc 350 |
| Ulrich R Ulua River project (Hondur | 1558 | U S National Institutes of Health Malaria Investigations 599 |
| oraa terver project (Hohaar | 1675 | U S National Resources Com- |
| Union of South Africa 865 | 900 | mittee 10 1646 1647 1571 |
| 1041 1166 1167 | 440 | Water Resources Committee |
| USSR 1 39 51 156 374 420 464 | 116 478 | 338 351 |
| 499 500 506 509 | 511 | U S National Resources Plan- ning Board 1559 |
| 514 515 531 533 | 534 | U S Navy 1626 |
| 537 542 560 565 | 587 | U S A SEE names of States and |
| 616 632 661 683 | 685 | regions |
| 687 706 707 710 724 726 745 777 | 719 787 | U S President's Water Re- |
| | 1005 | sources Policy Commission 318 341 |
| 1006 1022 1031 1034 | 1060 | U S Public Health Serv 614 |
| 1071 1102 1123 1125 | 1154 | U S Regional Salinity Labora- |
| 1173 1176-1178 1201- | | tory (Riverside Calif) 28 361 |
| 1307 1313 1316 1321 1352 1353 1396 1402 | 1345 1403 | 403 410 442 449 453 477 1257 1277 |
| 1427 1439 1440 1442 | 1460 | U S Soil Conservation Serv 88 |
| 1461 1465 1479 1531 | 1639 | 92 174 488 489 525 |
| 1731 1756 1767 1787 | 1789 | 791 827 854 875 887 |
| U S Bur of Agricultural Eco | | 1002 1203 1547 1599 1609 |
| nomics 197 392; U S Bur of Agricultural Eng | 1603a zi- | 1630 1634 1635 1644 1648 reports 25 |
| neering | 63 | Soil Conservation Experiment |
| U S Bur of Reclamation | 347 | Station (Bethany Mo) 1318 |
| 1651 | | Southeastern Region 352 |

| U S Soil Conservation Serv (Cont.) | Vernier Swamp (France) 1715 Vertical drainage 695 754 |
|--|---|
| Southeastern Tidewater Soil Conservation Experiment Station 42 | 800 bogs and swamps 1055 irrigated soils 473 |
| Southwest Region 353 Spartanburg Outdoor Hydrau- lics Laboratorv 827 881 Stillwater Outdoor Hydraulics Laboratory 1003 | New Jersey 693 Solomon Islands 1866 U S S R 1173 1307 Vertical drains 487 1283 1296 |
| Upper Mississippi region 792 793 | blasted 1107 bored 473 1021 1107 1287 |
| Upper Mississippi Valley Soil Conservation Experiment Station (La Crosse Wis) 227 U S Tennessee Valley Authority | California 1169 construction 693 Texas 790 Vicente-Chandler J 903 |
| 590 U S Waterways Experiment Station (Vicksburg Miss) 1047 | Vidme T 150 Vietnam 1860 Vik K 1562 |
| Upson J E 299 Uruguay 870 1680 | Villeneuve G O 1210 Vincent A E 1464 |
| Utah 46 233 241 282 325 329 344 392 395 407 409 410 411 413 435 | Vineyards 66 361 425 692 1720 Virgin Islands 1570 |
| 442 444 448 449 451 477 481 596 686 811 1082 1185 1226 1257 1277 | Virginia 64 88 141 180 486 543 582 1056 1558 1589 1626 |
| 1619 | Virginia Agricultural Experi- |
| Utah Agricultural Experiment Station 392 407 1082 Utz E J 1657 | ment Station 88 Visser W C 177 178 189 797 1211 |
| Valentin J 1204 | Viswanath B 168 Vladimirov A G 478 |
| Valenzuela A V M 794 Van Bavel C H M 1205 | Vlasov N P 1006 Vlei soils SEE Bogs and swamps |
| Vanderwerken R J 1298 Van Doren C A 175 176 | Vogelzang H 1212 Vohra H R 1299 |
| Van Hovenberg H W 1674 Van Kevich A B 1005 | Voida A N 1465 Voigt O 1466 |
| Vannote R L 611 1437 Van Schilfgaarde J 95 1206 | Volpi C A 1683 |
| 1207 1208 Van Straaten N J 900 | Wadleigh C H 402 Wageningen project (Brit |
| Van Vlack C H 795 1209 1560 | (Guiana) 1678 |
| Vasilakes G S 901 Veen J van 1781 | Walcheren project (Netherlands) 1305 1718 1750 1785 |
| Veenenbos J S 538 796 Vegetables 677 809 1518 Venezuela 149 774 1570 | Wales 11 333 647 734 1033 1314 1503 1529 1530 1826 |
| Venø Bay project (Denmark) 1749 | Walker A W 479 Walker C 1214 |
| Venstrom C 398 Vereeniging "Nederland in de | Walker E D 904 Walker G P 1218 |
| Vreemde'' 1783 Verhoeven B 72 902 | Walker J P 64 1056 1594 Walker P 180 |
| Verink J B 797 | Wallace J C 1831 |
| Vermaat J G 1561 Vermuyden C 1798 1807 | Wallihan E F 65 181 Wallis W T 1649 1650 |

| | Item | | | | Item |
|---|-------------|-----------------------------|-------------|--------------|--------------|
| Walton L | 1563 | WaterwaysCon | | 040 | |
| Warburton J H Ward O C | 905 308 | sodding 813 869 875 | 840 904 | 846 | 849 |
| Wardlaw H H | 480 | types | 201 | 847 | 851 |
| Wardrop G | 1467 | SEE ALSO Gra | ssed | | |
| Wäre M | 539 | Watson J D | | | Ĭ82 |
| Warne W E | 1651 | Webb C T | | | 1215 |
| Warnick F M | 481 1829 | Webb H W T Webb R | | | 1844 798 |
| Wash project (Gt Brit) 1831 | 1049 | Webb W P | | | 300 |
| Washington 231 252 | 256 | Weber J L | | | 708 |
| 261 263 368 393 | 421 | Weber Basin Red | lama | ition p | roj- |
| 639 997 1215 1319 | 1368 | ect (Utah) | | - | 392 |
| 1558 1580 | | Wedgwood F | | D E D | 1007 |
| Washington Dept of Conservation and Development | /a- 252 | Weed control SE | | DER | |
| Water policies 213 | 1647 | Weir W | les | | 799 |
| Water rights 312 313 | 328 | Weir W W 26 | 418 | 482 | 800 |
| Water spreading 237 821 | 867 | | 1652 | | |
| Water table 28 75 95 | 115 | Wel R A van | | | 802 |
| 119 120 179 229 | 231 | Welch D S | | | 567 |
| 235 271 408 California 211 | 1172 | Weld W A Well batteries | | 100 | 906 1247 |
| clay soils | 1096 | Well Drainage Di | stric | | |
| Florida 488 489 | 1537 | W 011 2 1 11 11 11 15 0 2 1 | | (21222 | 1497 |
| measurement | 33 | Wellington M S | | | 803 |
| peat and muck soils | 527 | Wells H M | | 4.00 | 301 |
| research 77 442 449 | 1206 | Wells 115 | 399 | 402 | 404 |
| Texas Western States | 431 38 | 417 429 1224 1229 | 453 1277 | 472 1273 | 664 1296 |
| SEE ALSO Ground water | 00 | 1524 1225 | 1211 | 1210 | 1200 |
| Waterlogging 181 | 379 | Arizona | | | 1258 |
| Gt Brit | 1382 | California | 482 | 1172 | 1258 |
| Pakistan | 470 | design | | | 1246 1839 |
| Quebec Rhodesia | 634 1484 | Egypt Florida | | | 457 |
| Southwestern States | 444 | France | | 1712 | 1739 |
| Watershed Protection and F | lood | Georgia | | | 1225 |
| Prevention Act of 1954 (U | S) | Idaho | | 279 | 281 |
| 315 317 349 357 | 358 | installation | | | 1259 |
| Watersheds 106 126 | 840 | Oregon | | | 231 1063 |
| 905 985 1523 1617 Arkansas | 308 | Sweden USSR | | | 706 |
| Iowa | 1324 | Utah | 409 | 1226 | |
| Louisiana | 308 | Washington | | | 231 |
| management 805 1492 | 1618 | SEE ALSO Obse | ervat | ion we | ells |
| Missouri | 309 | Welsh H D | | | 44 183 |
| Tennessee Texas | 1642 308 | Welton K Wentholt L R | | | 1008 |
| Waterways 727 | 1253 | Wenzel L K | | | 250 |
| Australia 840 | 905 | Werff H J van de | r | | 1784 |
| Brazil | 833 | Werff W A van de | er | | 1785 |
| construction 833 | 908 | Werner D A | | | 266 302 |
| design | 946 | Werner P W Wernimont K | | | 354 |
| location maintenance 833 851 | 908 869 | Wesseling J | | 1216 | |
| seeding 813 854 895 | 908 | West Virginia | | 523 | 925 |
| | | _ | | | |

| Westerhof J J | | | Item 72 | Wood I D | | 910 | <u>Item</u> 1566 |
|---|-------------|---------------------|---|--|------------------------|--------------------------------------|--|
| Westermann T | | | 804 | | | 010 | 1082 |
| Western States | 38 | 159 | 197 | Wood N N | | | 483 |
| 206 255 | 287 | 313 | 338 | | | | 200 |
| 345 382 | 430 | 432 | 490 | Wooden drains | | | 4400 |
| 1270 1517 | | | 1505 | British Colum | bia | | 1136 |
| Weston A D | | 1/00 | 1565 | Denmark Finland | | | 1104 1104 |
| Wheat Whisler B A | | 1498 | 1557 1684 | Germany | | | 1089 |
| Whitaker J R | | | 16 | | | | 767 |
| White D G | | | 1480 | New Zealand | | | 712 |
| White L R | | | 852 | Norway | | | 1075 |
| White W N | | 303- | - 306 | USSR | | | 706 |
| Whitley F H | | | 805 | Woodruff C M | | | 186 |
| Whitlock R | | 806 | 1834 | WOODS IN G IN | | | 910 |
| Whitt D M | | | 169 | Woodward G O Woodward L | | | 1220 811 |
| Wiancko A T Wiegering G | | | 1218 807 | | | | 1011 |
| Wiel S C | | | 345 | Wooley J C | | | 1325 |
| Wieringermeer | proje | ct (Ne | | | 1567 | 1655- | -1657 |
| lands) | | ` | 1698 | Workman L J | | | 1010 |
| Wijk W R van | | | 1216 | Worley L D | | | 911 |
| Wiklander L | | | 1219 | Wouda D F | | | 1786 |
| Wilcox E V | | | 808 | Wright S J | 387 | 200 | 1468 |
| Wilcox J C Wilcox L V | | | 184 450 | Wyoming 266 Wyoming Agricu | | | |
| Wilde S A | | | 540 | ment Station | iituiai | LAPE | 388 |
| Wildlife SEE E | ffects | on wil | | Wyoming State | Engine | er | |
| Williams G R | | | 1323 | | | | |
| Williams L L | | | 612 | Xinias Lake (Gr | eece) | | 1759 |
| Williams M B | | | 355 | | | | 4044 |
| Williams P C | | | 27 | Yarnell D L | | | 1011 |
| Willis G W Wilm H G | | | 307 1009 | | | 357 | 888 358 |
| | | | | | | | 000 |
| Wilmot R S | | | n 1.5 | | | | |
| Wilmot R S Wilson C M | | | 613 1675 | Young S P | | | 1012 |
| Wilson C M Wilson E | | | 1675 | Young S P Young T W | | 1569 | 1012 1568 |
| Wilson C M | | | | Young S P | | | 1012 1568 |
| Wilson C M Wilson E Wilson H Wilson H A | | | 1675 573 907 185 | Young S P Young T W Yugoslavia Zagumennyi A | | | 1012 1568 1732 912 |
| Wilson C M Wilson E Wilson H Wilson H A Wilson H M | | | 1675 573 907 185 908 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V | | | 1012 1568 1732 912 1787 |
| Wilson C M Wilson E Wilson H Wilson H A Wilson H M Wilson I S | | | 1675 573 907 185 908 809 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V Zeeuw J W de | | | 1012 1568 1732 912 1787 120 |
| Wilson C M Wilson E Wilson H Wilson H A Wilson H M Wilson I S Wilson R J | | | 1675 573 907 185 908 809 614 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V Zeeuw J W de Zhilin A P | | | 1012 1568 1732 912 1787 120 514 |
| Wilson C M Wilson E Wilson H Wilson H A Wilson H M Wilson I S Wilson R J Wilton W T | | | 1675 573 907 185 908 809 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V Zeeuw J W de Zhilin A P Ziegel W | | 1569 | 1012 1568 1732 912 1787 120 514 1788 |
| Wilson C M Wilson E Wilson H Wilson H A Wilson H M Wilson I S Wilson R J | | | 1675 573 907 185 908 809 614 1323 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V Zeeuw J W de Zhilin A P Ziegel W Zingg A W | | | 1012 1568 1732 912 1787 120 514 1788 309 |
| Wilson C M Wilson E Wilson H Wilson H A Wilson I S Wilson R J Wilton W T Windmills Denmark Gt Brit | | 1239 | 1675 573 907 185 908 809 614 1323 649 1806 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V Zeeuw J W de Zhilin A P Ziegel W Zingg A W Zlatkin M A Zock R T | | 1569 187 | 1012 1568 1732 912 1787 120 514 1788 309 |
| Wilson C M Wilson E Wilson H Wilson H A Wilson I S Wilson R J Wilson W T Windmills Denmark Gt Brit Netherlands | 1227 | 1239 1253 | 1675 573 907 185 908 809 614 1323 649 1806 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V Zeeuw J W de Zhilin A P Ziegel W Zingg A W Zlatkin M A Zock R T Zubets V M | | 1569 187 913 | 1012 1568 1732 912 1787 120 514 1788 309 1789 310 1005 |
| Wilson C M Wilson E Wilson H Wilson H A Wilson H M Wilson I S Wilson R J Wilton W T Windmills Denmark Gt Brit Netherlands 1701 | 1227 | 1239 1253 | 1675 573 907 185 908 809 614 1323 649 1806 1697 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V Zeeuw J W de Zhilin A P Ziegel W Zingg A W Zlatkin M A Zock R T Zubets V M Zuiderzee proje | ct (Ne | 1569 187 913 therla | 1012 1568 1732 912 1787 120 514 1788 309 1789 310 1005 nds) |
| Wilson C M Wilson E Wilson H Wilson H A Wilson H M Wilson I S Wilson R J Wilton W T Windmills Denmark Gt Brit Netherlands 1701 Winterberg S H | 1227 | 1239 1253 | 1675 573 907 185 908 809 614 1323 649 1806 1697 | Young S P Young T W Yugoslavia Zagumennyi A Zakarchenko V Zeeuw J W de Zhilin A P Ziegel W Zingg A W Zlatkin M A Zock R T Zubets V M Zuiderzee proje 143 188 | ct (Ne 750 | 1569 187 913 therla 1695 | 1012 1568 1732 912 1787 120 514 1788 309 1789 310 1005 nds) 1696 |
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