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# DRAINAGE

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SPECIAL AGENT FOR DRAINAGE

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Size of enterprises.....	559	571	585	593	605	617	625	641	649	657	665	675	683	691	703	708
Character of enterprises.....	560	572	585	594	606	618	626	641	649	658	666	675	684	691	704	708
Drainage works.....	561	574	586	595	607	618	627	642	650	658	666	676	685	693	704	711
Maintenance of works.....	562	574	587	596	607	619	628	643	651	659	667	677	685	693	705	711
Date of organization.....	562	575	587	596	607	619	628	643	651	659	667	677	686	694	705	711
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COUNTY TABLES.																
I.—Drainage on farms: 1920.....	563	576	588	597	608	620	629	644	652	660	669	678	687	695	706	713
II.—Operating drainage enterprises: 1920.....	565	578	589	599	611	621	632	645	653	661	671	679	688	697	706	728

<sup>1</sup> Statistics for drainage on farms are given for all other states, while statistics for drainage enterprises are given for only Arizona, Nevada, New Mexico, Oklahoma, and Oregon.

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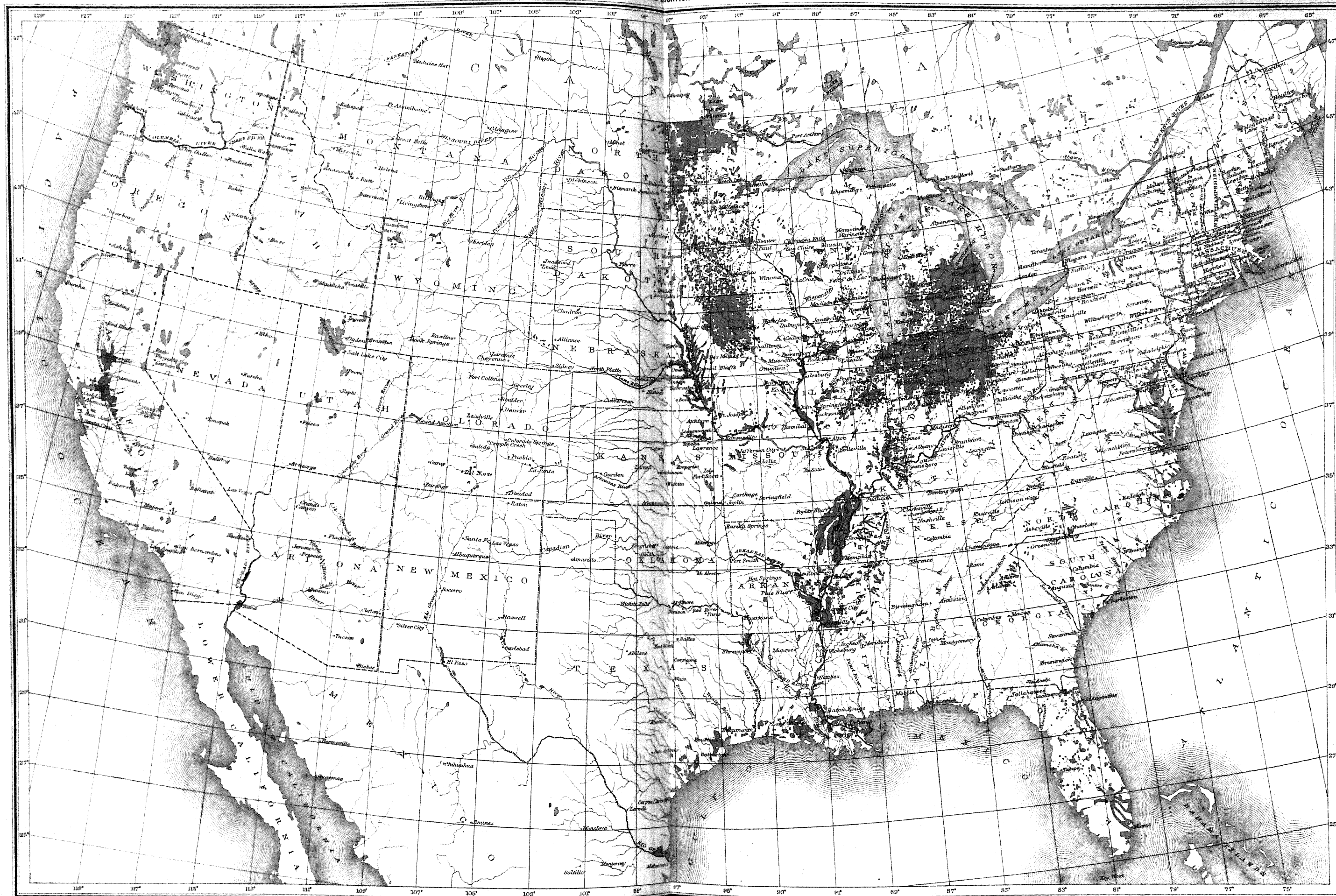
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Operating drainage enterprises shown in red

Scale 1:1,000,000  
0 100 200 300 400 500 600 Miles

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

# DRAINAGE.

## INTRODUCTION.

### THE FIRST CENSUS OF DRAINAGE.

The act of Congress providing for the Fourteenth Census, in the paragraph defining the scope of the census of agriculture, provides: "Inquiries shall be made as to the quantity of land reclaimed by \* \* \* drainage and the crops produced; also as to the location and character of \* \* \* drainage enterprises, and the capital invested in such enterprises." No provision for inquiries regarding drainage had been contained in any previous census act, and nothing comparable to a census of drainage has been taken heretofore.

In gathering these statistics, some difficulties have been encountered incident to a new investigation, and some due to the nature of an improvement that is partly hidden beneath the ground surface and that usually operates more or less effectively for a few years, at least, without expense or attention. These difficulties will be indicated more specifically in the paragraphs regarding method of canvass and accuracy of the statistics. It is believed, however, that the information obtained gives a reasonably accurate idea of the amount of farm land provided with artificial drainage; also of the extent and condition of land in enterprises organized for securing drainage in units of considerable size, which are larger than individuals could undertake and which affect many landowners; of the utilization of that land for agriculture; of the nature and extent of the drainage improvement works of those enterprises; and of the capital invested in them.

### SCOPE OF THE DRAINAGE CENSUS.

The scope of the census of drainage is as defined in general terms by the act making provision for the Fourteenth Census. The number of farms having land provided with artificial drainage and the area of that land were determined, also the number of farms having land that needed drainage in order to be suitable for crops and the acreage of such land in farms. The area embraced in enterprises organized by a number of individuals to drain land that is used for agricultural purposes, or will be so used, also was determined, together with the condition of that land on the census date and before the drainage was undertaken. The figures for capital invested in enterprises to December 31, 1919, were obtained, with the estimated amounts required to complete construction of the improvement works authorized. The kind and amount of those works installed by the enterprises were learned.

The information concerning the character of the enterprises required that a study be made of the drainage statutes of the various states. The names of the principal crops raised on the drained land were obtained, but not the acreage devoted to each crop. In planning the census, it was deemed quite impracticable to attempt to segregate for each farm the crops produced upon land artificially drained.

The statistics for farms and farm acreage provided with artificial drainage include all the states; those for drainage enterprises omit Alabama, Virginia, and West Virginia, where no organized drainage enterprises of a public nature had begun actual construction of the improvements, and all states north of Potomac River.

**Drainage census reports.**—For each of the 29 states in which drainage of land for agriculture is most important, a separate drainage bulletin has been issued. These bulletins show by counties the number of farms and the land in farms reported as provided with artificial drainage, and likewise the number of farms and the additional farm acreage reported as needing such drainage. The part of this land that needs clearing also, to be suitable for growing crops, is given by counties. Acreage and capital invested for all organized enterprises, and the estimated additional investment required to complete the enterprises, are classified according to the progress of construction of the drainage works; according to the drainage basin; according to condition of the land as regards improvement, timber, and drainage condition; and according to character of the enterprises. For those undertakings that had completed or had begun actual construction by January 1, 1920, the classification is made also according to kind of drainage works, maintenance provided for those works, and date of organization of the enterprises. For the same enterprises the statistics are given by counties regarding area and condition of the land, kind and length of drains, area drained by pumping, cost of drainage per acre, increase in improved land since drainage was begun, and the principal crops grown upon the drained land.

A summary bulletin for the United States has been issued, of the same form and subject matter as the state bulletins, but giving the more detailed statistics by states instead of by counties.

This volume presents all the published statistics for drainage collected at the Fourteenth Census. Following the general discussion of results, the tabular and other matter in the United States summary and

the state bulletins are printed, together with similar information for the states for which no separate bulletins were issued.

**Schedules and method of canvass.**—The information regarding number of farms and farm acreage provided with artificial drainage or needing drainage, and the number of farms in drainage and levee districts, was obtained from the farm operators as a part of the general agricultural information by the enumerators who visited every farm.

The statistics relating to organized enterprises were secured on a special drainage schedule by special agents, except that enumerators were instructed to secure those schedules in the more remote sections where it was expected that few or no drainage enterprises would be found. The information relating to the enterprises was obtained from a present or former official of each enterprise, or from some landowner having personal knowledge of the undertaking, wherever practicable. Where a county board or some county official serves as the executive authority for all or a large number of drainage enterprises in the county, as is provided by the laws of several states, it was necessary that the statistics be compiled by the special agents from county records and other available sources. This information was verified as far as possible by consultation with county officials and with other persons having knowledge of drainage in the locality.

The appendix to this volume contains a copy of the drainage questions from the agricultural schedule and of the instructions to enumerators regarding those questions; it contains also a copy of the special drainage schedule, and of the instructions to special agents regarding the inquiries on that schedule.

#### DEFINITIONS AND EXPLANATION OF TERMS.

**Drainage of agricultural land.**—For determining the scope of the drainage census, the drainage of agricultural land was defined as the act or process of drawing off an excess of water by underground conduits, pipes, or tiles, or by open or covered trenches in the surface of the ground for the purpose of improving the condition of the soil and crops. In this connection the area drained does not include land from which water flows without artificial aid into natural water courses; nor does it include land protected from overflow by levees, dikes, or embankments, nor areas guarded by trenches from the run-off from higher land, unless some form of drainage works has been constructed on the protected land.

The statistics for drainage naturally divide into two parts, one relating to the work which each farm owner may do independently and for himself only, the other relating to the work that is done by cooperation among a few or many landowners associated in some form of organization recognized by law. In

the census publications, the former has been designated as "drainage on farms," and the latter as "drainage enterprises;" terms used not uncommonly to distinguish these parts are "farm drainage" and "district drainage."

**Drainage on farms.**—Drainage on farms may be either inside or outside of drainage enterprises; that which is inside usually is connected with and supplemental to the work done by the enterprises.

The area provided with drainage, however, does not distinguish between land benefited by works of individual owners and that benefited by works of organized enterprises, but includes all the acreage of which the soil actually has been made of more value for agricultural purposes by drainage. Such temporary work as bedding the fields or laying out dead furrows to cause the surface water to flow away quickly is not considered as drainage, and the land thus treated has not been included in the statistics unless other more permanent drains also have been provided. Information was not obtained to show the amount of drainage on farms that is located within drainage enterprises.

The land needing drainage, in farms, is the area additional to that reported as provided with drainage, which could be made suitable for crops by drainage only, or by drainage and clearing. The acreage needing clearing was defined as that which was covered with trees, stumps, or perennial woody shrubs; the acreage covered with only grass, weeds, or other annual growth was considered not to need clearing.

**Drainage enterprises.**—Drainage enterprises comprise public and private corporations and local improvement districts organized to secure the drainage of land to be used for agricultural purposes; also government projects and other organizations engaged in extensive land drainage work. Schedules were obtained also for drainage undertakings, each to benefit 500 acres or more, by individual farm owners, and the figures are included in the statistics for enterprises. By the definition of drainage of agricultural land, mere flood-protection is not drainage, so statistics are not included for levee or diking districts that have not undertaken the construction of open ditches or tile drains.

Each drainage enterprise comprises that area organized into a separate drainage district, or assessed for the same public drain, or drained by works operated or constructed as a separate undertaking. In order to present the statistics by counties, an organized enterprise embracing land situated in more than one county was divided and a separate schedule was prepared for the part in each county; thus the number of enterprises given for each state represents the number of schedules, and exceeds the number of separate organizations if any enterprise in the state extends across a county boundary.



**Operating and nonoperating enterprises.**—The term "operating" has been applied by the census to those enterprises that had completed or had begun actual construction of the drainage improvement works, and the term "nonoperating" to those that had not begun construction, on or before January 1, 1920. This was deemed the most practicable way of dividing the actual from the prospective enterprises, though the completion of certain of those classed as nonoperating may be as little in doubt as the completion of many that were under construction on the census date.

**Land in enterprises and assessed acreage.**—The land in drainage enterprises is the acreage that has been or is to be benefited by drainage works constructed by the enterprises and, except in a few instances noted, is the land assessed to pay the cost of the enterprises. The exceptions are irrigation projects installing drains to benefit land damaged by seepage or by alkali as a result of the irrigation, and assessing the cost against the entire irrigation enterprise instead of against only the area needing drainage or protection. Under such circumstances the area thus assessed but not needing drainage has been omitted from the tabulations.

As some drainage enterprises are located wholly or partly within other enterprises, addition of the separate acreages would show more than the actual amount of land in the enterprises in some states and counties; therefore, in order to eliminate duplications, from the area in each enterprise was deducted the area situated in enterprises organized previously. The summation of the areas in the enterprises was tabulated and is shown as "assessed acreage," for comparison with the actual land in enterprises.

The condition of the land in enterprises, without respect to the amount of drainage needed or supplied, has been shown by dividing all the land into three classes—improved, timber and cut-over, and other unimproved land. The question on the drainage schedules asked for the percentage cultivated, but it is believed that all improved land in farms was so reported, and perhaps any other improved land in the enterprises. Timber and cut-over land is shown to indicate the amount of land that must be cleared as well as drained, to be fitted for agriculture, rather than the value of the land for lumbering operations.

To show the drainage condition, the acreage swampy, subject to overflow, or too wet for cultivation is stated, including the area damaged by seepage water and by alkali in those regions where irrigation is generally practiced. The condition of this part as to timber or improvement is not indicated. It is to be assumed that all land in drainage enterprises was in need of drainage before the improvement works were constructed. Nearly all the drainage laws imply, and many of them state, that no land shall be included in drainage districts or be assessed for drainage improvements unless it will be benefited by the works of the

enterprises. The area suffering a loss of crops shows the acreage which the owners or tenants planted to crops that suffered damage, either partial or complete, due to defective drainage. As the schedules were returned by special agents, effort was made to ascertain whether these figures included any land that merely would have been cultivated if it had been drained and protected against overflow, and to eliminate such acreages.

**Capital invested.**—The capital invested in drainage enterprises is the total cost of those enterprises. It includes the attorneys' fees, court costs, and other expenses for organizing the enterprises; the cost for engineering investigations and surveys, and for plans and specifications for the improvement works to be constructed; the purchase of land to be used as right of way for the ditches, and of land and buildings for other purposes necessary for the enterprise; the payment of awards to landowners claiming damages; expenditures for machinery and tools for constructing and maintaining the works; payments for labor, and payments to contractors for construction and installation of the improvements; expenses for supervision and administration; and any other items properly chargeable to drainage and paid by the enterprise. It does not include the cost of land or other property that is to be sold or used for any other purpose than the operation and maintenance of the drainage works, neither does it include the cost of operation for drainage pumping plants.

**Drainage works.**—The drainage works of an enterprise were defined to include all kinds of drains and all accessory structures for protecting the land in the enterprise against overflow or seepage and other waters that are constructed by or for the enterprise. Supplementary works constructed by private individuals or corporations were not included. The drains include both open ditches or canals, and covered or underground conduits of clay, concrete, wood, or other material. Ditches, as the term is used in the drainage census, include all open trenches artificially constructed or enlarged to drain away surface or soil waters; tile include all varieties of pipes, of whatever shape or material, placed beneath the surface of the ground in such manner as to permit the excess water to flow away. The dimensions of the ditches are expressed by the depth and the width of the ditch bottom; the size of tile, if circular, by the inside diameter in inches.

The accessory structures include all levees, dikes, dams, weirs, gates, sluices, pumping machinery, and other devices for draining away or controlling surface and soil waters. These are not considered drainage works in the strict sense of that term, but the cost of such accessory works as have been constructed by the drainage enterprises is included in the cost of those enterprises, and the other information is given in the statistics herein published.

Enterprises are called pumping districts if a part or all of the water from the drains is collected at some low point and must be raised by some form of machinery in order to be removed from the area. The type of drainage is the classification as to whether the drainage water is removed by pumping or by gravity. All kinds of machinery or devices for lifting the drainage water are classed as drainage pumps, and all varieties of engines or motors for operating those pumps are termed pumping engines.

#### ACCURACY OF THE STATISTICS.

**Drainage on farms.**—The figures relating to number of farms and farm acreage having drainage or needing drainage are probably as accurate as could be obtained, and sufficiently so for all practical purposes. The area provided with drainage could only be determined by the farm operator's estimate of the amount of land that had received benefit from the drains. The additional area that could be made suitable for crops by drainage, or by drainage and clearing, could only be estimated by the farm operator. It is not improbable that a few tenants or recent purchasers of farms did not report some land that actually had been artificially drained, through lack of knowledge of the work that had been done, but it is not believed such errors would affect the accuracy of the statistics.

A comparison of the figures by counties regarding number of farms in drainage and levee districts with the acreage in drainage enterprises indicates positively that in some states, at least, too few farms were so reported. The discrepancy undoubtedly is due in many instances to the fact that a new owner may not know of drainage assessments paid by a former possessor, and that a tenant may not be aware of payments for drainage work made by the owner. In other instances the enumerators or the farm operators may not have been properly diligent in answering all questions, and no answer regarding a drainage inquiry on the agricultural schedule was tabulated the same as an answer "No" or "None."

**Drainage enterprises.**—The land in drainage enterprises is believed to be reasonably accurate in most counties, and the acreage assessed subject to only such error as might be due to using approximations when exact figures were not obtainable by the persons making the canvass. Agents who were obliged to compile the figures from records found the information incomplete in several respects. In a few instances, drainage records of a county had been destroyed by fire, and in other cases some of the records had been misplaced or lost. The records frequently were incomplete and indefinite; acreages were not always given, and descriptions often were inadequate. Very often overlapping of enterprises could be determined only by platting the boundaries upon a map, no mention of such overlapping appearing in the records. For those counties where overlapping was believed to exist,

such platting was done as accurately as possible in the Census Bureau from the descriptions given on the schedules, and it is believed that the duplication of area thus determined is approximately correct.

In nearly all states, the number of enterprises stated is too large by reason of intercounty enterprises being counted in each county; otherwise, the number undoubtedly is correct for the states where each enterprise has a continuing existence and maintains the improvement works systematically. In some states, particularly Indiana, Michigan, and Ohio, new enterprises have been organized when old public drains have needed cleaning or enlarging, and the greater number of enterprises have been established for repairing, reconstructing, extending, and combining old ditches rather than for constructing new drains or for benefiting additional acreage.

The figures regarding capital invested should fairly represent the cash cost of the enterprises. In few of the cases where the work of construction was divided among the persons benefited, probably, was there a record made of the value of the work thus performed. It is known that the figures for a few counties include expenditures for repairing and extending the drains; it is probable that the same is true in some other counties. In states where it is customary to establish a new enterprise whenever an old drain is to be improved, the records give no basis for determining what amount should be considered as repair charges and what amount for new construction; no deduction has been made from the total cost of all the enterprises. Estimates of additional investments necessary to complete the works authorized are in some cases based upon contract prices for works under construction and in some cases upon engineers' estimates; the instructions to special agents explained that estimates were wanted for only works that had been authorized.

The condition of the land in drainage enterprises can be given only by estimates secured from the persons acquainted with the enterprises or with the localities. In the case of small enterprises mostly under cultivation, the estimates should be very nearly correct, but for large enterprises mostly undeveloped, for some counties the estimates of improved land in drainage enterprises exceeded the total improved land in farms as determined by the general census of agriculture. Under such circumstances a reduction was made in the bureau from the best information obtainable; the estimates thus determined have been indicated in the state reports. The figures for condition before drainage may be slightly less accurate than those for conditions on January 1, 1920. The condition before drainage does not refer to any specific date, but for each enterprise refers to the time when that enterprise was organized. In a number of counties where a great many enterprises have been completed, and the work has been done during a period of several decades, the figures for condition of land were obtained

as averages for all of each township or, in a few cases, for the county as a whole.

The lengths of completed and incompleted drains for enterprises having works under construction were computed on the assumption that the ditches and levees would be completed before the tile were installed. In some instances only lengths of completed drains were reported, and the statistics do not include the additional lengths to be installed to complete the improvements for which expenditures have been authorized. So far as was possible, deduction was made from the length of ditches in each enterprise to cover the amount that was merely enlarging or cleaning out a ditch tabulated in an earlier enterprise, or that was replacing such a ditch with tile, but in those states where maintenance and enlargement are done by organizing new enterprises the actual lengths of ditches probably are somewhat less than the figures show.

#### GENERAL DISCUSSION OF RESULTS OF DRAINAGE.

A complete analysis of all the statistics is not attempted. Such explanations are given as are deemed necessary to prevent a misunderstanding of the figures, and the significance of some of the more important items is noted. Maps have been used in the state bulletins and in the United States summary to show the approximate location and area of the operating drainage enterprises. Throughout the publications, effort has been made to give the statistics complete in tabular form so that the comparable figures would be brought close together and be most easily comprehended.

#### DRAINAGE ON FARMS.

The first drainage of land for agriculture was, naturally, by individual effort of each farm owner or operator upon his own farm. Though proper drainage many times requires cooperation by a great number of landowners, and most states have enacted laws specially designed to accommodate organized cooperative enterprises, the full benefits from the cooperative drainage works usually are not obtained until supplemental drains have been installed by the individual owners. It is known, however, that a few districts organized for draining irrigated land in western states have undertaken to drain and protect all the land in those enterprises so thoroughly that supplemental construction by the individual owners will be unnecessary. Land lying close to the outlet drains constructed by public enterprises also may be made more suitable for crop production by those drains. The statistics for artificial drainage provided on farms relate to the area actually improved by the installation of ditches, tile, or other drainage works. While no distinction is made between the land drained by individual effort and that benefited by the work of organ-

#### METHOD OF PRESENTING THE STATISTICS.

As has been stated previously, this volume contains all the statistics relating to drainage that have been printed by the census. In the discussion that follows, most of the data are grouped according to the nine geographic divisions of the country. The principal advantage of this arrangement is to combine the figures into a smaller number of divisions that are more easily comprehended than the larger number of individual states; it also makes easier the comparison of the statistics for neighboring states.

Since no census of drainage has been taken heretofore, no opportunity is afforded for making comparison with the status of drainage at some previous date, other than the classifications given by date of organization of the enterprises. However, the importance of drainage in agriculture is suggested by comparison of the acreages drained with the acreages of all land and with the acreages of improved land in farms.

ized enterprises, examination of the information obtained indicates that land receiving merely outlet facilities through the construction of public drains has not been included in this part of the statistics.

In presenting the figures for drainage on farms, it is recognized that undoubtedly there has been considerable difference in the conception of when land is provided with drainage. Where the more intensive methods of agriculture are not generally practiced, fields often are considered as drained if a few shallow ditches have been dug across or around them to carry away the surface water; elsewhere, in regions where expensive farm drainage is common, land will be said still to need drainage though many lines of tile may have been laid through it, if the excess moisture is not removed from the soil so promptly that there is no interference with farming operations and no diminution in the crop yield.

**Need for drainage on farms.**—In any region or locality, the amount of land that actually requires artificial drainage to make it suitable or most profitable for growing crops depends chiefly upon the topography, soil, and climate. A level ground surface, or dish-like pockets or depressions in a rolling surface, ordinarily must have more than the natural drainage before the land can have a high value for agriculture. A pervious subsoil or fissured stratum may provide natural drainage if it connects with some lower surface or subterranean watercourse. The amount and distribution of the rainfall and of the run-off from melting snow, particularly as related to the growing season and the kinds of crops suitable to the region, affect the practical sufficiency of the natural drainage. In the West where irrigation is generally practiced, seepage losses from canals and deep percolation from irrigated fields in a great many localities may water-log the soil

in depressions or at the foot of the benches, or may raise the water table sufficiently for evaporation from the ground surface to concentrate mineral salts, commonly called alkali, in the top soil until the crops are

injured or killed. The amount of land reported as needing drainage is affected, too, by the opinions of the farm operators regarding the potential value of the soil and the benefits that will accrue from drainage.

TABLE 1.—NUMBER OF FARMS AND LAND IN FARMS, PROVIDED WITH DRAINAGE AND NEEDING DRAINAGE: 1920.

DIVISION AND STATE.	NUMBER OF FARMS.							LAND IN FARMS.						
	All farms.	Provided with or needing drainage.		Provided with drainage.		Needing drainage.		All land in farms (acres).	Provided with drainage.		Additional needing drainage.			
		Number. <sup>1</sup>	Per cent of all farms.	Number.	Per cent of all farms.	Number.	Per cent of all farms.		Acreage.	Per cent of all land in farms.	Acreage.	Per cent of all land in farms.	Clearing required, also.	
													Acreage.	Per cent of all land in farms.
United States.....	6,448,343	1,478,287	22.9	924,815	14.3	956,095	14.8	955,883,715	53,024,975	5.5	39,169,639	4.1	28,710,468	3.0
GEOGRAPHIC DIVISIONS:														
New England.....	156,564	22,577	14.4	9,083	5.8	17,571	11.2	16,990,642	129,799	0.8	397,267	2.3	310,276	1.8
Middle Atlantic.....	425,147	102,567	24.1	61,549	14.5	69,216	16.3	40,572,901	1,673,638	4.1	1,412,038	3.5	906,128	2.2
East North Central.....	1,084,744	539,146	49.7	429,584	39.6	302,008	27.8	117,735,179	30,737,056	26.1	8,870,356	7.5	5,626,929	4.8
West North Central.....	1,096,951	256,386	23.4	163,714	14.9	169,593	15.5	256,973,229	11,768,939	4.6	7,260,539	2.8	3,073,154	1.2
South Atlantic.....	1,158,976	219,890	19.0	114,983	9.9	156,780	13.5	97,775,243	2,865,072	2.9	7,511,230	7.7	6,814,543	7.0
East South Central.....	1,051,600	150,536	14.3	69,597	6.6	106,972	10.2	78,897,463	1,720,517	2.2	4,279,968	5.4	3,817,928	4.8
West South Central.....	996,088	125,285	12.6	44,835	4.5	91,595	9.2	173,440,127	2,365,701	1.4	7,134,572	4.1	6,400,267	3.7
Mountain.....	244,109	21,740	8.9	9,754	4.0	14,988	6.1	117,337,226	456,015	0.4	969,948	0.8	640,589	0.5
Pacific.....	234,164	40,160	17.2	21,716	9.3	27,372	11.7	56,152,705	1,318,238	2.3	1,333,721	2.4	1,120,644	2.0
NEW ENGLAND:														
Maine.....	48,227	6,499	13.5	2,068	4.3	5,425	11.2	5,425,968	26,302	0.5	142,053	2.6	122,123	2.3
New Hampshire.....	20,523	2,351	11.5	1,013	4.9	1,794	8.7	2,603,806	11,777	0.5	40,783	1.6	30,869	1.2
Vermont.....	29,075	4,116	14.2	1,728	5.9	3,042	10.5	4,235,811	35,649	0.8	68,912	1.6	49,647	1.2
Massachusetts.....	32,001	5,736	17.9	2,955	9.2	4,112	12.8	2,494,477	39,022	1.6	80,883	3.2	59,671	2.4
Rhode Island.....	4,083	414	10.1	116	2.8	359	8.8	331,600	2,403	0.7	8,174	2.5	5,934	1.8
Connecticut.....	22,655	3,461	15.3	1,203	5.3	2,839	12.5	1,898,980	14,646	0.8	56,462	3.0	42,032	2.2
MIDDLE ATLANTIC:														
New York.....	183,195	56,496	29.2	33,896	17.5	38,523	19.9	20,632,803	1,180,423	5.7	779,467	3.8	460,602	2.2
New Jersey.....	29,702	6,712	22.6	4,903	16.5	3,428	11.5	2,282,585	174,260	7.6	77,881	3.4	48,688	2.1
Pennsylvania.....	202,250	39,359	19.5	22,760	11.2	27,265	13.5	17,657,513	318,955	1.8	554,690	3.1	396,838	2.2
EAST NORTH CENTRAL:														
Ohio.....	256,695	148,022	57.7	130,117	50.7	85,326	33.2	23,515,888	7,365,532	31.3	2,014,889	8.6	1,128,332	4.8
Indiana.....	205,126	122,268	59.6	111,435	54.3	66,413	32.4	21,063,332	8,908,944	39.4	1,717,068	8.2	1,043,116	5.0
Illinois.....	237,181	111,759	47.1	99,246	41.8	33,731	14.2	31,974,775	11,247,637	35.2	1,228,739	3.8	687,246	1.8
Michigan.....	196,447	95,215	48.5	66,948	34.1	64,310	32.7	19,032,961	3,156,682	16.6	2,070,387	10.9	1,490,574	7.3
Wisconsin.....	189,295	61,882	32.7	21,838	11.5	52,228	27.6	22,148,223	658,411	3.0	1,839,273	8.3	1,377,661	6.2
WEST NORTH CENTRAL:														
Minnesota.....	178,478	93,453	52.4	53,011	29.7	73,905	41.4	30,221,758	2,993,034	9.9	3,504,574	11.6	1,703,117	5.6
Iowa.....	213,439	107,746	50.5	88,865	41.6	56,083	26.3	33,474,896	7,334,404	21.9	2,052,942	6.1	391,198	1.2
Missouri.....	263,004	28,653	10.9	11,917	4.5	19,572	7.4	34,774,079	859,663	2.5	339,693	2.4	687,515	1.9
North Dakota.....	77,690	3,147	4.1	682	0.9	2,669	3.4	36,214,751	89,054	0.2	211,305	0.6	158,144	0.4
South Dakota.....	74,637	13,918	18.6	4,077	5.5	11,828	15.8	34,636,491	161,371	0.5	446,915	1.3	90,866	0.3
Nebraska.....	124,417	4,701	3.8	2,356	1.9	2,963	2.4	42,225,475	214,428	0.5	145,818	0.3	30,393	0.1
Kansas.....	165,286	4,768	2.9	2,806	1.7	2,573	1.6	45,425,179	106,985	0.2	68,292	0.2	31,921	0.1
SOUTH ATLANTIC:														
Delaware.....	10,140	5,114	50.4	4,246	41.9	2,488	24.5	944,511	185,831	19.7	68,969	7.3	61,002	6.5
Maryland.....	47,908	10,964	22.9	6,911	14.4	6,658	13.9	4,757,999	249,799	5.3	184,820	3.9	151,553	3.2
District of Columbia.....	204	30	14.7	21	10.3	12	5.9	5,668	197	3.5	115	2.0	57	1.0
Virginia.....	186,242	32,854	17.6	9,899	5.3	27,740	14.9	18,561,112	225,068	1.2	1,172,580	6.3	1,095,388	5.9
West Virginia.....	87,239	11,238	12.9	1,949	2.2	10,304	11.8	9,569,790	38,464	0.4	310,868	3.2	278,615	2.9
North Carolina.....	269,763	65,976	24.5	45,246	16.8	42,247	15.7	20,021,736	1,066,933	5.3	1,925,343	9.6	1,735,942	8.7
South Carolina.....	192,692	40,015	20.8	26,993	14.0	24,508	12.7	12,426,675	676,152	5.4	1,341,903	10.8	1,216,355	9.8
Georgia.....	310,732	42,912	13.8	15,121	4.9	34,337	11.1	25,441,061	274,688	1.1	1,819,611	7.2	1,676,424	6.6
Florida.....	54,006	10,787	20.0	4,597	8.5	8,486	15.7	6,046,691	147,940	2.4	687,021	11.4	599,207	9.9
EAST SOUTH CENTRAL:														
Kentucky.....	270,626	23,424	8.7	5,817	2.1	19,592	7.2	21,612,772	225,228	1.0	573,299	2.7	489,110	2.3
Tennessee.....	252,774	26,739	10.6	8,887	3.5	20,997	8.3	19,510,856	254,118	1.3	640,479	3.3	563,835	2.9
Alabama.....	256,099	46,675	18.2	19,967	7.8	36,511	14.3	19,576,856	415,293	2.1	1,610,656	8.2	1,460,628	7.5
Mississippi.....	272,101	53,698	19.7	34,926	12.8	29,872	11.0	18,196,979	825,878	4.5	1,455,534	8.0	1,304,355	7.2
WEST SOUTH CENTRAL:														
Arkansas.....	232,604	43,223	18.6	13,426	5.8	33,437	14.4	17,456,750	497,489	2.8	1,642,403	9.4	1,512,416	8.7
Louisiana.....	135,463	31,994	23.6	21,271	15.7	14,985	11.1	10,019,822	1,004,935	10.0	1,095,769	10.9	916,464	9.1
Oklahoma.....	191,688	9,266	4.9	2,032	1.1	8,065	4.2	31,351,934	107,014	0.3	265,786	0.8	225,998	0.7
Texas.....	436,033	40,732	9.3	8,106	1.9	35,108	8.1	114,020,621	766,263	0.7	4,130,614	3.6	3,745,389	3.3
MOUNTAIN:														
Montana.....	57,677	2,222	3.9	756	1.3	1,728	3.0	35,070,656	51,146	0.1	113,293	0.3	76,951	0.2
Idaho.....	42,106	3,704	8.8	1,167	2.8	2,595	6.9	8,375,873	64,648	0.8	199,574	2.4	162,308	1.9
Wyoming.....	15,748	1,430	9.1	433	2.7	1,127	7.2	11,809,351	35,654	0.3	69,066	0.6	45,229	0.4
Colorado.....	59,934	6,138	10.2	2,749	4.6	4,399	7.3	24,462,014	127,037	0.5	270,997	1.1	190,876	0.8
New Mexico.....	29,844	1,990	6.7	1,294	4.3	998	3.3	24,409,633	47,311	0.2	49,102	0.2	20,086	0.1
Arizona.....	9,975	1,580	15.5	241	2.4	425	4.4	5,802,126	9,651	0.2	41,951	0.7	32,355	0.6
Utah.....	25,662	5,068	19.7	2,729	10.6	3,085	12.0	5,050,410	74,316	1.5	165,926	3.3	91,140	1.8
Nevada.....	3,163	638	20.2	385	12.0	321	10.1	2,357,163	40,252	2.0	59,739	2.5	21,644	0.9
PACIFIC:														
Washington.....	66,288	19,155	28.9	10,020	15.1	14,323	21.6	13,244,720	274,696	2.1	576,005	4.3	530,799	4.0
Oregon.....	50,206	13,450	26.8	6,618	13.2	9,862	19.6	13,542,318	229,582	1.7	471,396	3.5	396,333	2.9
California.....	117,670	7,555	6.4	5,078	4.3	3,187	2.7	29,365,667	813,960	2.8	286,320	1.0	193,512	0.7

<sup>1</sup> There are 402,623 farms reported as having both land provided with drainage and additional land needing drainage.

The conditions influencing the need for artificial drains to remove water from the ground surface are generally recognized, while the unfavorable conditions that could be eliminated or mitigated by better drainage of the soil itself are not generally recognized. Lack of drainage makes a soil hard and lumpy when dry, difficult to cultivate and unsuited to the development of plant roots or to the release of plant food; it keeps the soil acid or "sour," counteracting the inherent fertility; it keeps the soil cold, delaying planting in the spring; and when only part of a field has poor drainage, it interferes with cultivation of the other parts. In the irrigated region, the need of protection against seepage and alkali often is not recognized until injury has resulted. If the benefits to be derived from soil drainage were more generally understood, undoubtedly in some sections a larger acreage would have been reported as needing drainage. The statistics given, as previously explained, relate only to the land included in farms on the date of the census.

**Number of farms having drainage.**—The figures in Table 1 show rather less than one-fourth (22.9 per cent) of all the farms in the United States as having land that has needed or does need artificial drainage. The percentages of such farms range from 8.9 for the Mountain division to 49.7 per cent for the East North Central division; for the individual states they range from 2.9 for Kansas to 59.6 for Indiana. For all the 1,478,287 farms not having adequate natural drainage, 35.3 per cent have provided the additional drainage recognized as necessary, 27.2 per cent have provided part of the work, and 37.4 per cent have yet to begin construction of the artificial drains required in order that the land may be most fully available for growing crops.

**Area provided with drainage.**—Drainage of farm land is most universally practiced in northern Indiana and the adjacent parts of Illinois and Ohio. This kind of farm improvement is general also in north central Iowa and southeastern Michigan, and it is common in southern and northwestern Minnesota, in

western New York, between the Delaware and Chesapeake Bays, in the coastal plain of the Carolinas, Louisiana, and eastern Texas, along lower Mississippi River, and in the San Joaquin Valley of California.

Table 1 shows that 9.6 per cent of all land in farms in the United States was reported as having been provided with artificial drainage or to be in need of that improvement. The portions in the geographic divisions and states range from 1.2 per cent for the Mountain division to 33.6 per cent for the East North Central division, and from 0.4 per cent for Kansas, Montana, and New Mexico to 47.6 per cent for Indiana.

Of the total area that has or requires artificial drainage on farms, the greatest portion is in the East North Central division, which embraced 43.0 per cent of all that land at the beginning of 1920. The West North Central division has the second largest portion, 20.6 per cent. Illinois has a greater area of such land than any other state, having 13.5 per cent of the total; Indiana has 10.9 per cent and Iowa and Ohio each has 10.2 per cent.

It was deemed impracticable to undertake to secure information regarding the kind and amount of drains, or the cost or value of the drainage provided. Seldom would an operator have definite knowledge of the work that was done before he came upon the farm. It is even probable that some land which was provided with tile drainage many years ago has been omitted from the enumeration because the present operator was entirely ignorant of the fact that such work had been done, but it is not supposed that the total of such omissions would materially affect the statistics obtained.

**Farms in drainage enterprises.**—The census of agriculture endeavored to learn the number of farms in drainage and levee districts, asking of each farm operator, "Has any part of this farm been afforded drainage or protection against overflow by a drainage or levee district, or by the state, county, or by a private company or individual?"

TABLE 2.—FARMS REPORTED IN DRAINAGE AND LEVEE DISTRICTS: 1920.

DIVISION.	Number of all farms.	FARMS IN DRAINAGE AND LEVEE DISTRICTS.		Approximate land area (acres).	LAND IN OPERATING DRAINAGE ENTERPRISES.		IMPROVED LAND IN FARMS.				
		Number.	Per cent of all farms.		Acreage.	Per cent of total land area.	For all farms.		For farms in drainage enterprises.		
							Total acreage.	Average per farm (acres).	Total acreage.	Acreage.	Per cent of average for all farms.
United States <sup>1</sup> .....	5,278,750	168,840	3.2	1,717,932,160	65,495,038	3.8	441,728,654	83.7	44,288,235	*262.3	313.4
East North Central.....	1,084,744	63,789	5.9	157,160,960	31,627,176	20.1	87,894,835	81.0	25,282,065	*396.3	489.3
West North Central.....	1,096,951	47,883	4.4	326,914,560	19,217,367	5.9	171,394,439	156.2	11,630,279	242.9	155.5
South Atlantic <sup>1</sup> .....	827,193	5,213	0.6	123,405,440	2,385,334	1.9	29,735,048	35.9	388,345	74.5	287.5
East South Central <sup>1</sup> .....	795,501	16,938	2.1	82,067,200	2,323,595	2.8	34,486,725	43.4	1,349,791	70.7	183.6
West South Central.....	996,088	25,010	2.5	275,637,440	7,924,197	2.8	64,189,606	64.4	3,877,166	155.0	249.7
Mountain.....	244,109	3,551	1.5	549,765,760	810,076	0.1	30,105,868	123.3	635,868	179.1	145.3
Pacific.....	234,164	6,456	2.8	203,580,800	1,207,243	0.6	23,921,533	102.2	1,124,721	174.2	170.5

<sup>1</sup> Omitting Alabama, Virginia, West Virginia, and all states north of Potomac River.

<sup>2</sup> These figures indicate that, especially in the East North Central states, the actual number of farms in drainage and levee districts is greater than the number so reported.



Computation of the average acreage of improved land per farm in drainage enterprises, in comparison with the average improved acreage for all farms, indicates that the number of farms reported as in such enterprises is much less than the actual number so included. (See Table 2.) The discrepancy is much more evident when comparisons are made for individual states and counties.

#### DRAINAGE ENTERPRISES.

Statistics were collected relating to both operating and nonoperating drainage enterprises. Concerning many of the nonoperating enterprises, complete information could not be secured because plans for the improvement works had not been completed, and the cost of the enterprise, and even the area to be included, were in some instances more or less uncertain. Therefore it is expedient, in much of the discussion that follows, to consider only the operating enterprises.

**Character of enterprises.**—It is a general condition in considerable parts of most states that the drainage of one individual's land can not be obtained without the construction of an artificial drain or the improvement of a natural watercourse through the land of another individual, or without materially benefiting other owners. Usually, under such circumstances the cost of the outlet drain is much greater than the benefit to any one farm, and much greater than any of the individuals could assume. In order that some farm owners may not be prevented from obtaining such drainage as is necessary for the full utilization of their land, and that the expense of reclaiming or improving considerable areas may be equitably apportioned, very nearly all of the states have recognized, directly or tacitly, that drainage of land for agriculture is a public good, and have passed laws permitting or encouraging the organization of public corporations or local improvement districts for this purpose.

Drainage laws have been enacted in all the states covered by the census of organized drainage enterprises. These statutes for each state are abstracted briefly in the bulletin for that state. The year in which the first general statute authorizing such organizations was enacted in each state is shown in Table 3. Before these dates, many enterprises were authorized by special acts of the legislatures, each act creating a special district. The information secured by the census indicates, however, that most if not all of those early districts have been abandoned or have been reorganized under later statutes. There are still a considerable number of special districts, particularly in Arkansas, California, and Florida, created either because the general laws were defective or because the promoters of the projects deemed it easier to secure special legislation than to adapt their plans to the laws then in force and perhaps not fully tested in practice.

TABLE 3.—DATES OF FIRST GENERAL LAWS AUTHORIZING THE ESTABLISHMENT OF PUBLIC DRAINAGE ENTERPRISES, BY STATES.

[Statutes authorizing merely the construction of levees, or drainage for sanitary purposes, are not included.]

STATE.	Year.	STATE.	Year.
Michigan.....	1847	Colorado <sup>2</sup> .....	1893
Ohio.....	1847	Florida.....	1893
Indiana.....	1852	Kentucky.....	1893
South Carolina.....	1853	Texas.....	1895
Minnesota.....	1853	Utah.....	1896
Missouri.....	1859	Mississippi <sup>3</sup> .....	1896
Wisconsin.....	1862	Idaho <sup>4</sup> .....	1898
Illinois.....	1865	Montana.....	1903
California.....	1868	Oklahoma.....	1905
North Carolina.....	1869	Virginia.....	1905
Kansas.....	1870	Tennessee.....	1906
Iowa.....	1872	Georgia.....	1909
Nebraska.....	1873	Nevada.....	1911
Washington <sup>1</sup> .....	1875	Wyoming.....	1911
Oregon.....	1880	Arizona.....	1912
North Dakota <sup>1</sup> .....	1883	New Mexico.....	1912
South Dakota <sup>1</sup> .....	1883	Alabama.....	1915
Louisiana.....	1888	West Virginia.....	1917
Arkansas.....	1891		

<sup>1</sup> These first statutes were enacted by the territories before admission as states.

<sup>2</sup> A law was enacted in 1883 and repealed in 1885.

<sup>3</sup> A law applying only in Lee County was enacted in 1886.

<sup>4</sup> This statute was declared unconstitutional in 1912, and a new law was enacted in 1913.

Table 4 shows, by periods, the date of organization of the first public drainage enterprise in each state as reported upon the schedules secured. Undoubtedly enterprises were organized before 1860 in Michigan as well as in Indiana and Ohio, as laws providing for the establishment of public drains were enacted as early as 1847. Then all the East North Central and West North Central states except the Dakotas had organized drainage enterprises before 1890, and before any other states except California and North Carolina.

TABLE 4.—DATE OF ORGANIZATION OF FIRST DRAINAGE ENTERPRISES REPORTED, BY STATES.

DATE OF ORGANIZATION.	STATES.
Before 1860.....	Indiana, Ohio.
1860 to 1869.....	California.
1870 to 1879.....	Illinois, Iowa, Kansas, Wisconsin.
1880 to 1889.....	Minnesota, Missouri, Nebraska, North Carolina. <sup>1</sup>
1890 to 1899.....	Kentucky, Louisiana, Michigan, <sup>2</sup> Mississippi, North Dakota.
1900 to 1904.....	Texas, Washington.
1905 to 1909.....	Arkansas, Florida, Montana, New Mexico, Oklahoma, South Dakota, Utah.
1910 to 1914.....	Arizona, Colorado, Georgia, <sup>3</sup> Idaho, South Carolina, Tennessee, Wyoming.
1915 to 1919.....	Nevada, Oregon.

<sup>1</sup> The enterprises reported in North Carolina before 1880 were under individual ownership.

<sup>2</sup> The canvass in Michigan omitted the enterprises established before 1897.

<sup>3</sup> The enterprises reported in Georgia before 1910 were under individual ownership.

Previous to the earliest acts for establishing public drains, a number of the states had recognized the right of every landowner to a drainage outlet by providing that an owner desiring drainage might apply to a designated official, and, if the necessity were proved, upon payment of damages secure easement to construct and maintain a private drain across his neighbor's land. The first of these laws were enacted by North Carolina in 1795, Florida in 1834, Michigan in 1839, Tennessee in 1842, and Virginia in 1848. Such private drains, however, are not generally included in the census statistics for drainage enterprises.

There are many shades of difference between the drainage laws of the various states, but there are in

general two principal types of organization. The corporate district is governed by its own officers, who either are elected by the residents or land owners of the district, or are specially appointed by the authority which creates the enterprise. The county drain is established and constructed as any other public work or local improvement, the enterprise being managed by regular officers who have charge of all these enterprises in their county. Some enterprises are administered by a commission or board consisting of one or more officials of the county and one or more members selected by the owners of the land assessed for the cost of the drainage.

The drainage districts and county drains represented, on January 1, 1920, 96 per cent in area of all the organized drainage enterprises, and 94 per cent in amount of capital invested. The other enterprises included in the statistics are township drains, similar in form to county drains but controlled by officers of the townships; state drainage projects controlled by state officials and embracing considerable amounts of state land; irrigation districts, similar in character to drainage districts, that have undertaken drainage of land in those districts; irrigation projects of the United States Reclamation Service; commercial companies reclaiming and improving wet land for sale; and individual owners draining as much as 500 acres each, to be used for agricultural purposes. The total acreage and capital invested in all drainage enterprises are shown classified by character of enterprise in Table 6, page 369.

**Area in drainage enterprises.**—The area embraced in all the organized drainage enterprises is approximately 69,419,859 acres. This is 3.65 per cent of the total land area of the United States, and 4.04 per cent of the land area of the 34 states included in the census of drainage enterprises. Nearly half (46.2 per cent) of the land in these enterprises is situated in the East North Central division, and more than a fourth (28.7 per cent) in the West North Central division. The West South Central division has 13.1 per cent of the total, and none of the others has more than 5 per cent.

The area in operating drainage enterprises is 65,495,038 acres, 94.3 per cent of that in all enterprises. The location and area of these enterprises are shown by the map following page 345, and by the state and county tables. The single states having the largest areas in operating enterprises are, in order, Michigan, Minnesota, and Indiana, each with more than 9,000,000 acres. Of the 3,924,821 acres in nonoperating enterprises, 1,138,283 acres are reported in Arkansas and Louisiana together, and more than 1,000,000 acres in Florida. State Table II, page 373, shows also the distribution of the land in nonoperating enterprises by geographic divisions and states.

The drainage works authorized to be constructed by the enterprises have been completed for 56,763,751

acres. This may be interpreted as indicating that the farms in this area have been at least fairly well provided with main or outlet drains. In some regions it is customary for the drainage districts to construct the drainage systems in such detail that a public drain will reach each farm; in other regions, where there is much unimproved land not in farms, a large district may construct only the main ditches that will serve the area as a whole, leaving the branch drains for construction by subdistricts to be organized as the landowners in those sections to be benefited by the respective branches may desire the improvements. Of the enterprises that have completed construction, 53.7 per cent in area is in the East North Central division and 29.9 per cent in the West North Central division. In each of the South Atlantic, Mountain, and Pacific divisions, the enterprises that have completed the authorized works comprise less than 1,000,000 acres.

The enterprises that were constructing drainage works on January 1, 1920, comprised 8,731,287 acres, of which more than 2,000,000 acres are situated in each of the West North Central and West South Central divisions and more than 1,000,000 acres each in the East North Central and South Atlantic divisions. In Arkansas and Florida together there are 2,640,150 acres in the partly completed enterprises. In some of these enterprises that are nearing completion a considerable part of the land may have been completely drained, and in others that had been started but recently no benefit may have yet been secured.

The condition of the land in drainage enterprises, both operating and nonoperating, is shown in State Table IV, page 375. As has already been explained, the entire acreage in the enterprises is divided under the three headings, improved, timber and cut-over, and other unimproved land, and the area reported as swampy or subject to overflow includes land injured by seepage or alkali and is partly timbered and partly open or cleared land.

The portions improved of the total areas in operating enterprises range from 16.3 per cent in the South Atlantic division to 79.9 in the East North Central division and 93.2 per cent in the Pacific division, the average for the United States being 67.6 per cent. The states having the greatest portions improved of all land in operating enterprises are Oregon and California, for which the percentages are 100.0 and 93.7, respectively. The improved portion in nonoperating drainage enterprises is 35.1 per cent for all the states, varying from 3.5 per cent for the South Atlantic division to 72.1 per cent for the Mountain division. The states having the largest portions are Kansas, with 93.4 per cent, and Arizona, with 87.9 per cent.

The percentage improved of all land in operating drainage enterprises is greater than the percentage improved of all land in farms for the United States as a whole, and for each geographic division except

the West North Central and the South Atlantic. For nonoperating enterprises the percentages improved are less than the averages for all farms, except in the Mountain and Pacific divisions where so large a part of the enterprises are for draining irrigated land.

Of the unimproved land in operating enterprises, slightly more than half is covered with timber, stumps, or other growth that will necessitate more or less expensive clearing in addition to drainage, to make it fully available for cultivation. The amount of land covered with merchantable timber was not determined by the census, nor were inquiries made to learn what part of all land in the enterprises is included in farms. In the nonoperating enterprises the relation between timbered and cleared land is roughly the same as for the operating enterprises, in all the divisions and in most of the states, suggesting that the open land has not been developed after drainage to any remarkably greater proportion than the timbered land. This fact is shown by the statistics for development of land in State Table V (pages 376 to 379), which show that in the operating enterprises the area timbered or cut-over prior to drainage has been reduced 48.1 per cent, and the other unimproved land 48.2 per cent for the United States as a whole. The percentages for the geographic divisions and for the individual states vary considerably, but the figures seem to indicate that development and utilization of the land usually have been determined by other conditions than the amount of clearing required. The amount of timber and stumps and the cost of clearing undoubtedly have their influence in determining whether any particular enterprise shall be organized.

**Crops on drained land.**—The crops grown upon the drained land generally are those most common to the regions in which the drainage enterprises are situated. The area actually devoted to any crop was not determined in any instance, but corn was reported as the principal crop by enterprises embracing 61 per cent of the improved land in all operating enterprises in the United States. It was reported as the principal crop by enterprises having 55 to 72 per cent of the improved land in enterprises in the East and West North Central and the South Atlantic divisions, and by enterprises having the greatest improved acreages in 12 of the 34 individual states canvassed. Wheat was reported the principal crop for Michigan, Minnesota, North Dakota, Kansas, Montana, and California; cotton for South Carolina, Mississippi, Arkansas, Oklahoma, and Arizona; vegetables for Florida; sugar cane for Louisiana; hay for Wisconsin; and alfalfa for Washington, Oregon, and the Mountain states except Arizona and Montana.

#### DRAINAGE WORKS OF ENTERPRISES.

**Drains and levees.**—The improvement works of the operating drainage enterprises consist of 107,468.2

miles of open ditches and 42,311.7 miles of tile drains completed, and 4,301.8 miles of ditches and 2,862.1 miles of tile drains under construction, together with accessory levees, pumping plants, and appurtenant structures. Of the levees, 3,519.8 miles had been completed and 810.2 miles additional were under construction at the beginning of 1920.

More than half the open ditch drains and more than half the tile drains constructed by organized enterprises are located in the East North Central states, and 40 per cent of the tile are in the West North Central states. The length of the open ditches is very much greater than the length of tile drains for the United States as a whole, and for each geographic division except the Mountain states, where the length of tile drains is two and one-half times as great as the length of open ditches (see Table 5). The drainage there is almost entirely for the reclamation or protection of land under irrigation, and in soils containing so-called alkali the ground water table should be kept below the range of capillarity to prevent evaporation from the ground surface and the concentration of the alkali in the top soil with the consequent injury to crops. Where the required capacity is much less than that of an open ditch of the necessary depth, covered tile drains of clay, concrete, or wood, though often more costly, usually have many advantages.

TABLE 5.—DRAINAGE WORKS OF OPERATING ENTERPRISES, CLASSIFIED BY KIND AND BY GEOGRAPHIC DIVISIONS: 1920.

KIND OF WORKS.	ALL AUTHORIZED.		Completed (miles).	Under construction (miles).
	Miles.	Per cent of total.		
<b>UNITED STATES:</b>				
Total.....	161,273.8	100.0	153,299.7	7,974.1
Open ditches.....	111,770.0	69.3	107,468.2	4,301.8
Tile drains.....	45,173.8	28.0	42,311.7	2,862.1
Levees and dikes.....	4,330.0	2.7	3,519.8	810.2
<b>EAST NORTH CENTRAL:</b>				
Total.....	90,007.2	100.0	89,115.9	891.3
Open ditches.....	65,333.2	72.6	64,924.3	408.9
Tile drains.....	23,694.8	26.3	23,325.2	369.5
Levees and dikes.....	979.2	1.1	866.4	112.8
<b>WEST NORTH CENTRAL:</b>				
Total.....	43,837.0	100.0	41,720.6	2,116.4
Open ditches.....	24,658.3	56.2	23,912.7	745.6
Tile drains.....	18,394.3	42.0	17,109.3	1,285.0
Levees and dikes.....	784.4	1.8	698.6	85.8
<b>SOUTH ATLANTIC:</b>				
Total.....	5,441.7	100.0	3,914.8	1,526.9
Open ditches.....	4,931.0	90.6	3,701.6	1,229.4
Tile drains.....	262.5	4.8	101.5	161.0
Levees and dikes.....	248.2	4.6	111.7	136.5
<b>EAST SOUTH CENTRAL:</b>				
Total.....	4,169.7	100.0	3,631.4	538.3
Open ditches.....	3,692.9	88.6	3,256.9	436.0
Tile drains.....	380.6	9.1	325.3	55.3
Levees and dikes.....	96.2	2.3	49.2	47.0
<b>WEST SOUTH CENTRAL:</b>				
Total.....	9,861.4	100.0	8,318.7	1,542.7
Open ditches.....	8,906.8	90.3	7,672.8	1,234.0
Tile drains.....	22.6	0.2	20.6	2.0
Levees and dikes.....	932.0	9.5	625.3	306.7
<b>MOUNTAIN:</b>				
Total.....	3,115.0	100.0	2,113.4	1,001.6
Open ditches.....	863.8	27.7	827.7	36.1
Tile drains.....	2,213.7	71.1	1,248.2	965.5
Levees and dikes.....	37.5	1.2	37.5	.....
<b>PACIFIC:</b>				
Total.....	4,841.8	100.0	4,484.9	356.9
Open ditches.....	3,384.0	69.9	3,172.2	211.8
Tile drains.....	205.3	4.2	181.6	23.7
Levees and dikes.....	1,252.5	25.9	1,131.1	121.4

The length of levees for the drainage enterprises is less than 3 per cent of the length of ditches and tile drains authorized for the whole country, but in the Pacific states slightly more than one-third as much as the total length of the drains.

When the works under construction have been completed, the drains provided by the enterprises will be all open ditches for three-fourths of the land in the operating enterprises. For one-sixth of the area, systems combining tile and open drains will be used, and for the remaining small amount tile drains only. The areas in operating enterprises in each geographic division are thus classified by kind of works in Table 6, which shows also the average length of drain per acre.

TABLE 6.—AREA DRAINED AND LENGTH OF DRAINS PER ACRE FOR OPERATING ENTERPRISES, CLASSIFIED BY KIND OF DRAINS AND GEOGRAPHIC DIVISIONS: 1920.

KIND OF DRAIN.	AREA DRAINED.		LENGTH OF DRAINS.		
	Acreage.	Per cent of total.	Total authorized (miles).	Per acre.	
				Feet.	Per cent of mean.
<b>UNITED STATES:</b>					
Total or mean.....	85,495,038	100.0	156,943.8	12.7	100.0
Open ditches only.....	49,314,485	75.3	93,244.3	10.0	78.7
Tile drains only.....	4,974,261	7.6	23,204.4	24.6	193.7
Open ditches and tile drains.....	11,206,292	17.1	40,495.1	19.1	150.4
<b>EAST NORTH CENTRAL:</b>					
Total or mean.....	31,627,176	100.0	89,028.0	14.9	100.0
Open ditches only.....	21,339,687	67.5	51,959.9	12.9	86.6
Tile drains only.....	3,068,495	9.8	12,524.0	21.3	143.0
Open ditches and tile drains.....	7,188,994	22.7	24,544.1	18.0	120.8
<b>WEST NORTH CENTRAL:</b>					
Total or mean.....	19,217,367	100.0	43,052.0	11.8	100.0
Open ditches only.....	14,301,750	74.4	20,886.3	7.7	65.3
Tile drains only.....	1,747,658	9.1	10,096.3	30.5	258.5
Open ditches and tile drains.....	3,167,959	16.5	12,070.0	20.1	170.3
<b>SOUTH ATLANTIC:</b>					
Total or mean.....	2,385,384	100.0	5,193.5	11.5	100.0
Open ditches only.....	2,376,184	99.6	4,816.0	10.7	93.0
Tile drains only.....					
Open ditches and tile drains.....	19,200	0.4	377.5	216.7	1,884.3
<b>EAST SOUTH CENTRAL:</b>					
Total or mean.....	2,323,595	100.0	4,073.5	9.3	100.0
Open ditches only.....	2,263,610	97.4	3,548.3	8.3	89.2
Tile drains only.....	8,917	0.4	115.0	68.1	732.3
Open ditches and tile drains.....	51,068	2.2	410.2	42.4	455.9
<b>WEST SOUTH CENTRAL:</b>					
Total or mean.....	7,924,197	100.0	8,929.4	5.9	100.0
Open ditches only.....	7,882,741	99.5	8,809.2	5.9	100.0
Tile drains only.....	3,100	( <sup>1</sup> )	20.0	34.1	578.0
Open ditches and tile drains.....	38,356	0.5	100.2	13.8	233.9
<b>MOUNTAIN:</b>					
Total or mean.....	810,076	100.0	3,077.5	20.1	100.0
Open ditches only.....	242,028	29.9	451.0	9.8	48.8
Tile drains only.....	105,525	13.0	402.8	20.2	100.5
Open ditches and tile drains.....	462,523	57.1	2,223.7	25.4	126.4
<b>PACIFIC:</b>					
Total or mean.....	1,207,243	100.0	3,589.3	15.7	100.0
Open ditches only.....	908,485	75.3	2,773.6	16.1	102.5
Tile drains only.....	10,566	0.9	46.3	23.1	147.1
Open ditches and tile drains.....	288,192	23.9	769.4	14.1	89.6

<sup>1</sup> All individual ownership enterprises.

<sup>2</sup> Less than one-tenth of 1 per cent.

It is to be understood that these figures are only approximations. Owing to the method of eliminating the overlapping of enterprises, as previously explained, the classification of land by drainage works was made according to the kind of works provided by the first

enterprise embracing any particular area. To correct the errors in this classification would increase the area shown for open ditches and tile together, and decrease the areas for open ditches only and for tile drains only. While some ditches have been replaced by tile drains, and probably a few tile by open drains, it is not probable that such changes would offset more than a small part of those in which ditches or tile have been supplemented by tile or ditches, respectively.

The average length of all drains per acre varies from 5.9 feet to 20.1 feet for the geographic divisions, and is 12.7 feet for the United States as a whole. These lengths are equivalent to parallel drains 1.40, 0.41, and 0.65 miles apart, respectively, without making any deduction of length for connecting one drain with another. The figures for the United States show an equivalent of drains 0.83 mile apart for drainage by open ditches only, and 0.34 mile apart for tile drains only, without deducting for connections.

The earliest drains constructed by public drainage enterprises were mostly open ditches. This was natural, because tile were relatively costly and were not generally made in large sizes; land was sufficiently plentiful that the area occupied by the ditches was not considered important; and the cost of construction could be paid in labor by the persons to be benefited by the drains. Before 1880, tile drains comprised less than 5 per cent in length of the public drains begun. During the next twenty years tile were adopted for 20 per cent of all drains undertaken. For the enterprises organized since 1900, tile are used for 34 per cent of the total length, and those operating enterprises organized in 1915 to 1919 have planned to use tile for 46 per cent of the total length of drains. The increase in use of tile for public drains is shown in Table 7.

TABLE 7.—OPEN DITCHES AND TILE DRAINS OF OPERATING ENTERPRISES, SHOWING INCREASING USE OF TILE DRAINS: 1920.

DATE.	ALL DRAINS.		OPEN DITCHES.		TILE DRAINS.	
	Miles.	Per cent of total.	Miles.	Per cent of all drains.	Miles.	Per cent of all drains.
Total.....	156,943.8	100.0	111,770.0	71.2	45,173.8	28.8
Before 1860.....	177.9	0.1	173.7	97.6	4.2	2.4
1860 to 1869.....	2,343.0	1.5	2,295.5	98.0	47.5	2.0
1870 to 1879.....	7,044.4	4.5	6,671.9	94.7	372.5	5.3
1880 to 1889.....	17,345.2	11.1	14,763.2	85.1	2,582.0	14.9
1890 to 1899.....	17,053.3	10.9	12,747.3	74.7	4,306.0	25.3
1900 to 1904.....	16,043.7	10.2	12,308.3	76.7	3,735.4	23.3
1905 to 1909.....	28,416.7	18.1	20,538.9	72.3	7,877.8	27.7
1910 to 1914.....	36,688.0	23.4	24,875.7	67.8	11,812.3	32.2
1915 to 1919.....	31,135.2	19.8	16,897.5	54.3	14,237.7	45.7
Not reported.....	696.4	0.4	498.0	71.5	198.4	28.5

The length of drains per acre provided by the enterprises was 9.7 feet for those undertakings organized before 1860. It increased to 17.1 feet for all organized before 1880, and has decreased to 12.7 feet for all established before 1920. The changes are shown, by periods, in Table 8.

TABLE 8.—LENGTH OF DRAINS PER ACRE IN OPERATING ENTERPRISES, SHOWING CHANGE IN LENGTH PROVIDED PER ACRE: 1920.

DATE.	Land in enterprises (acres).	Length of all drains <sup>1</sup> (miles).	Length per acre <sup>1</sup> (feet).
All operating enterprises reported as established before 1860.....	97,319	177.9	9.7
1870.....	880,676	2,520.9	15.1
1880.....	2,958,393	9,565.3	17.1
1890.....	8,382,687	26,910.5	17.0
1900.....	14,409,624	43,963.8	16.1
1905.....	22,016,377	60,007.5	14.4
1910.....	36,546,774	88,424.2	12.8
1915.....	53,890,872	125,112.2	12.3
1920.....	65,265,491	156,247.4	12.6
Total, including those not reporting date.	65,495,038	156,943.8	12.7

<sup>1</sup> When works under construction have been completed.

**Drainage by pumping.**—The area drained by pumping, wholly or for part of the time, is 1,544,010 acres. Of this, 781,441 acres are in enterprises drained entirely by pumping, the other 762,569 acres are embraced in enterprises drained partly by pumping and partly by gravity (see Table 14, page 363). The total capacities of all the pumping plants are 67,189 horsepower and 15,949,166 gallons per minute. The figures for each state and the totals for each geographic division are given in State Table V, pages 376–379 and by counties in the state reports, pages 381–728.

TABLE 9.—PUMPING PLANTS OF OPERATING DRAINAGE ENTERPRISES: 1920.

DIVISION AND STATE.	PUMP CAPACITY.			Mean lift of water (feet).	Engine capacity (horsepower).	Plant ratio. <sup>1</sup>
	Total (gallons per minute).	Per acre (gallons per minute).	Depth per 24 hours (ins.).			
UNITED STATES.....	15,949,166	10.3	0.55	11.4	67,189	1.46
GEOGRAPHIC DIVISIONS:						
East North Central.....	2,964,014	9.4	0.50	11.0	20,190	2.45
West North Central.....	1,086,800	5.2	0.28	10.9	6,003	2.01
South Atlantic.....	1,083,000	10.1	0.54	4.9	1,275	0.95
East South Central.....	78,000	1.8	0.10	5.0	250	2.54
West South Central.....	5,965,150	25.8	1.37	7.1	10,465	0.98
Mountain.....	72,560	2.1	0.11	13.4	480	1.95
Pacific.....	4,699,042	7.8	0.41	19.5	28,526	1.23
EAST NORTH CENTRAL:						
Ohio.....	3,600	2.1	0.11	8.1	125	16.98
Indiana.....	55,348	9.9	0.52	15.9	625	2.81
Illinois.....	2,843,066	9.7	0.51	10.8	18,225	2.35
Michigan.....	62,000	6.1	0.32	11.9	1,065	5.72
Wisconsin.....					160	
WEST NORTH CENTRAL:						
Iowa.....	530,800	3.9	0.21	11.3	3,153	2.08
Missouri.....	562,000	7.9	0.42	10.7	2,785	1.87
Kansas.....	4,000	1.8	0.10	12.0	65	5.36
SOUTH ATLANTIC:						
North Carolina.....	1,000,000	10.0	0.53	4.5	1,000	0.88
South Carolina.....	44,600	15.2	0.81	17.4	155	0.79
Florida.....	39,000	8.7	0.46	2.1	120	5.80
EAST SOUTH CENTRAL:						
Mississippi.....	78,000	1.8	0.10	5.0	250	2.54
WEST SOUTH CENTRAL:						
Arkansas.....	720,000	8.0	0.42	10.0	2,800	1.54
Louisiana.....	5,245,150	37.3	1.98	6.6	7,665	0.88
MOUNTAIN:						
Idaho.....	36,200	4.6	0.24	18.0	285	1.73
Arizona.....	38,660	1.3	0.07	9.0	175	2.29
Utah.....	2,700	1.9	0.10	8.0	20	3.67
PACIFIC:						
California.....	4,699,042	7.8	0.41	19.5	28,526	1.23

<sup>1</sup> Engine capacity divided by product of total pump capacity into mean lift reduced to horsepower.

The enterprises that pump either all or a part of the drainage water, because drainage by gravity is not obtainable, are situated mostly in the states bordering the Mississippi River, although California has nearly twice as great an acreage drained by pumping as any

other state, and North Carolina has the largest pumping district of any state. The information concerning pumping plants is summarized in Tables 9 and 14 and in State Table V, pages 376–379. In Table 9 the average computed capacities of the pumps are given both in gallons per minute per acre and in depth in inches of water per day over the area served. The mean heights that the water is lifted by the pumps are shown, and the ratios of the engine capacities to the effective horsepower of the pumps operating at their stated capacities and at the mean lifts. The mean lift of water is computed from the average lift for each enterprise weighted according to the capacity of the pumps of that enterprise. Louisiana has the greatest total capacity of pumps of any state, and more than twice the capacity per acre of any other state. California has much the greatest total engine capacity, which is reasonably required by the greatest mean lift of water and greatest area served by pumps.

More than nine-tenths of the drainage pumps are of the centrifugal type (see Table 10, page 370), having fully nine-tenths of the total capacity of all the pumps. The average capacity of the centrifugal pumps is 34,280 gallons per minute each. The eleven screw pumps have an average capacity of 111,242 gallons per minute each. More than half the power is supplied by electric motors (see Table 9, page 370), and almost 30 per cent by steam engines. Internal combustion engines supply only about one-tenth of the total horsepower.

#### COST OF DRAINAGE ENTERPRISES.

The statistics gathered by the census for capital invested in drainage enterprises to December 31, 1919, represent actual cash expenditures for drainage. Though a large part of the earlier drains were constructed by the labor of the men whose land would be benefited, no estimate of the value of such labor is included. It was intended that the figures should represent the cost for original construction and for enlargements and extensions, but not expenses for maintenance or repairs. However, where the enterprises do not have a continued separate existence, and repair of the drains is undertaken only by the establishment of new enterprises, part or all of the cost of many enterprises would be properly chargeable as for repair or renewal work. Information for making even an estimate of the expenditures for this kind of work was not obtainable, and the amount has been tabulated with the cost of new drains. It is known also that the costs for a small part of the enterprises that have a continuous existence included some charges for repairs. The amount thus included for those enterprises, though not known, is believed to be relatively small.

The capital invested in all operating drainage enterprises and the cost per acre, for each geographic division and state, are shown in Table 10. The aver-



age investment for those enterprises that have completed construction of drainage improvements undertaken is shown to be \$5.18 per acre, and that for all the enterprises to December 31, 1919, is \$5.68 per acre. The estimated investment, when the works under construction have been completed, is \$6.64 per acre, which is 28 per cent greater than the cost of the enterprises already completed. For the United States, the estimated average cost for the enterprises under construction, when they have been completed, is \$14.84 per acre upon the total area assessed. This cost probably would be increased slightly if the amount of overlapping among these enterprises were known and eliminated. However, it is undoubtedly much nearer

correct than the average cost computed after eliminating all overlapping, including duplication with completed enterprises, which would be \$16.12 per acre. In a few states the average for the later enterprises is less than in the completed enterprises, but in 11 states it is more than twice as great. Table 11 shows the capital invested and cost per acre assessed for each 10-year period before 1900 and each 5-year period since that date. It shows also the average cost per acre for all land in operating enterprises organized prior to the end of each period. It will be noted that the average cost per acre assessed was continuously less than \$3 before 1905, but for each period since then has increased by \$1.78 to \$1.92 over the preceding period.

TABLE 10.—CAPITAL INVESTED AND COST PER ACRE OF ALL OPERATING ENTERPRISES, AND OF OPERATING ENTERPRISES DRAINED WHOLLY BY GRAVITY: 1920.

DIVISION AND STATE.	ALL OPERATING ENTERPRISES.					COMPLETED ENTERPRISES.			ENTERPRISES UNDER CONSTRUCTION.			GRAVITY DISTRICTS ONLY.		
	Land in enterprises (acres).	Cost when completed.		Cost to Dec. 31, 1919.		Land in enterprises (acres).	Cost.		Assessed acreage.	Cost when completed.		Acreage.	Cost when completed.	
		Total.	Per acre.	Total.	Per acre.		Total.	Per acre.		Total.	Per acre.		Total.	Per acre.
UNITED STATES..	65,495,038	\$434,594,979	\$6.64	\$372,273,567	\$5.68	56,763,751	\$293,857,023	\$5.18	9,482,414	\$140,737,956	\$14.84	53,602,475	\$354,839,625	\$5.58
<b>GEOGRAPHIC DIVISIONS:</b>														
East North Central..	31,627,176	143,722,327	4.54	134,266,666	4.25	30,475,905	119,525,193	3.92	1,446,710	24,197,134	16.73	31,276,297	125,862,718	4.02
West North Central..	19,217,367	133,194,663	6.93	121,562,077	6.33	16,959,103	102,363,306	6.04	2,520,812	30,829,357	12.23	18,998,095	129,704,641	6.83
South Atlantic..	2,385,384	83,323,268	13.97	18,847,033	7.90	861,312	6,806,285	7.90	1,583,572	26,517,983	16.75	2,271,184	32,204,394	14.18
East South Central..	2,323,595	13,830,251	5.95	11,523,833	4.96	1,732,586	9,085,234	5.24	594,049	4,745,017	7.99	2,226,195	13,120,151	5.89
West South Central..	7,924,197	42,357,607	5.35	28,946,385	3.65	5,750,953	20,473,933	3.56	2,303,839	21,883,674	9.50	7,584,727	32,948,089	4.34
Mountain..	810,076	12,508,817	15.44	7,839,941	9.68	236,872	3,248,713	13.72	573,204	9,280,104	16.15	745,464	10,585,817	14.20
Pacific..	1,207,243	55,658,046	46.10	49,284,572	40.82	747,015	32,353,359	43.31	460,228	23,304,687	50.64	499,913	10,413,815	20.83
<b>EAST NORTH CENTRAL:</b>														
Ohio..	8,107,204	30,771,620	3.80	30,680,145	3.78	8,093,994	30,636,857	3.79	15,857	134,763	8.50	8,104,275	30,687,591	3.79
Indiana..	9,087,183	31,943,558	3.52	31,147,682	3.43	8,867,674	30,154,296	3.40	392,310	1,789,562	4.56	9,078,072	31,714,794	3.49
Illinois..	3,909,049	51,393,244	13.15	43,595,069	11.15	3,430,474	31,424,167	9.16	484,775	10,968,077	41.19	3,583,206	34,042,167	9.50
Michigan..	9,729,171	25,048,980	2.57	24,683,715	2.54	9,511,555	24,100,929	2.53	331,407	948,051	2.86	9,718,471	24,878,541	2.56
Wisconsin..	794,569	4,584,625	5.74	4,163,055	5.24	572,208	3,208,944	5.61	222,361	1,355,681	6.10	792,273	4,539,625	5.73
<b>WEST NORTH CENTRAL:</b>														
Minnesota..	9,232,709	44,183,838	4.79	42,017,447	4.56	8,552,900	36,764,850	4.30	703,309	7,418,988	10.55	9,232,709	44,183,838	4.79
Iowa..	5,224,478	54,169,878	10.37	49,627,304	9.50	4,685,080	44,630,537	9.53	608,235	9,539,341	15.68	5,085,312	53,024,636	10.43
Missouri..	2,506,204	24,749,735	9.53	20,723,128	7.98	1,858,945	13,294,035	7.15	907,470	11,455,700	12.62	2,518,898	22,468,905	8.92
North Dakota..	1,240,328	2,261,449	1.82	2,208,049	1.78	1,100,044	1,863,788	1.69	140,284	397,661	2.83	1,240,328	2,261,449	1.82
South Dakota..	222,062	1,732,729	7.80	1,461,063	6.58	124,132	942,757	7.59	97,830	789,972	8.07	222,062	1,732,729	7.80
Nebraska..	607,730	4,886,681	8.04	4,588,578	7.55	565,222	4,121,486	7.29	42,808	765,195	18.00	607,730	4,886,681	8.04
Kansas..	93,856	1,210,353	12.90	936,608	9.98	72,780	747,553	10.28	21,076	402,500	21.94	91,650	1,146,863	12.51
<b>SOUTH ATLANTIC:</b>														
North Carolina..	542,828	4,526,018	8.34	3,623,518	6.68	440,657	3,075,018	6.98	102,171	1,451,000	14.20	442,828	3,790,644	8.58
South Carolina..	140,031	986,514	6.99	582,183	4.16	24,884	198,570	7.98	115,167	738,144	6.41	131,831	661,514	5.02
Georgia..	65,452	1,093,239	16.78	794,585	12.14	43,723	614,136	14.06	21,729	433,603	22.26	65,452	1,093,239	16.78
Florida..	1,637,073	20,782,497	12.65	13,846,807	8.46	352,068	2,917,261	8.29	1,844,505	23,845,236	17.74	1,631,073	26,653,997	16.34
<b>EAST SOUTH CENTRAL:</b>														
Kentucky..	358,480	1,820,996	5.08	1,521,725	4.24	288,143	1,278,701	4.44	70,337	542,295	7.71	358,480	1,820,996	5.08
Tennessee..	303,671	3,447,991	9.48	2,925,944	8.05	268,667	2,283,589	8.50	95,004	1,164,402	12.26	363,671	3,447,991	9.48
Mississippi..	1,601,444	5,561,264	5.35	7,076,164	4.42	1,175,775	5,522,944	4.70	428,708	3,038,320	7.09	1,504,044	7,861,164	5.22
<b>WEST SOUTH CENTRAL:</b>														
Arkansas..	3,479,591	25,888,599	7.44	14,147,174	4.07	2,124,446	9,385,025	4.42	1,456,545	16,503,574	11.33	3,294,591	20,888,599	6.34
Louisiana..	2,266,323	9,990,788	4.41	9,021,991	3.98	1,534,634	5,956,938	3.88	780,894	4,033,850	5.30	2,111,858	5,581,270	2.64
Oklahoma..	12,150	77,415	6.37	76,415	6.29	11,750	76,165	6.48	400	1,250	3.13	12,150	77,415	6.37
Texas..	2,166,128	6,400,805	2.95	5,700,805	2.63	2,080,128	5,555,805	2.43	86,000	1,345,000	15.64	2,166,128	6,400,805	2.95
<b>MOUNTAIN:</b>														
Montana..	168,682	846,466	5.02	664,990	3.94	44,682	393,969	8.82	124,000	452,497	3.65	168,682	846,466	5.02
Idaho..	64,642	1,788,569	27.67	1,688,569	25.81	43,892	1,237,578	28.20	20,750	550,991	26.55	32,730	890,569	27.21
Wyoming..	95,474	1,667,367	17.46	1,175,962	12.32	11,740	32,321	2.75	83,734	1,635,136	19.53	95,474	1,667,367	17.46
Colorado..	171,656	1,285,070	7.49	1,081,875	6.30	66,816	508,663	7.61	104,840	776,407	7.41	171,656	1,285,070	7.49
New Mexico..	140,219	2,906,296	20.73	1,710,796	12.20	20,169	361,969	17.95	120,060	2,544,307	21.19	140,219	2,906,296	20.73
Arizona..	39,640	1,026,425	25.89	414,425	10.45	9,640	101,425	10.52	30,000	825,000	30.53	39,640	1,026,425	25.89
Utah..	113,823	2,870,773	25.22	1,005,473	8.83	23,993	495,007	20.63	89,830	2,375,796	26.46	111,123	2,770,773	24.95
Nevada..	15,940	117,851	7.39	117,851	7.39	15,940	117,851	7.39	.....	.....	.....	15,940	117,851	7.39
<b>PACIFIC:</b>														
Washington..	94,924	1,436,419	15.13	1,397,419	14.72	90,084	1,376,809	15.28	4,840	59,610	12.32	94,924	1,436,419	15.13
Oregon..	4,000	200,000	50.00	200,000	50.00	4,000	200,000	50.00	.....	.....	.....	4,000	200,000	50.00
California..	1,108,319	54,021,627	48.74	47,687,153	43.03	652,931	30,776,550	47.14	455,388	23,245,077	51.04	400,989	8,777,396	21.89

Cost according to location.—The capital invested in operating enterprises is divided among the geographic divisions and states somewhat differently than the land in the enterprises, which fact is reflected in the cost per acre. The East North Central division has the largest portion of the total investment to Decem-

ber 31, 1919, and the lowest expenditure per acre in the enterprises except the West South Central division; it has the greatest portion of the total estimated investment when the drainage works under construction have been completed, but the smallest cost per acre of any division. The Pacific division,

with 13 per cent of the capital invested and less than 2 per cent of the acreage, on the census date had expended four times as much per acre as the average for any other division, and upon completion of the works authorized will have expended three times as much per acre as any other division. The costs per acre are greatest in Oregon and California, being nearly

twice that in any other state. For the central and eastern divisions, where irrigation is not generally practiced, the past investment per acre is greater in Illinois than in any other state except Georgia, and the anticipated investment for the operating enterprises is greater than in any other state except Georgia and Florida.

TABLE 11.—CAPITAL INVESTED AND COST PER ACRE FOR OPERATING ENTERPRISES, WHEN WORKS UNDER CONSTRUCTION HAVE BEEN COMPLETED, CLASSIFIED BY DATE OF ORGANIZATION: 1920.

DATE OF ORGANIZATION.	United States.	GEOGRAPHIC DIVISIONS.						
		East North Central.	West North Central.	South Atlantic.	East South Central.	West South Central.	Mountain.	Pacific.
<b>Total:</b>								
Capital invested when works completed.....	\$434,504,979	\$143,722,327	\$133,194,663	\$33,323,268	\$13,830,251	\$42,357,607	\$12,508,817	\$55,658,046
Land in enterprises..... acres.....	65,495,038	31,627,176	19,217,267	2,385,384	2,322,595	7,924,197	810,876	1,207,243
Cost per acre.....	\$6.64	\$4.54	\$6.93	\$13.97	\$5.95	\$5.35	\$15.44	\$46.10
Acreage assessed.....	95,629,291	50,131,979	21,202,129	2,517,852	2,326,635	8,363,124	810,076	1,217,798
Cost per acre.....	\$4.54	\$2.43	\$6.26	\$13.23	\$5.94	\$5.06	\$15.44	\$15.70
<b>Before 1860:</b>								
Capital invested when works completed.....	\$182,716	\$172,716		\$10,000				
Land in enterprises..... acres.....	97,319	95,669		1,650				
Cost per acre.....	\$1.88	\$1.81		\$6.06				
Acreage assessed.....	98,119	96,469		1,650				
Cost per acre.....	\$1.86	\$1.79		\$6.06				
<b>1860 to 1869:</b>								
Capital invested, including earlier periods.....	\$1,672,568	\$1,512,568		\$10,000				\$350,000
Land in enterprises..... acres.....	880,676	865,828		1,650				13,200
Cost per acre.....	\$2.13	\$1.75		\$6.06				\$26.52
Capital invested for this period.....	\$1,680,552	\$1,339,552						\$350,000
Acreage assessed for this period.....	932,565	919,365						13,200
Cost per acre.....	\$1.81	\$1.46						\$26.52
<b>1870 to 1879:</b>								
Capital invested, including earlier periods.....	\$9,998,959	\$7,101,571	\$37,388	\$10,000				\$2,850,000
Land in enterprises..... acres.....	2,958,393	2,913,243	4,200	1,650				39,300
Cost per acre.....	\$3.38	\$2.44	\$8.90	\$6.06				\$72.52
Capital invested for this period.....	\$8,126,391	\$5,589,003	\$37,388					\$2,600,000
Acreage assessed for this period.....	3,413,277	3,382,977	4,200					26,100
Cost per acre.....	\$2.38	\$1.65	\$8.90					\$95.79
<b>1880 to 1889:</b>								
Capital invested, including earlier periods.....	\$35,774,118	\$29,317,100	\$197,083	\$23,000	\$4,000			\$0,232,935
Land in enterprises..... acres.....	8,382,687	8,198,459	53,234	14,157	800			116,037
Cost per acre.....	\$4.27	\$3.58	\$3.70	\$1.62	\$5.00			\$53.72
Capital invested for this period.....	\$25,775,159	\$22,215,529	\$159,695	\$13,000	\$4,000			\$3,382,935
Acreage assessed for this period.....	8,843,654	8,704,576	49,034	12,507	800			76,737
Cost per acre.....	\$2.91	\$2.55	\$3.26	\$1.04	\$5.00			\$44.08
<b>1890 to 1899:</b>								
Capital invested, including earlier periods.....	\$90,794,289	\$47,609,287	\$1,931,577	\$23,000	\$226,326	\$460,949		\$10,543,150
Land in enterprises..... acres.....	14,409,624	13,180,920	850,464	14,157	19,051	142,280		187,736
Cost per acre.....	\$6.22	\$3.61	\$2.26	\$1.62	\$11.87	\$3.24		\$56.16
Capital invested for this period.....	\$25,020,171	\$18,292,187	\$1,734,494		\$222,326	\$460,949		\$4,810,215
Acreage assessed for this period.....	11,575,924	10,528,526	815,158		18,261	142,280		71,699
Cost per acre.....	\$2.16	\$1.74	\$2.13		\$12.17	\$3.24		\$60.12
<b>1900 to 1904:</b>								
Capital invested, including earlier periods.....	\$88,209,816	\$66,139,124	\$8,214,056	\$23,000	\$553,825	\$1,056,949		\$12,222,862
Land in enterprises..... acres.....	22,016,877	18,623,193	2,694,038	14,157	59,075	401,278		224,631
Cost per acre.....	\$4.01	\$3.55	\$3.05	\$1.62	\$9.37	\$2.63		\$54.41
Capital invested for this period.....	\$27,415,627	\$18,529,837	\$6,282,479		\$327,499	\$596,000		\$1,679,712
Acreage assessed for this period.....	12,200,468	9,852,845	2,612,216		40,014	258,998		39,595
Cost per acre.....	\$2.25	\$1.88	\$3.12		\$8.18	\$2.30		\$45.53
<b>1905 to 1909:</b>								
Capital invested, including earlier periods.....	\$171,913,215	\$100,201,042	\$41,728,530	\$487,500	\$1,648,270	\$7,458,339	\$226,599	\$20,153,435
Land in enterprises..... acres.....	36,546,774	23,747,473	8,846,849	73,680	872,829	2,933,158	38,223	514,562
Cost per acre.....	\$4.70	\$4.22	\$4.72	\$6.62	\$4.42	\$2.53	\$5.93	\$39.17
Capital invested for this period.....	\$83,703,399	\$34,061,918	\$33,523,974	\$464,500	\$1,094,445	\$6,401,390	\$226,599	\$7,930,573
Acreage assessed for this period.....	20,228,636	10,126,903	6,681,182	67,723	815,794	2,698,880	38,223	289,931
Cost per acre.....	\$4.14	\$3.36	\$5.02	\$6.86	\$3.47	\$2.37	\$5.93	\$27.35
<b>1910 to 1914:</b>								
Capital invested, including earlier periods.....	\$306,644,221	\$122,456,477	\$83,971,896	\$19,667,293	\$7,797,858	\$25,850,833	\$4,396,596	\$42,503,268
Land in enterprises..... acres.....	53,890,872	28,293,599	15,282,766	1,309,757	1,546,730	6,216,975	283,401	957,674
Cost per acre.....	\$5.69	\$4.33	\$5.49	\$15.02	\$5.04	\$4.16	\$15.51	\$44.38
Capital invested for this period.....	\$124,731,006	\$22,255,435	\$42,233,866	\$19,179,793	\$6,149,588	\$18,392,494	\$4,169,997	\$22,349,833
Acreage assessed for this period.....	22,245,539	8,538,560	7,117,070	1,271,677	1,173,901	3,450,898	245,178	447,655
Cost per acre.....	\$5.06	\$2.61	\$5.93	\$15.08	\$5.24	\$5.33	\$17.01	\$49.93
<b>1915 to 1919:</b>								
Capital invested, including earlier periods.....	\$430,770,285	\$143,108,503	\$132,879,715	\$33,323,268	\$13,809,963	\$42,157,607	\$12,090,998	\$53,405,231
Land in enterprises..... acres.....	65,265,491	31,585,556	19,183,609	2,385,384	2,321,795	7,876,197	783,016	1,129,934
Cost per acre.....	\$6.60	\$4.53	\$6.93	\$13.97	\$5.95	\$5.35	\$15.44	\$47.26
Capital invested for this period.....	\$124,126,064	\$20,647,026	\$48,907,819	\$13,655,975	\$6,012,105	\$16,306,774	\$7,094,402	\$10,901,963
Acreage assessed for this period.....	15,828,501	6,897,435	4,548,753	1,164,295	776,065	1,764,068	499,615	178,270
Cost per acre.....	\$7.84	\$2.99	\$10.75	\$11.73	\$7.75	\$9.24	\$15.40	\$61.15
<b>Date not reported:</b>								
Capital invested when works completed.....	\$3,824,694	\$618,824	\$314,948		\$20,288	\$200,000	\$417,819	\$2,252,815
Land in enterprises..... acres.....	229,547	41,620	33,758		1,800	48,000	77,309	77,309
Cost per acre.....	\$16.66	\$14.87	\$9.33		\$11.27	\$4.17	\$15.44	\$29.14
Acreage assessed.....	262,608	74,523	33,916		1,800	48,000	27,060	77,309
Cost per acre.....	\$14.56	\$8.30	\$9.29		\$11.27	\$4.17	\$15.44	\$29.14

The higher cost of drainage in many of the Pacific and Mountain states is at least partly due to the fact that the drainage of irrigated land is usually more expensive than the drainage of land in the humid

region, where nature has provided a part of the drains and generally has washed from the soil whatever salts may have been formed there. Deeper drains are required to prevent concentration of the alkali

in the top soil by the upward movement of the water as evaporation occurs at the ground surface. The nature of the soil when saturated often is such that the sides of open ditches must have comparatively flat slopes, and trenches for tile many times must be elaborately braced or sheeted during construction of the drains. No inconsiderable part of the cost in many localities has been due to inexperience with the new engineering problems involved, and in work that proved to be experimental in character.

**Cost by character of enterprise.**—The anticipated costs per acre for drainage work authorized are least for township and county drains, and greatest for irrigation districts and irrigation projects of the United States Reclamation Service, as shown by Table 12. Practically all of the enterprises not reporting character are in Indiana, and are either drainage districts or county drains.

TABLE 12.—CAPITAL INVESTED AND COST PER ACRE FOR OPERATING ENTERPRISES, CLASSIFIED BY CHARACTER OF ENTERPRISE: 1920.

CHARACTER OF ENTERPRISE.	Land in enterprises (acres).	Capital invested when works completed.	COST PER ACRE.	
			Amount.	Per cent of mean.
Total or mean .....	65,495,038	\$434,594,979	\$6.64	100.0
Drainage districts.....	22,069,597	211,150,540	9.57	144.1
General acts .....	20,239,856	172,104,782	8.50	128.0
Special acts .....	1,829,741	39,045,758	21.34	321.4
County drains .....	37,870,808	179,425,570	4.74	71.4
Township drains .....	195,133	579,463	2.97	44.7
State enterprises .....	1,422,844	13,279,869	9.33	140.5
U. S. Reclamation Service.....	1,287,899	6,442,613	22.38	337.0
Irrigation districts.....	1175,200	4,013,543	22.91	345.0
Commercial developments .....	212,421	4,407,829	20.75	312.5
Individual ownerships.....	432,397	7,261,002	16.86	253.9
Not reported .....	2,828,744	8,004,550	2.83	42.6

<sup>1</sup> The area actually assessed for the cost of drainage in United States Reclamation Service projects and irrigation districts includes 600,578 acres that did not require drainage or protection.

The reasons for the low cost for the township and county drains may be that in those states where most drainage has been done these forms were the earliest used, when the price of labor was lowest; that the forms are most suited and economical for the smaller and simpler undertakings; and that much of the cost was paid in labor for which no value was entered in the records. The cost of draining irrigated land generally is greater than for land in the humid region, for reasons already stated. The higher cost is justified by the higher value of the land, which is largely improved. As explained on page 349, the cost of the drainage in the irrigation enterprises is charged partly against other land contributing to the injury, this other land considerably exceeding the acreage to be drained or protected. The average cost of the drainage by irrigation enterprises is \$9.83 per acre on all the land assessed.

The states reporting drainage districts established by special acts of the legislatures are Wisconsin, Florida, Arkansas, Louisiana, and California. Table

12 shows these districts to cost two and one-half times as much per acre as those districts organized under the general drainage laws. In three of these states the special act districts average less per acre than the others, but in Arkansas and California, which together have 1,577,061 acres in special districts, the average costs per acre are, respectively, \$11.40 and \$69.52 for the special districts and \$5.22 and \$50.92 for those formed under the general statutes.

Commercial enterprises reclaiming wet land for sale generally consist of land that is less favorably situated, which is mostly if not entirely unimproved, and which has relatively few natural drainage courses. Therefore the drainage systems that the commercial companies must undertake to construct, in order to find ready sale for the land, ordinarily will be more elaborate and more costly than those constructed by public drainage enterprises comprised more largely of land in farms.

**Cost by nature of drainage works.**—The kind of drains and accessory works installed by the enterprises materially affects the cost of the drainage in most cases. Table 13 shows that the average cost per acre for the operating enterprises that have installed only open ditches is not much more than half the average cost of those that have installed tile drains entirely; the cost per acre for systems combining both tile and open drains is just one and one-half times as great as for those providing open ditches only.

The costs per acre for most of the geographic divisions show the same general relation—the cost where only tile drains are used is much larger than where only open ditches are constructed, and the cost of combined systems lies between. The exceptions are that the combined systems have cost most per acre in the East South Central division, while in the Mountain and Pacific divisions the combined systems have cost least and open ditches only have cost most per acre.

The drainage enterprises that have constructed levees as part of the improvement works comprise less than 10 per cent of the area in all operating enterprises, but will have cost nearly 29 per cent of the total investment when the works under construction have been completed. As shown in State Table V, pages 376-379, the average cost for all enterprises constructing levees is \$20.22 per acre, and for those not constructing levees is \$5.23 per acre. For the United States, and for each geographic division except the East South Central, the cost of the enterprises constructing levees is from one and one-third to seven times as great per acre as for the other enterprises. These figures do not include the cost of levees or dikes built by the government, or by levee districts or flood protection enterprises that had not constructed ditches or other drains, even though land in the drainage enterprises receives protection by reason of those levees and may have been assessed for the cost of them.



TABLE 13.—CAPITAL INVESTED AND COST PER ACRE FOR OPERATING ENTERPRISES, CLASSIFIED BY GEOGRAPHIC DIVISIONS AND KIND OF WORKS: 1920.

KIND OF WORKS.	Land in enterprises (acres).	CAPITAL INVESTED.				KIND OF WORKS.	Land in enterprises (acres).	CAPITAL INVESTED.			
		When works completed.		To Dec. 31, 1919.	Additional required to complete.			When works completed.		To Dec. 31, 1919.	Additional required to complete.
		Total.	Per acre.					Total.	Per acre.		
UNITED STATES.											
Total or mean.....	65,495,038	\$424,594,979	\$6.64	\$372,273,567	\$62,321,412	2,323,595	\$13,830,251	\$5.95	\$11,523,833	\$2,306,418	
Open ditches only.....	49,314,485	287,125,105	5.82	238,211,512	48,913,593	2,263,610	13,109,485	5.79	10,951,137	2,158,348	
Tile drains only.....	4,974,261	49,318,155	9.91	46,801,986	2,516,169	8,917	80,479	9.03	64,979	15,500	
Open ditches and tile drains	11,206,292	98,151,719	8.76	87,260,069	10,891,650	51,068	640,287	12.54	507,717	132,570	
EAST NORTH CENTRAL.											
Total or mean.....	31,627,176	143,722,327	4.54	134,269,666	9,452,661	7,924,197	42,357,607	5.35	28,946,385	13,411,222	
Open ditches only.....	21,339,687	84,958,586	3.98	77,413,340	7,545,246	7,882,741	42,023,607	5.33	28,049,885	13,374,222	
Tile drains only.....	3,098,495	17,961,089	5.80	17,740,952	220,137	3,100	41,000	13.23	41,000	.....	
Open ditches and tile drains	7,188,994	40,802,652	5.68	39,115,374	1,687,278	38,356	293,000	7.64	256,000	37,000	
WEST NORTH CENTRAL.											
Total or mean.....	19,217,367	133,194,663	6.93	121,562,077	11,632,586	810,076	12,508,817	15.44	7,839,941	4,668,876	
Open ditches only.....	14,301,750	63,696,299	4.45	58,302,556	5,392,733	242,028	4,356,347	18.00	2,725,123	1,631,224	
Tile drains only.....	1,747,658	28,845,685	16.56	27,014,798	1,930,899	105,525	1,837,577	17.41	1,487,944	349,633	
Open ditches and tile drains	3,167,959	40,553,669	12.80	36,244,715	4,308,954	462,523	6,314,893	13.65	3,626,874	2,688,019	
MOUNTAIN.											
Total or mean.....	19,217,367	133,194,663	6.93	121,562,077	11,632,586	810,076	12,508,817	15.44	7,839,941	4,668,876	
Open ditches only.....	14,301,750	63,696,299	4.45	58,302,556	5,392,733	242,028	4,356,347	18.00	2,725,123	1,631,224	
Tile drains only.....	1,747,658	28,845,685	16.56	27,014,798	1,930,899	105,525	1,837,577	17.41	1,487,944	349,633	
Open ditches and tile drains	3,167,959	40,553,669	12.80	36,244,715	4,308,954	462,523	6,314,893	13.65	3,626,874	2,688,019	
PACIFIC.											
Total or mean.....	1,207,243	55,658,046	46.10	40,284,572	6,373,474	1,207,243	55,658,046	46.10	40,284,572	6,373,474	
Open ditches only.....	908,485	46,008,513	50.71	41,585,868	4,482,645	908,485	46,008,513	50.71	41,585,868	4,482,645	
Tile drains only.....	10,566	452,315	42.81	452,315	.....	10,566	452,315	42.81	452,315	.....	
Open ditches and tile drains	288,192	9,137,218	31.71	7,246,359	1,890,829	288,192	9,137,218	31.71	7,246,359	1,890,829	

† All individual ownership enterprises.

To investigate more minutely the cost of drainage for agricultural land, those enterprises in which the length of levees equaled or exceeded the length of drains, and those sanitary districts which evidently were not established primarily to improve land for agricultural uses, were deducted from the total acreages and costs stated in the tables. The costs per acre were then computed in the same way as those given in Table 13. The differences between the costs thus found and those given in the table were slight, exceeding approximately 5 per cent in only three instances: The cost of open ditches only in the East North Central states was computed as \$3.57 instead of \$3.98; in the Mountain states, \$15.91 instead of \$18; in the Pacific states, \$53.69 instead of \$50.71, being greater there than when all drainage enterprises were included.

**Cost of pumping districts.**—The capital invested when the works under construction have been completed, and the costs per acre, for those enterprises drained entirely by gravity are given in Table 10. It will be noted that the acreage costs vary but little from

those for all operating enterprises, except for Illinois, Louisiana, Arizona, and California, due to the comparatively small acreage in pumping districts in most states.

Table 14 shows the investment and the cost per acre for the pumping districts for the United States, and for each state having as much as 25,000 acres drained by pumping. Of those states not shown separately, Michigan has 10,100 acres served by pumps wholly or partly, and no other has so much as 8,000 acres. The capital invested to December 31, 1919, and the total estimated for the operating enterprises when they have completed construction of the works authorized, are more than six times as great per acre as for the gravity districts. In Iowa and North Carolina the estimated investment when construction has been completed is slightly less per acre than for the gravity districts; in the other states the cost of the pumping districts is greater by from \$2.07 per acre in Mississippi to \$42.07 in California and \$43.75 in Illinois.

TABLE 14.—CAPITAL INVESTED AND COST PER ACRE FOR PUMPING DISTRICTS: 1920.

STATE.	ALL PUMPING DISTRICTS.					DRAINAGE BY PUMPING ONLY.			PART GRAVITY DRAINAGE.			
	Acreage in enterprises.	Cost when completed.		Cost to Dec. 31, 1919.		Acreage in enterprises. <sup>1</sup>	Cost when completed.		Acreage in enterprises.	Cost when completed.		Acreage served by pumps. <sup>2</sup>
		Total.	Per acre.	Total.	Per acre.		Total.	Per acre.		Total.	Per acre.	
United States.....	1,802,503	\$79,755,354	\$42.05	\$65,830,264	\$34.70	781,441	\$34,022,568	\$43.54	1,111,122	\$45,732,780	\$41.00	762,509
Illinois.....	325,843	17,351,077	53.25	12,061,591	37.02	157,360	6,809,372	43.27	168,483	10,541,705	62.57	134,456
Iowa.....	139,166	1,145,192	8.23	1,145,192	8.23	79,686	778,770	9.77	59,480	860,422	6.16	54,930
Missouri.....	77,306	2,280,830	29.50	2,280,830	29.25	77,306	2,280,830	29.25	77,306	2,280,830	29.50	70,308
North Carolina.....	100,000	735,374	7.35	735,374	7.35	100,000	735,374	7.35	97,400	710,100	7.29	44,000
Mississippi.....	97,400	710,100	7.29	385,100	3.95							
Arkansas.....	185,000	5,000,000	27.03	500,000	2.70				185,000	5,000,000	27.03	90,000
Louisiana.....	154,470	4,409,518	28.55	3,909,743	25.70	137,250	4,261,518	31.05	17,220	148,000	8.59	3,559
Arizona.....	30,000	925,000	30.83	315,000	10.43				30,000	925,000	30.83	25,000
California.....	707,330	45,244,231	63.96	42,625,402	60.26	300,422	21,297,606	70.89	406,908	23,946,625	58.85	304,024
Other states.....	76,048	1,954,032	24.32	1,833,032	22.81	6,723	139,928	20.81	69,325	1,814,104	24.64	36,292

<sup>1</sup> Drained entirely by pumping.<sup>2</sup> An undetermined part of this acreage may at times be drained by gravity.

The cost of the pumping plants was not secured separately from the other costs of the enterprises, and it is not to be inferred that the difference between the cost of gravity districts and pumping districts, even for a state, represents only the cost of the plants. The condition is that those enterprises that require pumping generally are so situated that the other

drainage works also are more costly than the average, but an unusually high value of the land is believed to warrant the extraordinary expense. The real cost of drainage by pumping includes, of course, operating charges such as labor and fuel for which statistics were not obtained and no estimates are attempted.

# SUMMARY FOR THE UNITED STATES.

## INTRODUCTION.

This report presents a summary of the statistics of drainage for the United States collected at the census of 1920. The figures relate to conditions on January 1, 1920, except where indicated otherwise. No census of drainage has been taken heretofore, so there are no comparable figures for any previous year. The statistics relate to the artificial drainage of land in farms, and of other land that is expected to be used ultimately for agricultural purposes.

The drainage census divides naturally into two parts, one relating to improvement work undertaken by individual farm owners, the other to improvement or reclamation work of mutual benefit to a number of owners organized in accordance with the statutes. The former has been termed drainage on farms, and the latter termed drainage enterprises. These enterprises in some states include considerable areas of timber and other unimproved land not yet included in farms.

The statistics for drainage on farms were collected in the general census of agriculture, while those for drainage enterprises were obtained in a special canvass of those enterprises. Since drainage on farms may be either inside or outside a drainage enterprise, and since the drains that each owner installs upon his own farm may be either supplemental to or entirely independent of the works installed by an enterprise, the figures for the two parts of the drainage census are presented separately.

No census of drainage enterprises was taken in the states of the New England and Middle Atlantic divisions, or the other states north of Potomac River. No enterprises of a public nature in Alabama, Virginia, and West Virginia had begun actual construction on January 1, 1920, so those states have been omitted entirely from this part of the census. The figures for drainage on farms include all states.

TABLE 1.—SUMMARY: 1920.

ITEM.	Amount.	Per cent of total.
<b>DRAINAGE ON FARMS.</b>		
Number of all farms in the United States.....	6, 448, 343	100. 0
Farms reporting land having drainage.....	924, 810	14. 3
Farms reporting land needing drainage.....	956, 095	14. 8
All land in farms.....acres..	955, 883, 715	100. 0
Improved land in farms.....acres..	503, 073, 007	52. 6
Farm land reported as provided with drainage.....acres..	53, 024, 975	5. 5
Farm land reported as needing drainage.....acres..	39, 110, 357	4. 1
Needing drainage only.....acres..	10, 459, 181	1. 1
Needing drainage and clearing.....acres..	28, 651, 176	3. 0
<b>DRAINAGE ENTERPRISES.</b>		
Approximate land area of the states included.....acres..	1, 717, 932, 160	100. 0
All land in operating drainage enterprises.....acres..	65, 495, 038	3. 8
Improved land.....acres..	44, 288, 235	2. 6
Per cent of all improved land in farms.....	8. 8	
Timber and cut-over land.....acres..	11, 283, 532	0. 7
Other unimproved land.....acres..	9, 923, 271	0. 6
Swampy, subject to overflow, seeped, or alkali.....acres..	7, 224, 213	11. 0
Suffering a loss of crops from defective drainage.....acres..	3, 011, 407	4. 6
Improved land prior to drainage.....acres..	24, 586, 236	37. 5
Increase since drainage began.....acres..	19, 701, 999	30. 1
Land in nonoperating enterprises.....acres..	3, 924, 821	0. 2
Open ditches in operating enterprises.....miles..	111, 770. 0	100. 0
Completed.....miles..	107, 468. 2	96. 2
Additional under construction.....miles..	4, 301. 8	3. 8
Tile drains in operating enterprises.....miles..	45, 173. 8	100. 0
Completed.....miles..	42, 311. 7	93. 7
Additional under construction.....miles..	2, 862. 1	6. 3
Total capital invested in and required for completion of operating enterprises..	\$434, 594, 979	100. 0
Capital invested in these enterprises to Dec. 31, 1919.....	372, 273, 567	85. 7
Additional capital required to complete these enterprises.....	62, 321, 412	14. 3
Average cost per acre when completed.....	6. 64	

## DRAINAGE ON FARMS.

**Explanation of terms.**—To secure uniformity in the returns relating to drainage on farms, the Bureau of the Census supplied its enumerators with certain definitions, which were substantially as follows:

**Drainage of agricultural land** was defined, for census purposes, as the act or process of drawing off an excess of water by underground conduits, pipes, or tiles, or by open or covered trenches in the surface of the ground, for the purpose of improving the condition of the soil and crops.

**The area provided with drainage**, in farms, includes the acreage actually benefited or made of more value for agricultural purposes, by artificial drainage, but does not include land on which only temporary work has been done, such as "bedding" the fields or laying out "dead furrows" to hasten the surface flow.

**The area needing drainage**, in farms, comprises the additional land that is not now suitable for crops, but which could be made available for cultivation (1) "by drainage only," which is the acreage needing no clearing or which is covered with grass, weeds, or other annual growth, and (2) "by drainage and clearing," which is the acreage covered with trees, stumps, or perennial woody shrubs.

**Improved land in farms** includes all land regularly tilled or mowed, land in pasture which has been cleared or tilled, land lying fallow, land in gardens, orchards, vineyards, and nurseries, and land occupied by farm buildings.

**Woodland in farms** includes all land covered with natural or planted forest trees which produce, or later may produce, firewood or other forest products.

**Farms in drainage and levee districts** are those for which the operators answered affirmatively the question, "Has any part of this farm been afforded drainage or protection against overflow by a drainage or levee district, or by the state, the county, or a private company or individual?" Levee districts, however, generally are not included in the enterprises for which data are given in this report (see definition of drainage enterprises below).

**Farms and farm land.**—The acreage shown for drainage on farms represents land where drainage is actually in operation and which has actually become more fully available for growing crops by reason of the drainage. This is to be distinguished from the area merely provided with outlet facilities by organized drainage enterprises. Drainage on farms represents in most cases the result of work done by the farm owner, either independently or supplemental to the work done by a drainage enterprise, but the acreage would include also any farm land receiving similar benefits directly from the works of an enterprise.

## DRAINAGE ENTERPRISES.

**Explanation of terms.**—The more important terms used in connection with the census of drainage enterprises were defined as follows:

**Drainage enterprises** comprise public corporations and local improvement districts formed under state laws, commercial enterprises draining swamp or overflowed land for sale, any other organizations that may be engaged in extensive land-drainage work, and also tracts of 500 acres or more drained by individual owners. Enterprises such as levee districts that have not authorized the construction of open ditches or tile drains are not included.

**Enterprises located in more than one county** were divided, for tabulation, and the part in each county treated as a separate enterprise, though the capacities of drainage pumping plants are given only in the counties in which the plants are located.

**Operating enterprises**, as designated in this report, are those drainage enterprises that had completed the drainage works authorized, or had at any rate begun actual construction work, on or before January 1, 1920; enterprises that had been established but had not begun construction are termed "nonoperating."

**Land in drainage enterprises** is the area that has been benefited or is to be benefited by the improvement works constructed by the enterprises. In the case of overlapping enterprises, deduction has been made for the amount of duplication.

All land in drainage enterprises is divided, without regard to drainage condition, into (a) improved land; (b) timber and cut-over land, which would require clearing to be thoroughly fit for cultivation; and (c) all other unimproved land, which would not require expensive clearing before cultivation.

**The assessed acreage for any single enterprise** is the same as the area in that enterprise. However, the total assessed acreage may be considerably greater than the total land in enterprises, for in summing up the assessed acreage in the county or state, deduction was not made for acreage assessed in more than one enterprise.

**Improved land in drainage enterprises** consists very largely of improved farm land, though it may include some other improved land receiving benefit from the works of the enterprises.

**Timber and cut-over land** includes farm woodland of natural or planted forest trees as well as other timber land or areas that would need clearing of trees, stumps, or perennial woody shrubs.

**Land designated as swampy or subject to overflow** includes all land permanently or generally too wet for cultivation, land subject to periodical inundation by stream floods, seeped and alkali land in irrigated regions, and all other land unfit for cultivation by reason of insufficient drainage. This classification is without respect to the conditions as to improvement or timber.

**The area suffering a loss of crops** is intended to include only land devoted to planted crops, which suffer damage, either partial or complete, because of defective drainage. Land which would be cultivated if drained or protected against overflow is not included.

**Capital invested**, for the purpose of this investigation, was defined as cost, including charges for engineering, organization, rights of way, construction of drainage works, damages, land and buildings except those held for sale or farming, and any other expenditures properly chargeable to drainage and paid by the enterprise.

**The drainage works of an enterprise** include all varieties of underground conduits, pipes, or lines of tile, or drains of stone, wood, or other material; also open ditches and canals, together with accessory levees, dikes, dams, weirs, pumping machinery, gates, and other devices for the draining away or control of surface and soil waters.

**Tile**, as the term is here used, includes pipes of earthenware, concrete, or other material buried beneath the surface in such a way as to permit the excess water to flow away. The size, if circular, is expressed by the inside diameter in inches.

**Ditches** include all open artificial trenches, usually with sloping sides. The width is that of the bottom.

**The type of drainage** shows whether the drainage water from an enterprise is discharged by gravity or by pumping.

**A pumping district** is one where all or a part of the water from the drains collecting at a low point must be raised by some form of machinery in order that it may be removed from the area.

**Drainage pumps** include all kinds of machinery and devices for lifting the drainage water.

**Pumping engines** include all kinds of engines and motors for operating the drainage pumps.

Operating and nonoperating enterprises.—In most of the tables that follow, statistics are given for operating enterprises only. These enterprises, as already defined, include both those which have completed their drainage works and those with such works under construction; among the latter may be some that had completed the original plan of reclamation or improvement several years ago but were constructing extensions or enlargements on January 1, 1920. The nonoperating enterprises have a legal existence, though they have not yet accomplished any drainage. They may include enterprises that on the census date had completed their plans, sold bonds to cover the cost of the undertakings, and let contracts for the construction work; and also projects that had just been established by decree of the court or other designated authority and were still subject to considerable change in area, plan of drainage works, and cost. The figures are presented for the United States as a whole in Table 2, and for geographic divisions and states in State Tables II and III (pages 373 and 374).

TABLE 2.—LAND AND CAPITAL INVESTED IN ALL ENTERPRISES, CLASSIFIED AS BETWEEN OPERATING AND NONOPERATING ENTERPRISES: 1920.

CLASS.	LAND.		CAPITAL. <sup>1</sup>			
	Acreage.	Per cent of total.	To Dec. 31, 1919.		Additional required to complete.	
			Amount.	Per cent of total.		
All organized enterprises..	69,419,859	100.0	\$373,397,025	100.0	\$97,259,090	
Operating enterprises.....	65,495,038	94.3	372,273,567	99.7	62,321,412	
With works completed.....	58,763,751	81.8	293,857,023	78.7	.....	
With works under construction.....	8,731,287	12.6	78,416,544	21.0	62,321,412	
Nonoperating enterprises.....	3,924,821	5.7	1,123,458	0.3	34,937,678	

<sup>1</sup> The inquiry asked for the "total cost of the enterprise to Dec. 31, 1919," and for an "estimate of additional investment to complete."

Location of enterprises.—Three-fourths of all the land in drainage enterprises in the United States (78 per cent of the area in operating enterprises and 75 per cent of that in all enterprises) is situated in those states north of the Ohio and Missouri Rivers and east of the Rocky Mountains, including Missouri and Kansas. The Southern states from the Potomac to the Rio Grande contain 19 per cent of the land in operating enterprises and 22 per cent of that in all drainage enterprises, and the western states have the remaining 3 per cent. The drainage water from three-fourths of the land in the enterprises in the United States ultimately reaches the Mississippi River. In the northeastern states, omitted from these statistics, comparatively little drainage for agriculture has been undertaken.

Michigan has a greater area in drainage enterprises than any other state, 9,754,679 acres reported in all enterprises, and Indiana, Iowa, Minnesota, and Ohio reported areas ranging from 5,000,000 to 9,000,000 acres each. Indiana has the greatest portion of its area organized for drainage, more than 39 per cent of all

land in the state having been included in operating enterprises, and nearly 41 per cent in both operating and nonoperating enterprises. The distribution of the land in operating enterprises is shown by the map following page 346, and the figures for all enterprises, for each geographic division and state, are given in State Tables II, III, and IV (pages 373 to 375).

TABLE 3.—LAND AND CAPITAL INVESTED IN ALL ENTERPRISES, CLASSIFIED BY DRAINAGE BASIN: 1920.

DRAINAGE BASIN.	LAND.		CAPITAL.			
	Acreage.	Per cent of total.	To Dec. 31, 1919.		Additional required to complete.	
			Amount.	Per cent of total.		
All organized enterprises....	69,419,859	100.0	\$373,397,025	100.0	\$97,259,090	
Operating enterprises.....	65,495,038	94.3	372,273,567	99.7	62,321,412	
Atlantic Ocean.....	2,053,786	3.0	17,004,954	4.6	13,900,175	
Gulf of Mexico, east <sup>1</sup> .....	807,712	1.2	4,776,673	1.3	748,904	
Lower Mississippi River <sup>2</sup> .....	8,072,564	11.6	47,516,484	12.7	21,683,482	
Ohio River.....	10,998,378	15.8	42,582,673	11.4	1,588,775	
Missouri River.....	2,510,150	3.6	21,350,065	5.7	2,466,268	
Upper Mississippi River <sup>3</sup> .....	10,850,408	15.6	105,159,705	28.2	8,803,447	
Gulf of Mexico, west <sup>1</sup> .....	3,324,860	4.8	10,950,007	2.9	899,293	
Rio Grande.....	766,670	1.1	3,508,703	0.9	1,885,500	
Great Basin.....	129,763	0.2	1,123,324	0.3	1,865,300	
Colorado River.....	136,280	0.2	814,864	0.2	1,699,195	
Pacific Ocean.....	80,401	0.1	1,363,986	0.4	150,000	
San Francisco Bay.....	986,118	1.4	46,184,577	12.4	5,194,474	
Columbia River.....	173,716	0.3	3,378,710	0.9	149,000	
Hudson Bay.....	7,992,846	11.5	16,223,414	4.3	480,500	
Great Lakes.....	16,611,386	23.9	50,335,438	13.5	717,099	
Nonoperating enterprises.....	3,924,821	5.7	1,123,458	0.3	34,937,678	
Atlantic Ocean.....	1,044,921	1.5	242,721	0.1	2,957,792	
Gulf of Mexico, east <sup>1</sup> .....	41,230	0.1	25,056	( <sup>4</sup> )	463,194	
Lower Mississippi River <sup>2</sup> .....	1,194,609	1.7	350,928	0.1	11,476,017	
Ohio River.....	158,932	0.2	69,475	( <sup>4</sup> )	1,591,497	
Missouri River.....	352,894	0.5	155,916	( <sup>4</sup> )	6,735,433	
Upper Mississippi River <sup>3</sup> .....	521,759	0.8	140,028	( <sup>4</sup> )	7,424,581	
Gulf of Mexico, west <sup>1</sup> .....	383,490	0.6	46,000	( <sup>4</sup> )	1,417,500	
Rio Grande.....	7,000	( <sup>4</sup> )	.....	( <sup>4</sup> )	150,000	
Great Basin.....	20,731	( <sup>4</sup> )	9,500	( <sup>4</sup> )	647,500	
Colorado River.....	25,345	( <sup>4</sup> )	5,600	( <sup>4</sup> )	535,000	
Pacific Ocean.....	12,900	( <sup>4</sup> )	1,000	( <sup>4</sup> )	400,000	
Columbia River.....	18,955	( <sup>4</sup> )	54,725	( <sup>4</sup> )	205,000	
Hudson Bay.....	23,312	( <sup>4</sup> )	2,484	( <sup>4</sup> )	104,023	
Great Lakes.....	118,762	0.2	25,125	( <sup>4</sup> )	841,226	

<sup>1</sup> The eastern and western areas drained into the Gulf of Mexico are separated by the region tributary to Mississippi River, and do not include the land drained into either the Mississippi or the Rio Grande.

<sup>2</sup> The division between upper and lower Mississippi River is made at the Missouri.

<sup>3</sup> Less than one-tenth of 1 per cent.

Condition of land in enterprises.—The statistics secured show that of all the land in operating enterprises slightly more than two-thirds is improved, and somewhat more than one-tenth still is swampy or subject to overflow, including land too wet for cultivation and that injured by the concentration of salts, commonly called alkali, in the surface soil as a result of irrigation. The improved land is approximately 75 per cent of all land in the operating enterprises in the two north central geographic divisions of the United States, 45 per cent in the three southern divisions, and 87 per cent in the two western divisions. The portions swampy, wet, subject to overflow, or alkali are approximately 8 per cent, 24 per cent, and 12 per cent, respectively, in the northern, southern, and western groups of states. The condition of the land before drainage, in the operating enterprises, is shown in State Table V (pages 376 to 379).

In general, those drainage enterprises in the Atlantic Coastal Plain, from North Carolina to Texas and including the alluvial land of the lower Mississippi Valley,

have been organized for the reclamation of rather large areas of level swamp land. The swampy land in the North Central states, except in the northern parts of Minnesota, Wisconsin, and Michigan, is generally broken into smaller tracts by a slightly rolling topography. Those enterprises in the Piedmont section of the South Atlantic states and those bordering the streams of moderate size in the Mississippi River system are intended principally to protect against inundation by stream floods or to remove the overflow water promptly. Nearly all of the enterprises in the Mountain states and a large part of those in the Pacific states are for the drainage or protection of irrigated land injured or threatened with seepage and alkali.

In the Western states, irrigated land comprising 52,873 acres in drainage districts and 600,578 acres in irrigation districts and irrigation projects of the United States Reclamation Service is reported as not to have needed drainage or protection for itself, but to have been assessed for the cost of drainage merely on account of being responsible for injury to the other land. This acreage in the irrigation enterprises is not included in the tabulations in this report.

The usual purpose of an organized enterprise is merely to provide adequate outlets into which the landowners of the district may drain their farms and to afford relief from overflows for the district as a unit. Therefore, the fact that an enterprise which has completed the construction of the drainage works authorized contains land still swampy, subject to overflow, seeped, or alkali, or that suffers damage to crops, does not show that the improvement works are inadequate for the purpose intended. Perhaps some of the supplemental drains that are properly the work of individual farm owners have not been constructed.

TABLE 4.—LAND IN ALL ENTERPRISES, CLASSIFIED BY CONDITION: 1920.

CONDITION OF LAND.	OPERATING ENTERPRISES.				Non-operating enterprises (acres).
	Total.		Works completed (acres).	Works under construction (acres).	
	Acreage.	Per cent of all land.			
All land in enterprises.....	65,495,038	100.0	56,763,751	8,731,287	3,924,821
Improved land.....	44,288,235	67.6	40,828,982	3,459,253	1,376,495
Timber and cut-over land.....	11,283,532	17.2	8,209,402	3,074,040	1,294,018
Other unimproved land.....	9,923,271	15.2	7,725,277	2,197,994	1,254,308
Swampy, subject to overflow, seeped, or alkali.....	7,224,213	11.0	4,496,922	2,727,291	2,289,562
Suffering a loss of crops.....	3,011,407	4.6	2,340,065	671,342	239,192

**Size of enterprises.**—To show the statistics by counties, as has been done in the reports on drainage for separate states, required that an enterprise located in more than one county be divided, and the part in each county be considered as a separate enterprise. In this way 56,949 operating drainage enterprises are counted in the United States, with an average area of

1,680 acres assessed. The number of enterprises includes both those organized for original construction, and those for reconstruction undertaken by petition and hearings in the same manner as prescribed for establishing new drains, which has been the customary method for maintaining or renewing public ditches in some states; it includes also those organized for extending drains constructed previously, or for uniting two or more such drains into a single system.

The assessed acreage exceeds the land in operating enterprises by 30,134,253 acres, which is the amount of overlapping. The land in enterprises and the assessed acreage on each line of Table 5 refer to the same enterprises. From the total area of each enterprise, designated as the assessed area, the net amount of overlapping with enterprises organized previously was deducted, to determine the area to be tabulated as land in enterprises.

There are 543 nonoperating enterprises, which have a total assessed area of 5,245,428 acres and an average area of 9,660 acres. Of this total, 1,282,107 acres are a duplication of land assessed in earlier enterprises.

TABLE 5.—LAND IN OPERATING ENTERPRISES, CLASSIFIED BY SIZE OF AREA ASSESSED: 1920.

SIZE GROUP.	Land in enterprises (acres).	ASSESSED AREA.	
		Acreage.	Per cent of total.
All operating enterprises.....	65,495,038	95,629,291	100.0
Less than 200 acres.....	791,500	1,155,395	1.2
200 to 499 acres.....	3,283,873	5,285,772	5.5
500 to 999 acres.....	5,456,072	9,202,602	9.6
1,000 to 4,999 acres.....	18,637,501	30,153,424	31.5
5,000 to 9,999 acres.....	9,176,406	13,848,893	14.5
10,000 to 49,999 acres.....	17,737,764	23,412,104	24.5
50,000 to 99,999 acres.....	6,508,673	7,840,623	8.2
100,000 to 499,999 acres.....	3,923,243	4,730,978	4.9

**Character of enterprises.**—Most of the drainage enterprises, comprising 92.4 per cent of all the land in the operating enterprises, are public corporations or local improvement districts organized in accordance with general state laws specially framed to permit or to encourage the reclamation and improvement of land that is swampy, wet, or subject to overflow. Such enterprises have been classified here as drainage districts and county drains, according to whether the executive authority is vested in officers specially chosen for each district, or in regular county officials serving in the same capacity for all the county drains in their respective counties. This classification is not recognized in all states, however, and the term district is used in several states for enterprises here designated as county drains. The district form of organization has been used altogether in Colorado, Georgia, Idaho, Louisiana, Tennessee, Texas, Utah, and Wyoming, and the county form entirely in Iowa,<sup>1</sup> Michigan, Minnesota, Montana, North Dakota, Ohio, and South Dakota, for public enterprises established primarily for drainage. Both forms have been used in the

<sup>1</sup> Excepting those pumping districts governed by elected trustees.

other states where organized drainage is important, but in Arkansas, Florida, Illinois, and North Carolina the area served by county drains is less than 5 per cent of the total in enterprises. A few laws prescribe for each enterprise a governing board comprising both regular county officials and members specially appointed or elected for the enterprise.

A considerable number of drainage districts have been established by special acts of the state legislatures, which determined more or less specifically for each district what land should be included, the manner of selecting the officers, their duties and powers, and the various steps in securing construction of the improvement works, in financing the project, and in apportioning and collecting the assessments to pay the expenses incurred. Rather more than one-third, in acreage, of the operating drainage districts in Arkansas, and practically one-fourth in Florida, have been created by such special legislation.

In general, drainage districts and county drains are established by order of the administrative board of the county or by decree of a court designated in the drainage law, after petition, investigation, and public hearings to determine the necessity and public utility of the project. The statutes provide the basis for apportioning the cost against the property to be benefited by the proposed work, and most of the states authorize the issue of drainage bonds by the districts or by the counties.

Township drains are similar to county drains, but the officers of the townships, instead of the county boards, determine whether the enterprise shall be established and afterwards control construction of the works authorized.

The state drainage projects are located in Florida and Minnesota. Those in the former state are drainage districts organized under special acts of the legislature; those in the latter state have the character of enterprises classified here as county drains, with state instead of county officials in control after the decree of establishment has been issued.

Irrigation districts included as drainage enterprises are those public corporations formed to construct and operate irrigation works, which have undertaken the construction of works to drain or protect land in the district injured or threatened with seepage or alkali as a result of the irrigation. In character they are not unlike drainage districts. The area of the drainage enterprise is the area to be drained or protected, not the area of the irrigation district.

The United States Reclamation Service irrigation projects are included as drainage enterprises under the same circumstances as irrigation districts, the area of the drainage enterprise being the area to be benefited by the drainage works.

Commercial developments are principally enterprises formed under ordinary business corporation laws for the primary purpose of reclaiming unimproved land to be sold at a profit.

Individual ownership enterprises are private undertakings by single farm owners, or occasionally by a few owners cooperating without formal organization, for improving land already in farms. Only those individual enterprises designed to benefit 500 acres or more have been included in the statistics for drainage enterprises. They are included also with the smaller undertakings in the figures for drainage on farms.

TABLE 6.—LAND AND CAPITAL INVESTED IN ALL ENTERPRISES, CLASSIFIED BY CHARACTER OF ENTERPRISE: 1920.

CHARACTER OF ENTERPRISE.	LAND.		CAPITAL.		
	Acreage.	Per cent of total.	To Dec. 31, 1919.		Additional required to complete.
			Amount.	Per cent of total.	
All organized enterprises.....	69,419,859	100.0	\$373,397,025	100.0	\$97,259,090
Operating enterprises.....	65,495,038	94.3	372,273,567	99.7	62,321,412
Drainage districts <sup>1</sup> .....	22,069,597	31.8	172,013,972	46.1	39,136,568
General state laws.....	20,239,956	29.2	147,511,259	39.5	24,593,523
Special acts.....	1,829,641	2.6	24,502,713	6.6	14,543,045
County drains <sup>1</sup> .....	37,870,803	54.6	169,743,093	45.5	9,682,477
Township drains.....	195,133	0.3	574,963	0.2	4,500
State drainage projects.....	1,422,844	2.0	6,845,429	1.8	6,434,440
U. S. Reclamation Service.....	287,899	0.4	3,912,370	1.0	2,530,243
Irrigation districts.....	175,200	0.3	1,459,714	0.4	2,553,829
Commercial developments.....	212,421	0.3	3,279,829	0.9	1,128,000
Individual ownerships.....	432,397	0.6	6,449,252	1.7	841,750
Not reported <sup>2</sup> .....	2,823,744	4.1	7,994,945	2.1	9,605
Nonoperating enterprises.....	3,924,821	5.7	1,123,458	0.3	34,937,678
Drainage districts.....	3,260,104	4.7	772,334	0.2	26,339,970
General state laws.....	2,667,036	3.8	752,830	0.2	25,073,870
Special acts.....	593,048	0.9	20,004	( <sup>3</sup> )	1,206,000
County drains.....	596,694	0.9	302,224	0.1	8,139,808
Township drains.....	423	( <sup>3</sup> )	.....	.....	2,400
U. S. Reclamation Service.....	7,000	( <sup>3</sup> )	.....	.....	150,000
Commercial developments.....	50,000	0.1	45,000	( <sup>3</sup> )	150,000
Individual ownerships.....	10,600	( <sup>3</sup> )	3,400	( <sup>3</sup> )	155,500

<sup>1</sup> All of the statistics for which character of enterprises was not reported, except 35,052 acres and \$218,951 invested to Dec. 31, 1919, relate to either drainage districts or county drains in Indiana.

<sup>2</sup> Less than one-tenth of 1 per cent.

**Drainage works.**—The total works completed by drainage enterprises to December 31, 1919, comprised 107,468.2 miles of open ditches, 42,311.7 miles of tile drains, and 3,519.8 miles of accessory levees; the additional lengths under construction were 4,301.8 miles of open ditches, 2,862.1 miles of tile drains, and 810.2 miles of levees. These figures do not include drains or levees installed by individual farm owners supplemental to the works of the enterprises, nor the works of flood-protection or levee districts that had not undertaken the construction of ditches or tile drains. There are 212 pumping districts among the operating drainage enterprises in the United States.

The average depth of the main or outlet ditch was reported for each enterprise. The maximum depth of outlet reported for any enterprise in the United States and the maximum in each state are shown in line 15 of State Table V. The maximum length, width, and depth of outlet shown in that table for any state may not refer to the same enterprise.

In State Table V, line 16 shows the mean depth of branch ditches (open ditches only), which is a very crude indication of the depth of soil drainage that may be obtained in the enterprises as determined by the



depth of outlet provided for farm drains. The mean depth was computed by giving each separate depth a weight in proportion to the acreage it serves. As most enterprises reported depths in whole numbers only, the occasional decimals were omitted in making these computations. Depths less than 3 feet and those 10 feet and greater were omitted, because it seemed that they did not represent so well the average depths of outlet provided for all the farms in those enterprises. To include these groups, computed as 3 feet and 10 feet, respectively, would show the mean depth for the United States 5.5 instead of 5.4 feet.

TABLE 7.—LAND AND CAPITAL INVESTED IN OPERATING ENTERPRISES, CLASSIFIED BY KIND OF DRAINAGE WORKS: 1920.

KIND OF WORKS.	LAND.		CAPITAL.			
	Acreage.	Per cent of total.	To Dec. 31, 1919.		Additional required to complete.	
			Amount.	Per cent of total.		
All kinds.....	65,495,038	100.0	\$372,273,567	100.0	\$62,321,412	
Open ditches only.....	42,658,485	66.7	155,945,040	41.9	21,798,959	
Open ditches and levees.....	5,656,000	8.6	32,268,924	22.1	27,114,634	
Tile drains only.....	4,961,152	7.6	46,837,886	12.5	2,616,109	
Tile drains and levees.....	23,109	(1)	264,000	0.1		
Open ditches and tile drains.....	10,731,279	16.4	73,457,209	19.7	9,888,175	
Open ditches, tile drains, and levees.....	475,013	0.7	13,807,398	3.7	1,003,475	

<sup>1</sup> Less than one-tenth of 1 per cent.

TABLE 8.—LAND AND CAPITAL INVESTED IN OPERATING ENTERPRISES, CLASSIFIED BY TYPE OF DRAINAGE: 1920.

TYPE OF DRAINAGE.	LAND.		CAPITAL.			
	Acreage.	Per cent of total.	To Dec. 31, 1919.		Additional required to complete.	
			Amount.	Per cent of total.		
All operating enterprises...	65,495,038	100.0	\$372,273,567	100.0	\$62,321,412	
Gravity drainage only.....	63,602,475	97.1	306,443,303	82.3	48,396,322	
All drainage by pumping.....	781,441	1.2	32,030,807	8.6	2,001,761	
Part gravity and part pumping.....	1,111,122	1.7	33,809,457	9.1	11,923,329	
Total area served by pumps.....	1,544,010	2.4				

TABLE 9.—PUMPING PLANTS OF OPERATING ENTERPRISES, AND ACREAGE SERVED, CLASSIFIED BY KIND OF POWER: 1920.

KIND OF POWER.	ENGINE CAPACITY.		PUMP CAPACITY.		AREA SERVED.	
	Horse-power.	Per cent of total.	Gallons per minute.	Per cent of total.	Acreage.	Per cent of total.
All operating enterprises.....	67,189	100.0	15,949,166	100.0	1,544,010	100.0
Steam.....	17,311	25.8	7,125,848	44.7	496,426	32.0
Electric.....	36,472	54.3	5,733,756	36.0	706,794	45.6
Internal combustion.....	6,691	10.0	1,844,662	11.6	250,452	16.2
Steam and electric.....	1,485	8.2	974,200	6.1	67,466	4.4
Electric and internal combustion.....	2,800	1.3	189,500	1.2	14,723	1.0
Steam and internal combustion.....	215	0.3	77,600	0.5	5,800	0.4
Not reported.....	125	0.2	3,600	(4)	2,349	0.2

<sup>1</sup> Includes 2,450 steam, 1,330 electric, and 1,705 not divided.

<sup>2</sup> Includes 230 electric, 245 internal combustion, and 415 not divided.

<sup>3</sup> Includes 75 steam and 140 internal combustion.

<sup>4</sup> Less than one-tenth of 1 per cent.

<sup>5</sup> Includes 594 acres served by 1 water-wheel.

TABLE 10.—PUMPING PLANTS OF OPERATING ENTERPRISES, AND ACREAGE SERVED, CLASSIFIED BY KIND OF PUMP: 1920.

KIND OF PUMP.	Number of pumps.	PUMP CAPACITY.		ENGINE CAPACITY.		AREA SERVED.	
		Gallons per minute.	Per cent of total.	Horse-power.	Per cent of total.	Acreage.	Per cent of total.
All operating enterprises.....	453	15,949,166	100.0	67,189	100.0	1,544,010	100.0
Centrifugal.....	423	14,500,308	90.9	62,509	93.0	1,371,447	88.8
Rotary.....	7	53,348	0.3	380	0.5	4,341	0.3
Rotary and centrifugal.....	3	75,000	0.5	200	0.3	2,600	0.2
Screw.....	11	1,223,660	7.7	3,845	5.7	129,804	8.4
Centrifugal and screw.....	3	84,000	0.5	125	0.2	4,200	0.3
Not reported.....	6	12,850	0.1	150	0.2	13,618	2.0

<sup>1</sup> Includes 594 acres served by 1 water-wheel.

TABLE 11.—LAND IN OPERATING ENTERPRISES, CLASSIFIED BY AVERAGE DEPTH OF BRANCH DITCHES: 1920.

DEPTH OF BRANCH DITCHES.	Acreage.	Per cent of total.
All operating enterprises.....	65,495,038	100.0
Less than 3 feet.....	1,295,633	2.0
3.0 to 3.9 feet.....	4,100,380	6.3
4.0 to 4.9 feet.....	6,640,135	10.1
5.0 to 5.9 feet.....	5,402,497	8.2
6.0 to 6.9 feet.....	5,737,251	8.8
7.0 to 7.9 feet.....	3,488,588	5.3
8.0 to 8.9 feet.....	4,019,691	6.1
9.0 to 9.9 feet.....	496,595	0.8
10 feet and more.....	1,511,584	2.3
Not reporting branches.....	32,802,684	50.1

**Maintenance of works.**—Most of the laws governing drainage enterprises provide that the executive boards of those enterprises classified herein as drainage districts may maintain and repair the drainage works of their districts, and that the county boards or other designated public officials may keep the county drains in proper condition. In states having two or more drainage laws, a different method of maintenance may be provided for the enterprises established under each statute. Inspection of the public drainage works at least once each year is required in Iowa, and twice each season in those counties of Minnesota in which the cost of the enterprises has reached \$50,000. Annual estimates of funds necessary for maintenance work are now required by law for part or all of the public drainage enterprises in nearly every state in which public drainage organization is authorized. All public drains in Michigan and all dredged ditches in Indiana are repaired or reconstructed only upon petition and after proceedings similar to those required for establishing a new drain. In some other states also this has been the usual method of obtaining repairs until very recently.

The greater part of the laws provide that the costs for maintenance and repairs shall be assessed against the land that was assessed for original construction of the works, and in the same proportion as the construction cost. Maintenance costs for all the drainage enterprises in Texas and for those established under certain laws in other states are apportioned according to the assessed value of the property in the enterprises. In Louisiana



the costs are assessed in proportion to property valuation or at a uniform rate per acre. Some statutes have authorized or required that the ditches be divided into sections and allotted to the landowners for keeping in repair.

TABLE 12.—LAND AND CAPITAL INVESTED IN OPERATING ENTERPRISES, CLASSIFIED BY METHOD OF MAINTENANCE: 1920.

METHOD OF MAINTENANCE.	LAND.		CAPITAL.		
	Acreage.	Per cent of total.	To Dec. 31, 1919.		Additional required to complete.
			Amount.	Per cent of total.	
All operating enterprises.....	65,495,038	100.0	\$372,273,567	100.0	\$62,321,412
By district forces.....	14,184,281	21.7	132,883,309	35.7	23,717,025
By contract.....	12,687,978	19.4	83,422,369	22.4	5,474,587
By method not specified.....	553,058	0.8	6,317,582	1.7	313,775
By landowners.....	3,550,148	5.4	16,082,606	4.3	1,668,543
No maintenance provided.....	30,512,636	46.6	113,343,700	30.4	8,852,658
Not reporting.....	4,006,937	6.1	20,224,001	5.4	22,294,824

Further information than is given in the above table was not secured regarding maintenance provided for the drainage works. It is probable that the amount of systematic maintenance is actually much less than the table would seem to indicate; that only an inconsiderable number of landowners clean out the public drains of their own initiative; and that much of the contract work, and even some of that reported as done by district forces, is really reconstruction of drains that have been more or less neglected.

**Date of organization.**—The progress in drainage development is shown only roughly by the dates of the organization of the enterprises, which are the dates when the orders of establishment were issued, since there may be a period of one or more years between the order of establishment and the beginning of actual construction, and since the work of construction may occupy several years for a large enterprise. It was not practicable, however, for the census to secure data as to the time of the beginning or the completion of the drainage works. Under the date of organization are tabulated the entire area, works, and capital of each enterprise, even including extensions made after the original plan of reclamation was completed. For such enterprises as irrigation districts, the date is approximately that when the drainage, rather than the irrigation, was undertaken.

Owing to the incompleteness of the records of drainage work in Michigan before 1897, when the county drain law was enacted, no attempt was made to secure information regarding the enterprises established previous to that year. In some counties in other states, more particularly in Indiana and Ohio, the records of the earlier drainage enterprises were incomplete or, in some cases, entirely missing.

TABLE 13.—LAND IN OPERATING ENTERPRISES, CLASSIFIED BY DATE ENTERPRISE WAS ORGANIZED: 1920.

DATE OF ORGANIZATION.	LAND.		AREA ASSESSED.	
	Acreage.	Per cent of total.	Acreage.	Per cent of total.
All operating enterprises.....	65,495,038	100.0	95,629,291	100.0
Before 1860.....	97,319	0.1	98,119	0.1
1860 to 1869.....	783,357	1.2	932,565	1.0
1870 to 1879.....	2,077,717	3.2	3,413,277	3.6
1880 to 1889.....	5,424,294	8.3	8,843,654	9.2
1890 to 1899.....	6,026,937	9.2	11,576,924	12.1
1900 to 1904.....	7,606,763	11.6	12,200,468	12.8
1905 to 1909.....	14,530,397	22.2	20,228,686	21.2
1910 to 1914.....	17,344,098	26.5	22,245,539	23.3
1915 to 1919.....	11,374,619	17.4	15,828,501	16.6
Not reported.....	229,547	0.4	262,608	0.3

TABLE 14.—CAPITAL INVESTED IN OPERATING ENTERPRISES, CLASSIFIED BY DATE ENTERPRISE WAS ORGANIZED: 1920.

DATE OF ORGANIZATION.	CAPITAL.		
	To Dec. 31, 1919.		Additional required to complete.
	Amount.	Per cent of total.	
All operating enterprises.....	\$372,273,567	100.0	\$62,321,412
Before 1860.....	182,718	( <sup>1</sup> )	.....
1860 to 1869.....	1,689,852	0.5	.....
1870 to 1879.....	8,126,391	2.2	.....
1880 to 1889.....	23,934,380	6.4	1,840,829
1890 to 1899.....	24,498,861	6.6	521,810
1900 to 1904.....	26,706,464	7.2	709,063
1905 to 1909.....	76,072,320	20.4	7,612,491
1910 to 1914.....	120,289,586	32.3	14,455,410
1915 to 1919.....	87,379,002	23.5	36,771,659
Not reported.....	3,414,035	0.9	410,659

<sup>1</sup> Less than one-tenth of 1 per cent.

TABLE 15.—DRAINS AND LEVEES (COMPLETED AND UNDER CONSTRUCTION) IN OPERATING ENTERPRISES, CLASSIFIED BY DATE ENTERPRISE WAS ORGANIZED: 1920.

DATE OF ORGANIZATION.	DITCHES.		TILE.		LEVEES.	
	Miles.	Per cent of total.	Miles.	Per cent of total.	Miles.	Per cent of total.
All drains and levees.....	111,770.0	100.0	45,173.8	100.0	4,830.0	100.0
Before 1860.....	173.7	0.2	4.2	( <sup>1</sup> )	.....	.....
1860 to 1869.....	2,295.5	2.1	47.5	0.1	21.0	0.5
1870 to 1879.....	6,671.9	6.0	372.5	0.8	64.2	1.5
1880 to 1889.....	14,763.2	13.2	2,582.0	5.7	218.7	5.0
1890 to 1899.....	12,747.3	11.4	4,306.0	9.5	376.1	8.7
1900 to 1904.....	12,308.3	11.0	3,735.4	8.3	438.5	10.1
1905 to 1909.....	20,538.9	18.4	7,877.8	17.4	801.1	18.5
1910 to 1914.....	24,875.7	22.3	11,812.3	26.1	1,331.1	30.7
1915 to 1919.....	16,897.5	15.1	14,237.7	31.5	885.8	20.4
Not reported.....	493.0	0.4	198.4	0.4	193.5	4.5

<sup>1</sup> Less than one-tenth of 1 per cent.

**Crops.**—The principal crops grown upon the drained land in drainage enterprises are corn, wheat, cotton, hay, and sugar beets. Data were not secured to show the part of each enterprise planted to any crop, so the enterprises have been classified according to the principal crop, and the total area of improved land is shown thus classified in State Table V. No data were secured at the general census of agriculture which would make it possible to separate the crops grown upon land drained artificially from those produced upon land drained naturally.

STATE TABLE I.—DRAINAGE ON FARMS, BY GEOGRAPHIC DIVISIONS AND STATES: 1920.

DIVISION AND STATE.	NUMBER OF FARMS.				Area of all land (acres).	LAND IN FARMS.							Needing drainage.		
	All farms.	Having drainage.	Needing drainage.	In drainage and levee districts.		Total (acres).	Improved (acres).	Woodland (acres).	Other unimproved (acres).	Provided with drainage (acres).			Total (acres).	Drainage only (acres).	Drainage and clearing (acres).
<b>United States.....</b>	<b>6,448,343</b>	<b>924,815</b>	<b>956,085</b>	<b>173,793</b>	<b>1,903,215,380</b>	<b>955,883,715</b>	<b>503,073,007</b>	<b>167,730,794</b>	<b>285,079,914</b>	<b>53,024,975</b>			<b>39,169,639</b>	<b>10,459,181</b>	<b>28,710,458</b>
<b>GEOGRAPHIC DIVISIONS:</b>															
New England.....	158,564	9,083	17,571	232	39,664,640	16,990,642	6,114,601	7,020,311	3,855,730	129,799			397,267	86,991	310,276
Middle Atlantic.....	425,147	61,549	69,216	1,583	64,000,000	40,572,901	26,562,107	8,659,237	5,351,557	1,673,638			1,412,038	505,910	906,128
East North Central.....	1,084,744	429,584	302,008	63,789	157,160,960	117,735,179	87,894,835	18,061,460	11,778,884	30,737,056			8,870,356	3,243,427	5,626,929
West North Central.....	1,096,951	103,714	169,593	47,883	326,914,560	256,973,229	171,394,439	18,761,832	66,816,958	11,758,939			7,200,539	4,187,385	3,073,154
South Atlantic.....	1,158,976	114,983	156,780	6,979	172,205,440	97,775,243	48,509,886	41,802,263	7,463,094	2,865,072			7,511,230	696,687	6,814,543
East South Central.....	1,051,600	69,597	106,972	17,290	114,885,760	78,897,463	44,380,132	28,414,524	6,102,807	1,720,517			4,279,968	462,040	3,817,928
West South Central.....	996,088	44,835	91,595	25,010	275,037,440	173,449,127	64,189,606	29,749,152	79,510,369	2,365,701			7,134,572	734,305	6,400,267
Mountain.....	244,109	9,754	14,988	3,551	549,765,760	117,337,226	30,105,968	6,887,071	80,344,287	456,015			969,948	329,359	640,589
Pacific.....	234,164	21,716	27,372	6,456	203,580,800	56,152,705	23,921,533	8,374,944	23,856,228	1,318,238			1,333,721	213,077	1,120,644
<b>NEW ENGLAND:</b>															
Maine.....	48,227	2,068	5,425	25	19,132,800	5,425,968	1,977,329	2,447,597	1,001,042	26,302			142,053	19,930	122,123
New Hampshire.....	29,523	1,013	1,794	16	5,779,849	2,603,806	702,902	1,269,838	601,066	11,777			40,783	9,914	30,869
Vermont.....	29,075	1,728	3,042	35	5,839,360	4,235,811	1,691,595	1,428,809	1,115,907	35,640			68,912	19,265	49,647
Massachusetts.....	32,001	2,955	4,112	138	5,144,990	2,494,477	908,834	1,030,386	555,257	39,022			80,883	21,212	59,671
Rhode Island.....	4,083	116	359	2	682,880	331,000	132,855	130,482	68,283	2,403			8,174	2,240	5,934
Connecticut.....	22,655	1,203	2,839	36	3,084,800	1,998,980	701,086	683,719	514,175	14,646			56,462	14,430	42,032
<b>MIDDLE ATLANTIC:</b>															
New York.....	193,195	33,896	38,523	1,447	39,498,560	20,632,803	13,158,781	4,160,567	3,313,455	1,180,423			779,467	318,865	460,602
New Jersey.....	29,702	4,933	3,428	136	4,808,960	2,282,585	1,555,607	454,768	272,210	174,260			77,881	29,193	48,688
Pennsylvania.....	202,250	22,750	27,265	238	28,092,480	17,687,513	11,847,719	4,043,902	1,765,892	318,956			554,690	157,852	396,838
<b>EAST NORTH CENTRAL:</b>															
Ohio.....	256,695	130,117	85,326	7,315	26,073,600	23,515,888	18,542,353	3,198,929	1,774,606	7,365,532			2,014,889	836,557	1,128,332
Indiana.....	205,126	111,435	66,413	14,839	24,068,800	21,063,332	16,680,212	3,141,042	1,242,078	8,308,844			1,717,068	673,952	1,043,116
Illinois.....	237,181	99,246	33,731	14,586	35,867,520	31,974,775	27,294,533	3,102,579	1,577,663	11,247,637			1,228,739	641,493	587,246
Michigan.....	196,447	66,948	64,310	23,356	36,787,200	19,032,961	12,925,621	3,217,000	2,890,440	3,156,632			2,070,387	579,813	1,490,574
Wisconsin.....	189,295	21,838	52,228	3,693	35,363,840	22,145,221	12,452,216	5,401,910	4,294,097	658,411			1,839,273	461,612	1,377,661
<b>WEST NORTH CENTRAL:</b>															
Minnesota.....	178,478	53,011	73,905	16,421	51,749,120	30,221,758	21,481,710	4,482,656	4,257,892	2,993,034			3,504,574	1,801,457	1,703,117
Iowa.....	219,439	88,865	56,083	20,658	35,575,040	33,474,896	28,636,951	2,295,274	2,572,671	7,334,404			2,052,942	1,061,744	991,198
Missouri.....	263,004	11,917	19,572	7,743	43,985,280	34,774,679	24,832,666	8,583,657	1,387,856	850,663			830,693	163,178	667,515
North Dakota.....	77,699	652	2,669	341	44,917,120	36,214,751	24,563,178	679,836	10,971,737	89,054			211,305	53,161	158,144
South Dakota.....	74,637	4,077	11,828	1,028	49,195,520	34,636,491	18,199,250	536,183	15,901,058	161,871			446,915	356,049	90,866
Nebraska.....	124,417	2,356	2,963	1,064	49,157,120	42,225,475	23,109,624	900,933	18,214,918	214,428			145,818	115,425	30,393
Kansas.....	165,286	2,806	2,573	628	52,335,360	45,425,179	30,600,760	1,313,093	13,511,326	106,985			68,292	36,371	31,921
<b>SOUTH ATLANTIC:</b>															
Delaware.....	10,140	4,246	2,438	1,321	1,267,600	944,511	453,052	222,658	68,801	185,831			68,969	7,967	61,002
Maryland.....	47,908	6,911	6,658	272	6,362,240	4,767,999	3,136,728	1,327,221	294,050	249,799			184,820	33,267	151,553
District of Columbia.....	204	21	12		38,400	5,668	4,258	828	582	197			115	58	57
Virginia.....	186,242	9,899	27,740	140	25,767,680	18,561,112	9,460,492	7,907,352	1,193,268	225,068			1,172,580	77,192	1,095,388
West Virginia.....	87,299	1,949	10,304	33	15,874,080	9,509,790	5,520,308	3,499,444	580,038	38,404			310,868	32,253	278,615
North Carolina.....	269,763	45,246	42,247	1,881	31,193,600	20,021,736	8,198,409	10,299,547	1,066,933	1,925,343			1,925,343	189,401	1,735,942
South Carolina.....	192,693	26,993	24,508	1,071	19,516,800	12,426,675	6,184,159	5,302,575	939,941	676,152			1,341,903	125,548	1,216,355
Georgia.....	310,732	15,121	34,337	995	37,584,000	25,441,061	13,055,200	10,491,848	1,894,004	274,688			1,819,611	143,187	1,676,424
Florida.....	54,005	4,597	8,496	1,266	35,111,040	6,046,891	2,297,271	2,780,790	968,630	147,940			687,021	87,814	599,207
<b>EAST SOUTH CENTRAL:</b>															
Kentucky.....	270,626	5,817	19,592	773	25,715,840	21,612,772	13,975,746	6,018,280	1,618,746	225,228			573,299	84,189	489,110
Tennessee.....	252,774	8,887	20,997	2,669	26,679,080	19,510,856	11,185,302	7,080,169	1,245,385	254,118			640,479	76,644	563,835
Alabama.....	256,099	19,967	36,511	352	32,818,560	19,576,856	9,893,407	8,301,177	1,382,272	415,293			1,610,656	150,028	1,460,628
Mississippi.....	272,101	34,926	29,872	13,496	29,671,680	18,196,979	9,325,677	7,014,898	1,856,404	825,878			1,455,534	151,179	1,304,355
<b>WEST SOUTH CENTRAL:</b>															
Arkansas.....	232,604	13,426	33,437	10,882	33,616,000	17,456,750	9,210,556	7,396,028	850,166	497,489			1,642,403	129,987	1,512,416
Louisiana.....	135,463	21,271	14,985	10,516	29,061,760	10,019,822	5,626,226	3,614,040	779,556	1,004,935			1,095,769	179,805	916,464
Oklahoma.....	191,988	2,032	8,065	834	44,424,960	31,951,934	18,125,321	4,206,171	9,620,442	107,014			265,786	39,788	225,998
Texas.....	436,033	8,106	35,106	2,778	167,934,720	114,020,621	31,227,503	14,532,913	63,260,205	756,263			4,130,614	385,225	3,745,389
<b>MOUNTAIN:</b>															
Montana.....	57,677	756	1,728	336	93,523,840	35,070,656	11,007,278	1,646,462	22,416,916	51,146			113,293	36,342	76,951
Idaho.....	42,106	1,167	2,895	647	53,346,560	8,375,873	4,511,680	820,876	3,043,317	64,648			199,874	37,566	162,308
Wyoming.....	15,748	433	1,127	337	62,430,720	11,809,351	2,102,065	421,806	9,285,540	35,654			69,066	23,837	45,229
Colorado.....	59,934	2,749	4,399	696	66,341,120	24,462,014	7,744,757	1,415,420	15,301,837	127,037			270,997	80,121	190,876
New Mexico.....	29,844	1,294	998	484	78,401,920	24,409,633	1,717,224	1,417,460	20,874,949	47,311			49,102	29,016	20,086
Arizona.....	9,975	241	435	28	72,838,400	5,802,126	712,803	523,648	4,585,676	9,651			41,951	9,596	32,355
Utah.....	25,662	2,729	3,085	791	52,597,760	5,050,410	1,715,380	212,762	3,122,268	74,316			165,926	74,786	91,140
Nevada.....	3,163	385	321	232	70,285,440	2,357,163	594,741	28,637	1,733,785	46,252			59,739	38,095	21,644
<b>PACIFIC:</b>															
Washington.....	66,288	10,620	14,323	2,680	42,775,040	13,244,720	7,129,343	1,813,061	4,302,316	274,096			576,005	45,206	530,799
Oregon.....	50,206	6,618	9,862	573	61,183,480	13,542,318	4,913,851	2,309,596	6,318,871	229,582			471,996	75,063	396,933
California.....	117,670	5,078	3,187	3,203	99,617,280	29,365,667	11,878,339	4,252,287	13,235,041	813,960			286,320	92,808	193,512

## DRAINAGE.

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STATE TABLE II.—LAND IN ALL DRAINAGE ENTERPRISES, CLASSIFIED AS BETWEEN OPERATING AND NONOPERATING ENTERPRISES, BY GEOGRAPHIC DIVISIONS AND STATES: 1920.

DIVISION AND STATE.	Approximate land area of states included (acres).	ALL ENTERPRISES.		OPERATING ENTERPRISES.				NONOPERATING ENTERPRISES.	
		Acreage.	Per cent of total.	All operating enterprises.		Works completed (acres).	Works under construction (acres).	Acreage.	Per cent of total.
				Acreage.	Per cent of total.				
States included.....	1,717,932,160	69,419,859	100.0	65,495,038	100.0	56,763,751	8,731,287	3,924,821	100.0
GEOGRAPHIC DIVISIONS:									
East North Central.....	157,160,980	32,073,734	46.2	31,627,176	48.3	30,475,905	1,151,271	440,558	11.4
West North Central.....	326,914,500	19,936,111	28.7	19,217,367	29.3	16,959,103	2,258,264	718,744	18.3
South Atlantic.....	123,405,440	3,436,887	5.0	2,385,384	3.6	861,312	1,524,072	1,051,503	26.8
East South Central.....	82,067,290	2,796,530	4.0	2,323,595	3.5	1,732,586	591,009	473,235	12.1
West South Central.....	275,637,440	9,062,489	13.1	7,924,197	12.1	5,750,958	2,173,239	1,138,283	29.0
Mountain.....	519,765,760	888,809	1.3	810,076	1.2	236,872	573,204	78,733	2.0
Pacific.....	206,580,800	1,225,008	1.8	1,207,243	1.8	747,015	460,228	17,765	0.5
EAST NORTH CENTRAL:									
Ohio.....	26,073,600	8,147,546	11.7	8,107,204	12.4	8,093,994	13,210	40,343	1.0
Indiana.....	23,068,800	9,375,907	13.5	9,087,183	13.9	8,807,674	219,509	288,724	7.4
Illinois.....	35,867,520	3,982,033	5.7	3,909,049	6.0	3,459,474	478,575	72,984	1.9
Michigan.....	36,787,200	9,754,679	14.1	9,723,171	14.9	9,511,555	217,616	25,508	0.6
Wisconsin.....	35,363,840	813,569	1.2	794,569	1.2	572,208	222,361	19,000	0.5
WEST NORTH CENTRAL:									
Minnesota.....	51,749,120	9,362,944	13.5	9,232,709	14.1	8,552,900	679,809	130,235	3.3
Iowa.....	35,575,040	5,283,012	7.8	5,224,478	8.0	4,685,050	539,398	158,534	4.0
Missouri.....	43,985,280	2,960,205	4.3	2,566,204	4.0	1,858,945	737,259	384,061	9.8
North Dakota.....	44,917,120	1,248,328	1.8	1,240,328	1.9	1,100,044	140,284	8,000	0.2
South Dakota.....	49,195,520	222,062	0.3	222,062	0.3	124,132	97,930	.....	.....
Nebraska.....	49,157,120	633,566	0.9	607,730	0.9	565,222	42,508	25,836	0.7
Kansas.....	52,335,360	105,934	0.2	93,856	0.1	72,730	21,076	12,073	0.3
SOUTH ATLANTIC:									
North Carolina.....	31,193,600	542,828	0.8	542,828	0.8	440,657	102,171	.....	.....
South Carolina.....	19,516,800	144,237	0.2	140,031	0.2	24,864	115,167	4,206	0.1
Georgia.....	37,584,000	104,006	0.1	65,452	0.1	43,723	21,729	38,564	1.0
Florida.....	35,111,040	2,645,816	3.8	1,637,073	2.5	352,068	1,285,005	1,008,743	25.7
EAST SOUTH CENTRAL:									
Kentucky.....	25,715,840	471,874	0.7	358,480	0.5	288,143	70,337	113,394	2.9
Tennessee.....	26,679,680	445,955	0.6	363,671	0.6	268,667	95,004	82,284	2.1
Mississippi.....	29,671,680	1,879,001	2.7	1,601,444	2.4	1,175,776	425,668	277,557	7.1
WEST SOUTH CENTRAL:									
Arkansas.....	23,616,000	4,151,834	6.0	3,479,591	5.3	2,124,446	1,355,145	672,243	17.1
Louisiana.....	29,061,760	2,732,368	3.9	2,266,328	3.5	1,534,634	731,694	496,040	11.9
Oklahoma.....	44,424,960	12,150	(1)	12,150	(1)	11,750	400	.....	.....
Texas.....	167,934,720	2,166,128	3.1	2,166,128	3.3	2,080,128	86,000	.....	.....
MOUNTAIN:									
Montana.....	93,523,840	168,682	0.2	168,682	0.3	44,682	124,000	.....	.....
Idaho.....	53,346,560	78,732	0.1	64,642	0.1	43,892	20,750	14,090	0.4
Wyoming.....	62,430,720	107,041	0.2	95,474	0.1	11,740	83,734	11,567	0.3
Colorado.....	66,341,120	171,656	0.2	171,656	0.3	66,816	104,840	.....	.....
New Mexico.....	78,401,920	147,219	0.2	140,219	0.2	20,169	120,050	7,000	0.2
Arizona.....	72,838,400	64,985	0.1	39,640	0.1	9,640	30,000	25,345	0.6
Utah.....	52,597,760	134,554	0.2	113,823	0.2	23,993	89,530	20,731	0.5
Nevada.....	70,285,440	15,940	(1)	15,940	(1)	15,940	.....	.....	.....
PACIFIC:									
Washington.....	42,775,040	99,789	0.1	94,924	0.1	90,084	4,840	4,865	0.1
Oregon.....	61,188,480	4,000	(1)	4,000	(1)	4,000	.....	.....	.....
California.....	99,617,280	1,121,219	1.6	1,108,319	1.7	652,931	455,388	12,900	0.3

1 Less than one-tenth of 1 per cent.

## AGRICULTURE.

STATE TABLE III.—CAPITAL INVESTED IN ALL DRAINAGE ENTERPRISES, CLASSIFIED AS BETWEEN OPERATING AND NONOPERATING ENTERPRISES, BY GEOGRAPHIC DIVISIONS AND STATES: 1920.

DIVISION AND STATE.	INVESTED TO DEC. 31, 1919.								ADDITIONAL REQUIRED TO COMPLETE.			
	Total.		Operating enterprises.				Nonoperating enterprises.		Total.		All operating enterprises.	Non-operating enterprises.
			All operating enterprises.		Works completed.	Works under construction.						
	Amount.	Per cent.	Amount.	Per cent.	Amount.	Amount.	Amount.	Per cent.	Amount.	Per cent.	Amount.	Amount.
States included.....	\$373,397,025	100.0	\$372,273,567	100.0	\$293,857,023	\$78,416,544	\$1,123,458	100.0	\$97,259,090	100.0	\$62,321,412	\$34,937,678
GEOGRAPHIC DIVISIONS:												
East North Central.....	134,359,233	36.0	134,269,666	36.1	119,525,193	14,744,473	89,567	8.0	13,376,507	13.8	9,452,661	3,923,846
West North Central.....	121,824,200	32.6	121,562,077	32.7	102,365,306	19,196,771	262,123	23.3	23,743,744	24.4	11,632,586	12,111,168
South Atlantic.....	19,096,139	5.1	18,847,093	5.1	6,805,285	12,041,808	249,046	22.2	17,512,611	18.0	14,476,175	3,036,436
East South Central.....	11,808,449	3.2	11,523,833	3.1	9,085,234	2,438,599	284,616	25.3	7,333,076	7.5	2,306,418	5,026,658
West South Central.....	29,112,366	7.8	28,946,385	7.8	20,473,933	8,472,452	165,981	14.8	21,902,834	22.5	13,411,222	8,491,612
Mountain.....	7,866,066	2.1	7,839,941	2.1	3,248,713	4,591,228	26,125	2.3	6,541,844	6.7	4,668,876	1,872,968
Pacific.....	49,330,572	13.2	49,284,572	13.2	32,353,359	16,931,213	46,000	4.1	6,848,474	7.0	6,373,474	475,000
EAST NORTH CENTRAL:												
Ohio.....	30,707,863	8.2	30,680,145	8.2	30,636,857	43,288	27,718	2.5	397,396	0.4	91,475	305,921
Indiana.....	31,201,517	8.4	31,147,682	8.4	30,154,296	993,386	53,835	4.8	2,729,055	2.8	796,176	1,932,879
Illinois.....	43,595,069	11.7	43,595,069	11.7	31,424,167	12,170,902	-----	-----	9,199,841	9.5	7,798,175	1,401,666
Michigan.....	24,636,729	6.6	24,683,715	6.6	24,100,929	582,786	3,014	0.3	537,645	0.6	365,265	172,380
Wisconsin.....	4,168,055	1.1	4,163,055	1.1	3,208,944	954,111	5,000	0.4	512,570	0.5	401,570	111,000
WEST NORTH CENTRAL:												
Minnesota.....	42,089,304	11.3	42,017,447	11.3	36,764,850	5,252,597	71,857	6.4	5,095,002	5.2	2,166,391	2,928,611
Iowa.....	49,649,775	13.3	49,627,304	13.3	44,630,537	4,996,767	22,471	2.0	6,858,477	7.1	4,542,574	2,315,903
Missouri.....	20,899,328	5.6	20,723,128	5.6	13,294,635	7,429,093	166,200	14.8	10,178,401	10.5	4,026,607	6,151,794
North Dakota.....	2,208,049	0.6	2,208,049	0.6	1,863,788	344,261	-----	-----	77,723	0.1	53,400	24,323
South Dakota.....	1,461,063	0.4	1,461,063	0.4	942,757	518,306	-----	-----	271,666	0.3	271,666	-----
Nebraska.....	4,588,578	1.2	4,588,578	1.2	4,121,486	467,092	-----	-----	821,841	0.8	298,103	523,738
Kansas.....	938,103	0.3	936,508	0.3	747,853	188,655	1,595	0.1	440,634	0.5	273,845	166,789
SOUTH ATLANTIC:												
North Carolina.....	3,623,518	1.0	3,623,518	1.0	3,075,018	548,500	-----	-----	902,500	0.9	902,500	-----
South Carolina.....	583,083	0.2	582,183	0.2	198,370	383,813	900	0.1	445,845	0.5	354,331	91,514
Georgia.....	828,681	0.2	794,585	0.2	614,636	179,949	34,096	3.0	1,231,176	1.3	303,654	927,522
Florida.....	14,060,857	3.8	13,846,807	3.7	2,917,261	10,929,546	214,050	19.1	14,933,090	15.4	12,915,690	2,017,400
EAST SOUTH CENTRAL:												
Kentucky.....	1,620,027	0.4	1,621,725	0.4	1,278,701	243,024	98,302	8.7	1,825,513	1.9	299,271	1,526,242
Tennessee.....	2,995,515	0.8	2,925,944	0.8	2,283,589	642,355	69,571	6.2	1,447,230	1.5	522,047	925,183
Mississippi.....	7,192,907	1.9	7,076,164	1.9	5,522,944	1,553,220	118,743	10.4	4,060,333	4.2	1,485,100	2,575,233
WEST SOUTH CENTRAL:												
Arkansas.....	14,217,155	3.8	14,147,174	3.8	9,385,025	4,762,149	69,981	6.2	18,637,337	19.2	11,741,425	6,895,912
Louisiana.....	9,117,991	2.4	9,021,991	2.4	5,956,938	3,065,053	96,000	8.5	2,564,497	2.6	968,797	1,595,700
Oklahoma.....	76,415	( <sup>1</sup> )	76,415	( <sup>1</sup> )	76,165	250	-----	-----	1,000	( <sup>1</sup> )	1,000	-----
Texas.....	5,700,805	1.5	5,700,805	1.5	5,055,805	645,000	-----	-----	700,000	0.7	700,000	-----
MOUNTAIN:												
Montana.....	664,990	0.2	664,990	0.2	393,969	271,021	-----	-----	181,476	0.2	181,476	-----
Idaho.....	1,678,294	0.4	1,668,569	0.4	1,237,578	430,991	9,725	0.9	250,000	0.3	120,000	130,000
Wyoming.....	1,182,362	0.3	1,175,962	0.3	32,231	1,143,731	6,400	0.6	901,873	0.9	491,405	410,468
Colorado.....	1,081,875	0.3	1,081,875	0.3	508,663	573,212	-----	-----	203,195	0.2	203,195	-----
New Mexico.....	1,710,796	0.5	1,710,796	0.5	361,989	1,348,807	-----	-----	1,345,580	1.4	1,195,500	150,000
Arizona.....	414,925	0.1	414,425	0.1	101,425	313,000	500	( <sup>1</sup> )	1,147,000	1.2	612,000	535,000
Utah.....	1,014,973	0.3	1,005,473	0.3	495,007	510,466	9,500	0.8	2,512,800	2.6	1,865,300	647,500
Nevada.....	117,851	( <sup>1</sup> )	117,851	( <sup>1</sup> )	117,851	-----	-----	-----	-----	-----	-----	-----
PACIFIC:												
Washington.....	1,442,419	0.4	1,397,419	0.4	1,376,809	20,610	45,000	4.0	114,000	0.1	39,000	75,000
Oregon.....	200,000	0.1	200,000	0.1	200,000	-----	-----	-----	-----	-----	-----	-----
California.....	47,688,153	12.8	47,687,153	12.8	30,776,550	16,910,603	1,000	0.1	6,734,474	6.9	6,334,474	400,000

<sup>1</sup> Less than one-tenth of 1 per cent.

STATE TABLE IV.—LAND IN ALL DRAINAGE ENTERPRISES, CLASSIFIED BY CONDITION, BY GEOGRAPHIC DIVISIONS AND STATES: 1920.

DIVISION AND STATE	Land in all enterprises (acres).	Per cent of all land in state.	OPERATING ENTERPRISES.						NONOPERATING ENTERPRISES.					
			Total (acres).	Improved land (acres).	Timber and cut-over land (acres).	Other unimproved land (acres).	Swampy or subject to overflow (acres).	Suffering a loss of crops (acres).	Total (acres).	Improved land (acres).	Timber and cut-over land (acres).	Other unimproved land (acres).	Swampy or subject to overflow (acres).	Suffering a loss of crops (acres).
States included....	69,419,859	3.6	65,495,038	44,288,235	11,283,532	9,923,271	7,224,213	3,011,407	3,924,821	1,376,495	1,294,018	1,254,306	2,209,562	239,192
GEOGRAPHIC DIVISIONS:														
East North Central....	32,073,734	20.4	31,627,176	25,282,065	4,457,151	1,887,960	2,012,248	1,283,296	446,558	270,083	77,653	98,822	144,363	61,024
West North Central....	19,936,111	6.1	19,217,367	11,630,279	2,530,012	5,057,076	2,007,511	901,857	718,744	406,744	89,443	222,557	441,137	28,656
South Atlantic.....	3,436,887	2.0	2,385,384	388,345	862,334	1,134,705	849,342	58,194	1,051,503	36,900	314,640	700,063	719,579	38,280
East South Central....	2,796,830	2.4	2,323,595	1,349,791	914,404	59,400	434,602	78,809	473,235	198,494	223,185	51,556	239,554	19,359
West South Central....	9,082,480	3.3	7,924,197	3,877,160	2,506,431	1,540,606	1,670,037	483,495	1,138,283	398,471	587,147	152,065	709,355	68,150
Mountain.....	888,809	0.2	810,076	635,868	87	174,121	194,437	154,551	78,733	56,729	1,950	20,054	31,258	23,723
Pacific.....	1,225,008	0.6	1,207,243	1,124,721	13,113	60,409	56,036	51,205	17,765	9,174	.....	8,591	14,316	.....
EAST NORTH CENTRAL:														
Ohio.....	8,147,546	31.2	8,107,204	6,707,328	950,894	442,982	247,273	141,481	40,342	24,375	4,363	11,604	19,776	7,603
Indiana.....	9,375,907	40.6	9,087,183	7,605,565	942,378	539,240	386,320	210,678	288,724	192,190	51,212	45,322	64,677	38,456
Illinois.....	3,982,033	11.1	3,909,049	3,532,316	184,573	192,160	228,337	229,065	72,984	44,993	3,714	24,277	29,294	13,507
Michigan.....	9,754,679	26.5	9,729,171	7,182,352	2,195,562	351,257	1,020,207	692,224	25,508	8,245	15,039	2,224	12,316	1,458
Wisconsin.....	813,569	2.3	794,569	254,504	177,744	362,321	130,111	9,848	19,000	280	3,325	15,395	18,300	.....
WEST NORTH CENTRAL:														
Minnesota.....	9,362,944	18.1	9,232,709	3,818,490	1,370,023	4,044,196	1,193,136	471,094	130,235	34,494	7,158	88,583	78,922	981
Iowa.....	5,383,012	15.1	5,224,478	4,493,407	74,652	656,419	320,893	157,542	158,534	84,722	4,350	69,462	68,197	5,058
Missouri.....	2,980,265	0.8	2,596,204	1,474,302	1,074,880	47,042	454,360	242,238	384,061	265,063	77,268	41,730	270,382	17,917
North Dakota.....	1,248,328	2.8	1,240,328	1,026,574	.....	213,754	12,332	4,819	8,000	5,334	.....	2,666	2,000	.....
South Dakota.....	222,062	0.5	222,062	178,540	.....	43,522	6,067	481	.....	.....	.....	.....	.....	.....
Nebraska.....	633,566	1.3	607,730	551,517	6,342	49,871	14,019	19,575	25,836	5,853	267	19,716	21,636	4,700
Kansas.....	105,934	0.2	93,856	87,449	4,135	2,272	6,704	6,088	12,078	11,278	400	400	.....	.....
SOUTH ATLANTIC:														
North Carolina.....	542,828	1.7	542,828	204,928	244,576	93,324	77,494	12,771	.....	.....	.....	.....	.....	.....
South Carolina.....	144,237	0.7	140,031	59,075	64,955	16,001	18,206	3,093	4,206	976	1,548	1,082	4,106	.....
Georgia.....	104,006	0.3	65,452	29,763	10,155	25,544	21,951	1,832	38,554	9,622	9,425	19,506	23,232	6,862
Florida.....	2,645,816	7.5	1,637,073	94,589	542,648	999,836	731,091	40,498	1,008,743	26,202	303,666	678,875	692,241	31,418
EAST SOUTH CENTRAL:														
Kentucky.....	471,874	1.8	358,490	245,334	92,495	20,651	69,413	36,723	113,394	67,526	28,539	17,329	55,339	875
Tennessee.....	445,955	1.7	363,671	163,218	189,945	10,508	104,063	29,879	82,284	23,116	57,150	2,018	76,004	17,536
Mississippi.....	1,879,001	6.3	1,601,444	941,239	631,964	28,241	261,126	12,207	277,557	107,852	137,496	32,209	106,211	948
WEST SOUTH CENTRAL:														
Arkansas.....	4,151,834	12.4	3,479,591	1,481,777	1,923,382	64,432	897,547	153,957	672,243	217,491	414,707	40,045	496,573	20,774
Louisiana.....	2,732,368	9.4	2,266,328	1,269,391	467,822	529,115	569,189	198,935	466,040	180,980	172,440	112,620	212,782	47,376
Oklahoma.....	12,150	( <sup>1</sup> )	12,150	8,845	3,305	.....	2,250	1,838	.....	.....	.....	.....	.....	.....
Texas.....	2,166,128	1.3	2,166,128	1,107,153	111,922	947,053	201,051	128,765	.....	.....	.....	.....	.....	.....
MOUNTAIN:														
Montana.....	198,682	0.2	168,682	141,252	.....	27,430	19,630	21,964	.....	.....	.....	.....	.....	.....
Idaho.....	78,732	0.1	64,642	52,098	87	12,457	11,402	164	14,090	7,514	1,950	4,626	3,326	3,101
Wyoming.....	107,041	0.2	95,474	84,846	.....	10,628	20,785	6,595	11,567	7,513	.....	4,054	6,554	1,000
Colorado.....	171,656	0.3	171,656	123,031	.....	48,625	26,446	15,282	.....	.....	.....	.....	.....	.....
New Mexico.....	147,219	0.2	140,219	92,477	.....	47,742	20,572	24,420	7,000	1,750	.....	5,250	.....	1,155
Arizona.....	64,985	0.1	39,640	36,880	.....	2,760	2,160	2,160	25,345	22,276	.....	3,069	1,069	1,069
Utah.....	134,554	0.3	113,823	97,314	.....	16,509	88,181	76,803	20,731	17,676	.....	3,055	20,309	17,398
Nevada.....	15,940	( <sup>1</sup> )	15,940	7,970	.....	7,970	5,261	7,163	.....	.....	.....	.....	.....	.....
PACIFIC:														
Washington.....	99,789	0.2	94,924	81,886	850	12,188	10,873	8,996	4,865	3,174	.....	1,691	1,416	.....
Oregon.....	4,000	( <sup>1</sup> )	4,000	4,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
California.....	1,121,219	1.1	1,108,319	1,088,835	12,283	57,221	45,163	42,209	12,900	6,000	.....	6,900	12,900	.....

<sup>1</sup> Less than one-tenth of 1 per cent.

STATE TABLE V.—OPERATING DRAINAGE ENTERPRISES,

		GEOGRAPHIC DIVISIONS.							
		STATES INCLUDED.	East North Central.	West North Central.	South Atlantic.	East South Central.	West South Central.	Mountain.	Pacific.
LAND AREA.									
1	Approximate land area of the division or state	acres.	1,717,932,160	157,160,960	326,914,560	123,405,440	82,067,200	275,037,440	549,765,760
2	All land in operating drainage enterprises	acres.	65,495,038	31,627,176	19,217,367	2,385,384	2,323,695	7,924,197	810,076
3	Improved land	acres.	44,288,235	25,282,065	11,630,279	388,345	1,349,791	3,877,166	635,868
4	Per cent of all improved land in farms	per cent.	8.8	28.8	6.8	0.8	3.0	6.0	2.1
5	Timber and cut-over land	acres.	11,283,532	4,457,151	2,530,012	862,334	914,404	2,506,431	87
6	Other unimproved land	acres.	9,923,271	1,887,960	5,057,076	1,134,705	59,400	1,540,600	174,121
7	Swampy or subject to overflow, in enterprises	acres.	7,224,213	2,012,248	2,007,511	849,342	434,602	1,070,037	194,437
8	Suffering a loss of crops from defective drainage	acres.	3,011,407	1,283,296	901,857	58,194	78,809	483,495	154,551
9	Assessed acreage	acres.	95,629,291	59,131,679	21,262,129	2,517,852	2,326,635	8,363,124	810,076
10	Excess over all land in operating enterprises	acres.	30,134,253	27,504,503	2,044,762	132,468	3,040	438,927	10,553
DRAINAGE WORKS.									
11	Open ditches:								
12	Completed	miles.	107,468.2	64,924.3	23,912.7	3,701.6	3,256.9	7,672.8	827.7
13	Additional under construction	miles.	4,801.8	408.9	745.6	1,229.4	436.0	1,234.0	211.8
14	Maximum completed in any enterprise	miles.	324.0	144.5	216.0	166.0	121.0	305.0	108.0
15	Maximum width at bottom of ditch	feet.	400	125	125	90	120	200	25
16	Maximum of average depths of outlet ditches	feet.	42.0	42.0	30.0	22.0	20.0	30.0	16.0
17	Mean depth of branch ditches	feet.	5.4	4.7	5.5	5.1	6.8	5.6	6.7
18	Tile drains:								
19	Completed	miles.	42,811.7	23,325.2	17,109.3	101.5	325.2	20.6	1,248.2
20	Additional under construction	miles.	2,932.1	309.6	1,285.0	161.0	55.3	2.0	965.5
21	Maximum completed in any enterprise	miles.	210.0	200.0	210.0	64.0	80.0	10.0	206.0
22	Maximum size of tile	inches.	60	60	52	24	36	40	38
23	Accessory levees and dikes:								
24	Completed	miles.	3,519.8	866.4	698.6	111.7	49.2	625.3	37.5
25	Additional under construction	miles.	810.2	112.8	85.8	136.5	47.0	306.7	121.4
26	Pumping plants:								
27	Engine capacity	horsepower.	67,189	20,190	6,003	1,275	250	10,465	480
28	Pump capacity	gallons per minute.	15,949,166	2,964,014	1,086,800	1,083,600	78,000	5,905,150	72,560
29	Area served by pumps	acres.	1,544,010	315,879	207,124	107,440	44,000	230,809	34,312
30	Area drained by open ditches only	acres.	43,658,485	20,579,653	13,191,826	1,724,706	1,952,386	5,805,234	210,616
31	Length of these ditches	miles.	84,628.5	51,005.9	19,304.1	3,787.9	3,234.4	6,409.4	422.9
32	Average length per acre	feet.	10.2	13.1	7.7	11.6	8.7	5.8	10.6
33	Area having open ditches and levees	acres.	5,656,000	769,634	1,109,924	651,478	311,224	2,077,507	31,412
34	Length of these ditches	miles.	8,615.8	954.0	1,582.2	1,028.1	313.9	2,399.8	28.1
35	Average length per acre	feet.	8.0	6.6	7.5	8.3	5.3	6.1	4.7
36	Length of the accessory levees	miles.	3,746.7	670.3	683.0	206.2	96.2	931.0	32.0
37	Area drained by tile only	acres.	4,951,152	3,088,386	1,734,668	8,917	3,100	105,625	10,566
38	Length of these tile	miles.	23,193.4	12,522.0	10,087.3	115.0	20.0	402.8	46.3
39	Average length per acre	feet.	24.7	21.4	30.7	68.1	34.1	20.2	23.1
40	Area having tile drains and levees	acres.	23,109	10,109	13,000				
41	Length of these tile	miles.	11.0	2.0	9.0				
42	Average length per acre	feet.	2.5	1.0	3.7				
43	Length of the accessory levees	miles.	26.5	10.0	10.5				
44	Area drained by open ditches and tile	acres.	10,731,273	6,941,175	3,071,610	51,068	28,856	459,323	179,247
45	Length of these drains	miles.	37,678.9	22,977.3	11,024.8	410.2	85.0	2,157.7	423.9
46	Average length per acre	feet.	18.5	17.5	20.0	42.4	15.6	24.8	12.5
47	Area having open ditches, tile drains, and levees	acres.	475,013	247,819	96,349	9,200	9,500	3,200	108,945
48	Length of these drains	miles.	2,566.2	1,506.8	445.2	377.5	15.2	66.0	345.5
49	Average length per acre	feet.	31.3	33.4	24.4	216.7	8.4	108.9	18.7
50	Length of the accessory levees	miles.	556.8	292.9	90.9	42.0	1.0	5.5	124.5
DEVELOPMENT OF LAND.									
51	Improved land in operating enterprises, 1920	acres.	44,288,235	25,282,065	11,630,279	388,345	1,349,791	3,877,166	635,868
52	Improved land prior to drainage	acres.	24,586,236	13,610,812	6,850,589	173,033	774,771	2,394,636	477,899
53	Increase since drainage	acres.	19,701,999	11,771,253	4,779,690	215,312	575,020	1,482,530	157,969
54	Per cent of increase	per cent.	80.1	87.1	69.8	123.7	74.2	61.9	33.1
55	Per cent increase is of all improved land in farms, 1920	per cent.	3.9	13.4	2.8	0.4	1.3	2.3	0.5
56	Timber and cut-over land, 1920	acres.	11,283,532	4,457,151	2,530,012	862,334	914,404	2,506,431	87
57	Timber and cut-over land prior to drainage	acres.	21,753,774	12,924,601	3,229,756	971,139	1,420,474	3,164,160	97
58	Decrease since drainage	acres.	10,470,242	8,467,450	699,744	108,805	506,070	657,729	10
59	Per cent of decrease	per cent.	48.1	65.5	21.7	11.2	35.6	20.8	10.3
60	Other unimproved land, 1920	acres.	9,923,271	1,887,960	5,057,076	1,134,705	59,400	1,540,600	174,121
61	Other unimproved land prior to drainage	acres.	19,155,028	5,191,763	9,137,022	1,240,612	128,550	2,365,401	332,080
62	Decrease since drainage	acres.	9,231,757	3,803,803	4,079,946	105,907	68,950	824,801	157,959
63	Per cent of decrease	per cent.	48.2	68.6	44.7	8.5	53.7	34.9	47.6
64	Swampy or subject to overflow, 1920	acres.	7,224,213	2,012,248	2,007,511	849,342	434,602	1,670,037	194,437
65	Swampy or subject to overflow, prior to drainage	acres.	31,696,513	13,702,611	9,388,660	1,784,869	1,179,003	4,351,751	427,502
66	Decrease since drainage	acres.	24,472,300	11,690,363	7,381,149	935,527	745,001	2,681,714	233,065
67	Per cent of decrease	per cent.	77.2	85.3	78.6	52.4	63.2	61.6	54.5
CAPITAL INVESTED AND COST PER ACRE.									
68	Total capital invested in and required to complete enterprises	dollars.	434,594,979	143,722,327	133,194,663	33,323,268	13,830,251	42,357,607	12,608,817
69	Capital invested in these enterprises to Dec. 31, 1919	dollars.	372,273,567	134,266,666	121,562,077	18,847,093	11,523,833	28,946,385	7,839,941
70	Additional capital required to complete these enterprises	dollars.	62,321,412	9,455,661	11,632,586	14,476,175	2,306,418	13,411,222	4,668,876
71	Average cost per acre when completed	dollars.	6.64	4.34	6.93	13.97	5.95	5.35	15.44
72	Enterprises constructing open ditches only	dollars.	177,741,999	64,064,791	52,342,663	21,024,626	11,475,140	21,492,022	3,351,347
73	Average cost per acre when completed	dollars.	4.07	3.11	3.97	12.19	5.88	3.70	15.91
74	Enterprises constructing open ditches and levees	dollars.	109,378,508	20,889,257	11,352,636	11,888,642	1,634,345	20,531,585	1,005,000
75	Average cost per acre when completed	dollars.	18.34	27.48	10.23	18.25	5.25	9.88	31.99
76	Enterprises constructing tile drains only	dollars.	49,054,155	17,801,089	28,841,089		50,479	41,000	1,837,577
77	Average cost per acre when completed	dollars.	9.91	8.06	16.03		9.03	13.23	17.41
78	Enterprises constructing tile drains and levees	dollars.	264,000	160,000	104,000				
79	Average cost per acre when completed	dollars.	11.42	15.83					
80	Enterprises constructing open ditches and tile drains	dollars.	83,345,384	34,190,397	38,456,628		640,287	253,000	6,174,893
81	Average cost per acre when completed	dollars.	7.77	4.93	12.52		12.64	8.77	13.44
82	Enterprises constructing open ditches, tile drains, and levees	dollars.	14,810,873	6,616,793	2,097,041	410,000		40,000	140,000
83	Average cost per acre when completed	dollars.	31.18	26.70	21.77	44.57		4.21	43.75
CROPS.									
84	Improved land in enterprises reporting—								
85	Corn as principal crop on drained land	acres.	27,089,387	18,280,046	6,951,913	215,984	456,124	1,057,601	1,130
86	Wheat as principal crop on drained land	acres.	6,936,078	3,398,947	3,118,868			750	138,006
87	Cotton as principal crop on drained land	acres.	2,763,213		250,681	70,986	857,557	1,505,619	36,240
88	Hay as principal crop on drained land	acres.	1,941,236	802,990	1,067,258		1,080	4,315	17,008
89	Sugar beets as principal crop on drained land	acres.	1,207,244	1,140,880	16,284				48,585
90	Peas and beans (dried) as principal crop on drained land	acres.	643,359	616,142					27,197
91	Alfalfa as principal crop on drained land	acres.	558,866		3,230			28,500	373,459
92	Vegetables as principal crop on drained land	acres.	570,218	207,810	7,339	32,737		152,044	80,288
93	Rice as principal crop on drained land	acres.	523,167					446,130	77,037
94	Sugar cane as principal crop on drained land	acres.	483,896			17,623		466,273	
95	Potatoes as principal crop on drained land	acres.	272,175	148,871	5,939				97,461
96	Oats as principal crop on drained land	acres.	274,242	102,926	169,739				1,822
97	Barley as principal crop on drained land	acres.	161,752		1,778				159,074
98	Fruit as principal crop on drained land	acres.	28,173						38,173
99	Citrus fruit as principal crop on drained land	acres.	10,820	379,142		10,820			
100	Other crops as principal ones on drained land	acres.	617,587	879,142	2,184	17,491		216,034	640
101	Not reporting principal crop on drained land	acres.	196,842	114,311	38,056	2,800	5,600		5,290

1 When works under construction have been completed.



## DRAINAGE.

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BY GEOGRAPHIC DIVISIONS AND STATES: 1920.

EAST NORTH CENTRAL.					WEST NORTH CENTRAL.						
Ohio.	Indiana.	Illinois.	Michigan.	Wisconsin.	Minnesota.	Iowa.	Missouri.	North Dakota.	South Dakota.	Nebraska.	Kansas.
28,073,600	23,068,800	35,897,620	38,787,200	35,263,840	51,749,120	35,575,040	43,985,280	44,817,120	49,185,620	49,157,120	52,335,390
8,107,204	9,087,183	3,909,049	9,729,171	794,669	9,232,709	5,224,478	2,596,204	1,240,328	222,062	607,730	93,856
6,707,328	7,606,565	3,532,316	7,182,352	254,504	3,818,490	4,493,407	1,474,802	1,026,574	178,540	551,517	87,449
36.2	45.6	12.9	55.6	2.0	17.8	15.7	5.9	4.2	1.0	2.4	0.3
956,894	942,378	184,573	2,195,562	177,744	1,370,028	74,652	1,074,800	213,754	43,522	6,342	4,135
442,982	539,240	192,160	351,257	362,321	4,044,196	656,419	47,042	12,832	6,067	49,871	2,272
247,273	386,320	228,337	1,020,207	130,111	1,193,186	320,893	454,800	4,819	6,481	14,019	6,704
141,481	210,678	229,065	692,224	9,848	471,694	157,542	242,258	1,240,328	234,201	708,450	6,088
23,464,812	15,015,221	4,090,999	15,766,478	794,569	9,974,682	5,905,743	3,104,886	1,240,328	234,201	708,450	93,856
15,357,608	5,928,038	181,550	6,037,307	741,958	741,958	681,265	508,685	12,139	100,720	100,720	10
24,984.0	17,470.7	4,754.5	10,023.8	1,691.3	14,657.0	3,998.0	3,438.7	708.3	237.8	734.5	138.4
13.4	123.4	65.7	118.4	88.0	166.1	81.1	460.4	4.0	8.1	18.7	7.2
44.1	100.0	80.0	75.0	144.5	218.0	82.3	179.3	45.1	25.6	80.0	14.4
125	125	100	70	60	72	90	125	80	100	100	30.0
18.0	27.5	42.0	13.0	13.0	24.0	25.0	22.0	14.0	10.0	18.0	4.3
3.9	5.1	4.8	4.3	6.5	4.9	6.5	7.0	3.7	4.8	6.1	16
9,205.3	3,227.6	3,507.1	2,173.9	211.3	5,924.6	10,354.9	38.8	9.3	179.3	359.4	213.0
8.3	185.7	127.1	8.4	40.1	462.7	768.6	5.9	33.6	14.2	14.2	18
50.0	100.0	200.0	10.5	43.0	153.0	127.0	15.0	4.5	25.9	100.0	210.0
60	48	48	48	30	48	52	30	22	36	48	30
9.6	165.8	650.2	83.1	7.7	0.1	45.2	456.9	2.1	2.4	26.8	165.1
4.0	9.2	97.1	2.5	2.5	0.3	74.9	74.9	74.9	2.8	7.8	7.8
125	625	18,225	1,065	150	580,800	3,153	2,785	1,217,028	145,834	445,431	27,038
3,600	55,348	2,843,066	62,000	6,597	580,800	580,800	552,000	70,308	134,616	445,431	4,000
1,755	5,611	291,816	10,100	6,597	134,616	134,616	134,616	1,217,028	145,834	445,431	2,200
4,738,114	5,133,620	1,508,090	8,541,556	657,068	8,440,167	1,294,243	1,612,083	706.0	168.9	528.9	53.3
19,924.4	12,487.2	2,406.7	14,725.0	1,492.6	13,482.0	1,984.7	2,480.3	3.1	6.1	6.3	7.0
22.2	12.8	8.4	2.1	8.4	8.4	7.9	8.1	3.1	6.1	6.3	7.0
7,078	270,784	452,588	2,000	27,584	26,228	26,228	883,432	9,600	4,120	138,551	47,993
11.1	210.5	559.7	63.6	79.1	45.4	45.4	1,278.3	4.0	8.3	177.9	68.3
8.3	4.1	469.1	33.1	7.7	29.1	29.1	7.6	2.2	10.6	6.8	7.5
6.8	153.6	392,738	318,514	2,958	271,118	1,415,176	451.7	2.1	1.8	29.6	138.7
1,139,856	1,234,320	1,206.9	1,303.7	97.2	2,816.1	6,785.7	760	10,820	30,764	6,020	33
5,274.7	4,639.5	16.2	21.6	173.5	54.8	25.3	4.0	9.0	116.0	356.5	31
24.4	10.8	10.09	2.0	2.0	6.0	6,000	7,000	4.4	19.9	312.7	35
2,219,770	2,423,949	1,327,996	867,101	102,359	516,782	2,444,906	46,240	2,880	40,664	17,728	2,410
8,633.4	8,481.7	3,012.4	2,202.2	347.6	4,907.3	6,392.2	88.9	2.6	164.5	63.5	5.8
21.2	15.5	12.0	13.4	17.9	50.1	13.8	10.2	4.8	21.4	18.9	42
2,356	24,510	216,923	4,000	44.2	4,642	37,925	46,687	680	680	680	6,415
67.4	188.5	1,266.7	44.2	55.0	55.0	68.6	89.3	1.1	1.1	1.1	281.2
149.2	40.6	30.8	58.3	62.6	62.6	9.6	10.1	8.5	8.5	8.5	190.3
6.8	21.4	262.2	2.5	0.4	0.4	8.1	47.6	0.6	0.6	0.6	84.2
6,707,328	7,606,565	3,532,316	7,182,352	254,504	3,818,490	4,493,407	1,474,802	1,026,574	178,540	551,517	87,449
3,955,220	5,396,387	2,062,521	2,046,613	50,071	1,722,875	3,210,496	700,796	691,035	98,724	292,621	74,072
2,752,106	2,209,178	1,469,795	5,135,739	204,438	2,065,615	1,282,911	713,506	835,609	79,516	258,896	13,377
69.0	40.9	71.3	250.9	408.3	121.6	40.0	95.8	45.6	80.8	38.5	18.1
14.8	13.2	5.4	39.7	1.6	9.8	4.5	2.9	1.4	0.4	1.1	51
956,894	942,378	184,573	2,195,562	177,744	1,370,028	74,652	1,074,800	213,754	43,522	6,342	4,135
3,079,180	2,324,978	1,367,030	6,809,213	231,732	1,478,820	96,994	1,045,297	571,437	2,455	8,797	6,848
2,122,286	1,382,600	294,925	4,613,651	53,988	108,797	19,342	571,437	213,754	43,522	2,455	2,713
68.9	61.5	61.5	67.8	23.3	7.0	24.6	84.7	213,754	43,522	2,455	2,713
442,982	539,240	192,160	351,257	362,321	4,044,196	656,419	47,042	12,832	6,067	49,871	2,272
1,072,804	1,365,818	1,367,030	873,345	512,709	6,036,014	1,919,988	189,111	549,823	123,338	306,312	12,936
629,822	826,578	1,174,870	522,088	150,445	1,991,818	1,283,569	142,069	335,569	70,816	266,441	10,664
58.7	60.5	85.9	69.8	28.3	83.0	65.8	75.1	61.1	64.7	83.7	67.4
247,273	386,320	228,337	1,020,207	130,111	1,193,186	320,893	454,800	12,332	6,067	14,019	6,704
3,126,885	3,247,205	1,894,138	4,703,010	701,307	4,634,641	1,567,960	2,013,704	619,159	141,491	395,253	16,452
2,879,612	2,890,945	1,635,801	3,742,808	571,196	3,441,505	1,247,067	1,559,344	606,827	135,424	381,234	9,748
92.1	88.1	87.8	78.6	81.4	74.3	79.5	77.4	98.0	95.7	96.5	59.3
30,771,920	31,943,858	51,393,244	25,048,980	4,564,625	44,183,838	54,160,878	24,749,735	2,261,449	1,782,729	4,896,681	1,210,353
30,680,145	31,147,682	43,595,069	24,683,715	4,163,555	42,017,447	49,627,304	20,723,128	2,208,049	1,461,063	4,588,578	986,508
91,475	796,176	7,798,175	365,265	401,570	2,166,391	4,542,574	4,026,607	53,400	271,666	298,103	273,845
3.80	3.52	13.15	2.57	5.74	4.79	10.37	9.53	1.82	7.80	8.04	12.90
15,360,631	14,565,990	11,874,658	19,041,495	3,222,017	23,238,989	8,856,170	13,442,666	2,200,158	891,770	3,034,949	677,961
3.24	2.81	7.87	2.23	4.90	2.75	6.84	8.24	1.81	6.11	6.81	18.30
50,080	920,976	19,459,251	176,284	282,666	78,770	25.69	9,215,065	12,368	9,447	1,010,524	431,462
7.08	3.40	33.00	83.14	10.25	7,391,548	20,886,476	17,500	42,908	360,263	143,000	8,99
5,997,998	6,278,168	3,181,397	2,287,056	59,770	20,21	14.76	23.03	3.97	11.71	23.75	71
5.26	5.08	8.10	7.18	20.21	27.26	90,000	14,000	11.71	23.75	23.75	71
100,000	15.83	15.83	15.83	15.83	15.83	15.83	15.83	15.83	15.83	15.83	15.83
9,285,211	9,811,999	10,641,870	3,544,145	907,172	13,360,171	23,424,200	485,230	6,015	468,539	698,208	14,265
4.18	4.05	8.01	4.09	8.86	25.85	9.58	10.49	2.09	11.52	39.39	5.92
78,000	369,725	6,076,068	93,000	93,000	183,130	239,262	1,575,274	2,710	2,710	2,710	86,665
32.69	15.08	28.01	23.25	23.25	41.60	6.31	33.74	3.99	3.99	3.99	18.51
6,309,143	6,943,654	3,404,489	1,525,685	97,075	827,801	4,365,787	980,387	1,000,889	148,804	495,683	33,451
248,186	392,529	88,520	2,669,222	560	1,774,205	90,361	248,234	26,185	27,926	21,295	51,819
126,815	121,608	456,601	1,140,880	97,906	940,935	360	250,681	32	32	9,725	81
14,883	2,296	5,380	272,843	2,408	2,408	2,408	2,408	2,408	2,408	16,284	82
4,741	64,647	28,723	119,909	239	5,939	166,239	1,778	1,778	1,778	1,778	88
201	80,901	5,204	359,351	10,560	2,184	36,579	36,579	36,579	36,579	36,579	89
3,359	80,901	5,204	11,687	13,160	1,187	36,579	36,579	36,579	36,579	36,579	90

\* Less than one-tenth of 1 per cent.

\* Includes 17,980 acres reported as grain.

STATE TABLE V.—OPERATING DRAINAGE ENTERPRISES.

		SOUTH ATLANTIC.				EAST SOUTH CENTRAL.			WEST SOUTH CENTRAL.	
		North Carolina.	South Carolina.	Georgia.	Florida.	Kentucky.	Tennessee.	Mississippi.	Arkansas.	Louisiana.
LAND AREA.										
1	Approximate land area of the state.....	31,193,600	19,516,800	37,534,000	35,111,040	25,715,840	26,679,680	29,671,680	33,616,000	29,061,760
2	All land in operating drainage enterprises.....	542,828	140,031	65,452	1,637,073	358,480	363,671	1,601,444	3,479,591	2,266,328
3	Improved land.....	204,928	59,075	29,753	94,589	245,334	163,218	941,239	1,491,777	1,269,391
4	Per cent of all improved land in farms.....	2.5	1.0	0.2	4.1	1.8	1.5	10.1	16.2	22.6
5	Timber and cut-over land.....	244,576	64,955	10,155	542,648	92,495	189,945	631,964	1,923,382	467,822
6	Other unimproved land.....	93,324	16,001	25,544	999,836	20,651	10,508	28,241	64,432	529,115
7	Swampy or subject to overflow, in enterprises.....	77,494	18,206	21,951	731,691	69,413	104,063	261,126	897,547	569,189
8	Suffering a loss of crops from defective drainage.....	12,771	3,093	1,832	40,498	36,723	29,879	12,207	153,957	198,935
9	Assessed acreage.....	552,428	140,031	65,452	1,759,941	358,480	363,671	1,604,484	3,842,812	2,342,034
10	Excess over all land in operating enterprises.....	9,600			122,888			3,040	363,221	75,706
DRAINAGE WORKS.										
Open ditches:										
11	Completed.....	1,171.3	262.7	276.8	1,990.8	664.5	777.3	1,815.1	3,154.1	1,771.6
12	Additional under construction.....	367.8	87.7	79.9	694.0	135.4	223.6	54.2	197.1	162.7
13	Maximum completed in any enterprise.....	110.0	100.0	21.5	166.0	21.3	55.0	121.0	305.0	100.0
14	Maximum width at bottom of ditch.....	70	28	46	90	34	80	120	100	100
15	Maximum of average depths of outlet ditches.....	14.0	10.0	10.0	22.0	20.0	16.0	20.0	18.0	30.0
16	Mean depth of branch ditches.....	6.7	5.2	5.1	4.3	5.1	6.8	6.8	6.9	5.1
Tile drains:										
17	Completed.....		101.5			86.2	0.3	238.8	20.4	0.2
18	Additional under construction.....		161.0			1.0	0.1	54.2	2.0	
19	Maximum completed in any enterprise.....		64.0			32.0	0.3	80.0	10.0	0.2
20	Maximum size of tile.....		24			24	10	36	20	40
Accessory levees and dikes:										
21	Completed.....	33.5	12.0		66.2	0.2	42.3	6.7	119.8	440.7
22	Additional under construction.....		30.0		106.5		10.2	36.8	240.8	65.9
Pumping plants:										
23	Engine capacity.....	1,000	155		120			250	2,800	7,665
24	Pump capacity.....	1,000,000	44,600		39,000			78,000	720,000	5,245,150
25	Area served by pumps.....	100,000	2,940		4,500			44,000	90,000	140,809
26	Area drained by open ditches only.....	435,295	130,831	65,452	1,093,128	345,605	332,317	1,274,464	2,267,281	1,913,870
27	Length of these ditches.....	1,494.6	235.4	350.7	1,791.2	837.1	892.2	1,685.1	2,464.3	1,386.4
28	Average length per acre.....	17.0	9.5	28.8	8.7	10.5	13.7	7.0	5.7	3.8
29	Area having open ditches and levees.....	107,533			543,945	1,140	30,854	279,230	1,171,354	351,958
30	Length of these ditches.....	134.5			893.6	4.3	60.5	259.1	1,598.8	507.4
31	Average length per acre.....	6.6			8.7	19.9	8.6	4.9	7.1	8.5
32	Length of the accessory levees.....	33.5			172.7	0.2	52.6	43.5	359.6	506.6
33	Area drained by tile only.....					117	500	8,300	3,100	
34	Length of these tile.....					2.6	0.4	112.0	20.0	
35	Average length per acre.....					117.3	4.2	71.2	34.1	
36	Area having tile drains and levees.....									
37	Length of these tile.....									
38	Average length per acre.....									
39	Length of the accessory levees.....									
40	Area drained by open ditches and tile.....									
41	Length of these drains.....					11,618		39,450	28,356	500
42	Average length per acre.....					134.7		275.5	84.3	0.7
43	Area having open ditches, tile drains, and levees.....		9,200			61.2		36.9	15.7	7.4
44	Length of these drains.....		377.5						9,500	
45	Average length per acre.....		216.7						15.2	
46	Length of the accessory levees.....		42.0						8.4	
DEVELOPMENT OF LAND.										
47	Improved land in operating enterprises, 1920.....	204,928	59,075	29,753	94,589	245,334	163,218	941,239	1,491,777	1,269,391
48	Improved land prior to drainage.....	84,714	51,349	7,229	30,341	181,915	86,028	506,828	887,864	936,902
49	Increase since drainage.....	120,214	7,726	22,524	64,248	63,419	77,190	434,411	603,913	332,489
50	Per cent of increase.....	141.9	15.0	311.6	211.8	34.9	89.7	85.7	68.0	35.5
51	Per cent increase is of all improved land in farms, 1920.....	1.5	0.1	0.2	2.8	0.5	0.7	4.7	6.6	5.9
52	Timber and cut-over land, 1920.....	244,576	64,955	10,155	542,648	92,495	189,945	631,964	1,923,382	467,822
53	Timber and cut-over land prior to drainage.....	311,628	68,691	26,081	565,741	146,096	282,163	1,012,215	2,460,170	580,418
54	Decrease since drainage.....	67,050	3,736	14,266	23,093	53,601	72,218	380,251	536,788	112,596
55	Per cent of decrease.....	21.5	5.4	59.5	4.1	36.7	27.5	37.6	21.8	19.4
56	Other unimproved land, 1920.....	93,324	16,001	25,544	999,836	20,651	10,508	28,241	64,432	529,115
57	Other unimproved land prior to drainage.....	146,488	19,991	33,142	1,040,991	30,460	15,480	82,401	131,557	749,008
58	Decrease since drainage.....	53,164	3,990	7,598	41,155	9,818	4,972	54,160	67,125	219,893
59	Per cent of decrease.....	36.3	20.0	22.9	4.0	32.2	32.1	65.7	51.0	29.4
60	Swampy or subject to overflow, 1920.....	77,494	18,206	21,951	731,691	69,413	104,063	261,126	897,547	569,189
61	Swampy or subject to overflow, prior to drainage.....	311,110	91,354	54,092	1,328,313	199,161	353,027	627,415	2,065,284	1,278,995
62	Decrease since drainage.....	233,616	73,148	32,141	596,622	128,748	248,964	366,289	1,167,717	709,806
63	Per cent of decrease.....	75.1	80.1	59.4	44.9	65.1	70.5	58.4	56.5	55.5
CAPITAL INVESTED AND COST PER ACRE.										
64	Total capital invested in and required to complete enterprises, dollars.....	4,526,018	936,514	1,098,239	26,782,497	1,820,996	3,447,991	8,561,264	25,888,599	9,990,788
65	Capital invested in these enterprises to Dec. 31, 1919.....	2,623,518	582,183	794,585	13,846,807	1,521,725	2,925,944	7,076,164	14,147,174	9,021,991
66	Additional capital required to complete these enterprises, dollars.....	902,500	354,331	303,654	12,935,690	299,271	522,047	1,485,100	11,741,425	968,797
67	Average cost per acre when completed.....	8.34	6.69	16.78	16.35	5.08	9.48	5.35	7.44	4.41
68	Enterprises constructing open ditches only.....	3,729,644	526,514	1,098,239	15,670,229	1,702,397	2,951,791	6,820,652	11,001,651	4,868,251
69	Average cost per acre when completed.....	8.57	4.02	16.78	14.34	4.93	8.88	5.35	4.85	2.54
70	Enterprises constructing open ditches and levees.....	796,374			11,092,283	8,333	488,790	1,137,812	14,555,948	5,119,537
71	Average cost per acre when completed.....	7.41			20.39	7.31	15.84	4.07	12.43	14.55
72	Enterprises constructing tile drains only.....					1,979	7,600	71,000	41,000	
73	Average cost per acre when completed.....					16.91	15.00	8.55	13.23	
74	Enterprises constructing tile drains and levees.....									
75	Average cost per acre when completed.....									
76	Enterprises constructing open ditches and tile drains.....									
77	Average cost per acre when completed.....									
78	Enterprises constructing open ditches, tile drains, and levees.....		410,000			108,287		532,000	250,000	3,000
79	Average cost per acre when completed.....		44.57			9.32		13.49	8.82	6.00
CROPS.										
Improved land in enterprises reporting—										
80	Corn as principal crop on drained land.....	183,658	3,035	29,291		239,254	110,022	136,848	461,230	103,608
81	Wheat as principal crop on drained land.....									
82	Cotton as principal crop on drained land.....	19,678	51,308							
83	Hay as principal crop on drained land.....						53,196	804,391	909,973	241,430
84	Sugar beets as principal crop on drained land.....					1,080			2,320	
85	Peas and beans (dried) as principal crop on drained land.....									
86	Alfalfa as principal crop on drained land.....									
87	Vegetables as principal crop on drained land.....		1,232							
88	Rice as principal crop on drained land.....				31,505					6,341
89	Sugar cane as principal crop on drained land.....									446,130
90	Potatoes as principal crop on drained land.....		1,120		17,623					466,273
91	Oats as principal crop on drained land.....				18,784					
92	Barley as principal crop on drained land.....									
93	Fruit as principal crop on drained land.....									
94	Citrus fruit as principal crop on drained land.....									
95	Other crops as principal ones on drained land.....	1,350	2,380		10,820					
96	Not reporting principal crop on drained land.....	242		462	13,761	2,096			118,254	5,609

1 Less than one-tenth of 1 per cent.

2 When works under construction have been completed.

3 Includes 1,000 acres reported as grain.



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[illegible]<sup>b</sup> Includes 198,012 acres reported as grain.