Twelfth Census of the United States.

CENSUS BULLETIN.

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MANUFACTURES.

WATCHES AND WATCH CASES.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on the manufacture of watches and watch cases for the census year 1900, prepared under my direction by Mr. William A. Countryman, of the Census Office.

The statistics included in the report were collected, as in previous censuses, upon the schedules used for the general statistics of manufactures. At no census has the manufacture of watches and watch cases been the subject of a special report, except that in 1880 a study of the manufacture of watches was presented in a report on manufactures of interchangeable mechanism. As 1900 virtually completed a half century of the systematic and continuous manufacture of machine-made watches in the United States (and, therefore, in the world), it was decided to supplement the ordinary presentation of statistics with a special report, setting forth the important features of the industry and giving a concise history of its rise and progress.

The statistics are presented in 17 tables. Table 1 is a summary for the combined manufacture of watches and watch cases for 1900; Table 2 presents comparative statistics for watches only, from 1870 to 1900, inclusive; Table 3 is a summary of watch manufacture by states for 1900; Table 4 shows the geographical distribution of watch establishments, and the increase or decrease during the decade 1890 to 1900; Table 5 is a comparative summary of capital invested in watchmaking for 1890 and 1900; Table 6 is a summary of miscellaneous expenses for watches for 1900; Table 7 shows the cost of the various materials used for watches, 1900; Table 8 presents the kind, quantity, and value of products of watch establishments for 1900; Table 9 is a detailed summary for watches by states for 1900; Table 10 presents comparative statistics for watch cases only, from 1870 to 1900, inclusive; Table 11 is a summary for watch cases by states for 1900; Table 12 shows the geographical distribution of watch-case establishments, 1890 and 1900, and the increase or decrease during the decade; Table 13 is a comparative summary of capital invested in watch-case making for 1890 and 1900; Table 14 is a summary of miscellaneous expenses for watch cases for 1900; Table 15 shows the cost of the various materials used for watch cases in 1900; Table 16 presents the kind, quantity, and value of products of watch-case establishments for 1900; and Table 17 is a detailed summary for watch cases by states for 1900.

Tables 2 and 10 show the growth of the industry for the thirty years which terminate with the Twelfth Census. As regards watchmaking, the manufacturing statistics of the censuses prior to 1870 were too imperfect and fragmentary in character to make it proper to reproduce them in such a table as a measure of the growth of the industry. Owing to changes in the method of taking the census, comparisons between the earlier and later decades, represented in Tables 2 and 10, should be drawn only in the most general way. Nevertheless, the rate of growth in the manufacture of watches

and watch cases may be fairly inferred from the figures given.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

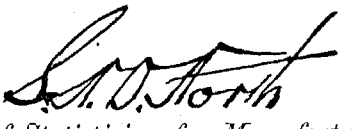
Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is, therefore, impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class, overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

The reports show a capital of $22,754,483 invested in the manufacture of watches and watch cases in the 43 establishments reporting for the United States. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations engaged in this industry. The value of the products is returned at $14,606,571, to produce which involved an outlay of $583,815 for salaries of officials, clerks, etc.; $5,511,570 for wages; $889,982 for miscellaneous expenses, including rent, taxes, etc.; and $5,684,965 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the manufacture of watches and watch cases during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the works. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,



Chief Statistician for Manufactures.

WATCHES AND WATCH CASES.

By WILLIAM A. COUNTRYMAN.

The first systematic manufacture of watch movements in the world, by machinery, began in the United States in 1851, and of watch cases shortly afterwards. The census of 1900, therefore, was taken at substantially the completion of a half century in the history of this remarkable revolution, during which automatic machinery for the most delicate operations has been brought forward toward perfection in a more wonderful degree, perhaps, than in any other manufacture. A review of the manufacture is, therefore, of unusual interest at this time.

Unfortunately, early methods of census taking were not as accurate as those of to-day. At the census of 1860 the manufacture of watches was classified with "watches, watch repairing, and materials" for the United States, although occasionally for a state it was classified separately. It is a matter of regret that even in such a state it is impossible to trace the industry statistically, the establishments being fewer than three in number. Massachusetts, which was the pioneer in the manufacture, and which produces watch movements in greater quantity and value than any other state, was, for instance, necessarily included under "all other states" at the census of 1900, as at certain other censuses. Only those familiar with the industry know that Massachusetts has always led in the manufacture of watches. Illinois, which appears first among the states shown separately, is second, a position it has occupied for years. The manufacture of watch cases is most largely carried on in the states of New York, Pennsylvania, and New Jersey. The first statistics available for comparative purposes, either for watches or watch cases, are those of the census of 1870.

The census manufacturing classification of watches comprises those establishments of which watch movements are either the whole or the principal product. A watch is technically the movement and the case together, but the corporations owning and operating watch-movement factories are legally and commercially known as watch companies. Moreover, the two classifications of watches and watch cases, long known to the Census Office, are convenient and not wholly inaccurate, for the movement has been denominated the "watch proper." In order, however, to present a complete survey of watch manufacture, it is necessary to give the combined statistics for watches and watch cases. This is done in Table 1, which is the summary for 1900.

TABLE 1.—WATCHES AND WATCH CASES: SUMMARY FOR THE UNITED STATES, 1900.

	Total.	Watches.	Watch cases.
Number of establishments	43	13	30
Capital:			
Total	$22,354,483	$14,235,191	$8,119,292
Land	$1,001,236	$572,051	$429,185
Buildings	$2,298,869	$1,686,544	$612,325
Machinery, tools, and implements	$6,885,504	$5,405,472	$1,480,032
Cash and sundries	$12,168,874	$6,571,124	$5,597,750
Salaried officials, clerks, etc., number	400	165	235
Salaries	$583,815	$294,449	$289,366
Wage-earners, average number	10,787	6,880	3,907
Total wages	$5,511,570	$3,586,723	$1,924,847
Miscellaneous expenses	$889,982	$572,080	$317,902
Cost of materials used	$5,684,965	$1,291,318	$4,393,647
Value of products	$14,606,571	$6,822,611	$7,783,960

WATCHES.

The analysis of the statistics shown in the tables under this head is really an analysis of the manufacture of watch movements. Table 2 is a comparative summary from 1870 to 1900, inclusive, with the percentages of increase for each decade.

TABLE 2.—WATCHES: COMPARATIVE SUMMARY, 1870 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.				PER CENT OF INCREASE.		
	1900	1890	1880	1870	1890 to 1900	1880 to 1890	1870 to 1880
Number of establishments	13	19	11	37	[1]31.6	72.7	[1]70.3
Capital	$14,235,191	$10,106,114	$4,144,327	$2,666,133	40.9	143.9	55.4
Salaried officials, clerks, etc., number	165	[2]80	([3])	([3])	106.3	.....	.....
Salaries	$294,449	[2]$101,119	([3])	([3])	191.2	.....	.....
Wage-earners, average number	6,880	6,595	3,346	1,816	4.3	97.1	84.3
Total wages	$3,586,723	$3,587,808	$1,712,276	$1,304,304	([4])	109.5	31.3
Men, 16 years and over	3,381	3,935	2,127	1,202	[1]14.1	85.0	77.0
Wages	$2,247,617	$2,575,068	([3])	([3])	[1]12.7	.....	.....
Women, 16 years and over	3,473	2,640	1,219	592	31.6	116.6	105.9
Wages	$1,336,332	$1,007,340	([3])	([3])	32.7	.....	.....
Children, under 16 years	26	20	.....	22	30.0	.....	.....
Wages	$2,774	$5,400	.....	([3])	[1]48.6	.....	.....
Miscellaneous expenses	$572,080	$733,404	([5])	([5])	[1]22.0	.....	.....
Cost of materials used	$1,291,318	$995,740	$982,224	$412,783	29.7	1.4	138.0
Value of products	$6,822,611	$6,051,066	$3,271,244	$2,819,080	12.8	85.0	16.0

[1] Decrease.
[2] Includes proprietors and firm members, with their salaries; number only reported in 1900.
[3] Not reported separately.
[4] Less than one-tenth of 1 per cent decrease.
[5] Not reported.

The value of products as shown in Table 2 is not large compared with such values in manufactures of articles of less durability, or of greater necessity, but the increase of $4,003,531, or 142 per cent, during the last thirty years, notwithstanding the fall in prices, is noticeable. It will be observed that the period of greatest absolute increase, as well as the greatest percentage of increase, was during the decade from 1880 to 1890. The average number of women employed has gradually increased and the number of men has gradually decreased, which is explainable by the increasing adaptability of women to the delicate operations of automatic machinery and to the assembling of the parts. There are practically no children employed in the industry. The table shows 26 in the entire United States in 1900. In some of the larger factories, making the higher grade movements, there were none. The amount paid in wages in 1900 was 52.6 per cent of the value of the products; but a better way of showing the large proportionate amount of labor expended upon the manufacture is to state that, of the total cost of materials used and wages paid, wages constituted 73.5 per cent. The diminution in the number of establishments during the thirty years from 1870 was 64.9 per cent, the greatest part of which was shown at the census of 1880. At the following census there was an increase, and at the census of 1900 there was a decrease.

Table 3 is a summary by states for 1900.

TABLE 3.—WATCHES: SUMMARY BY STATES, 1900.

	United States.	Illinois.	New Jersey.	All other states.[1]
Number of establishments	13	3	3	7
Capital:				
Total	$14,235,191	$6,353,411	$910,592	$6,971,188
Land	$572,051	$340,000	$76,051	$156,000
Buildings	$1,686,544	$812,518	$155,125	$718,901
Machinery, tools, and implements	$5,405,472	$2,548,581	$336,410	$2,520,481
Cash and sundries	$6,571,124	$2,652,312	$343,006	$3,575,806
Salaried officials, clerks, etc., number	165	56	14	95
Salaries	$294,449	$69,266	$35,926	$190,157
Wage-earners, average number	6,880	2,578	525	3,777
Total wages	$3,586,723	$1,384,152	$261,135	$1,941,436
Men, 16 years and over	3,381	1,275	289	1,817
Wages	$2,247,617	$857,277	$190,255	$1,200,085
Women, 16 years and over	3,473	1,303	210	1,960
Wages	$1,336,332	$526,875	$68,106	$741,351
Children, under 16 years	26	.....	26	.....
Wages	$2,774	.....	$2,774	.....
Miscellaneous expenses	$572,080	$119,040	$95,473	$357,567
Cost of materials used	$1,291,318	$246,392	$134,259	$910,667
Value of products	$6,822,611	$1,839,792	$551,444	$4,431,375

[1] Includes establishments distributed as follows: Connecticut, 1; Massachusetts, 2; New York, 1; Ohio, 2; Pennsylvania, 1.

The apparent center of the manufacture is the state of Illinois, but the statistics included under "all other states" are mostly those of Massachusetts, which is really the principal center. This table shows that the 26 children employed in the industry were all in New Jersey. The percentage of wages to total wages and materials was largest in Illinois.

The distribution of establishments by geographical divisions and states for 1890 and 1900, and the increase or decrease, with the number established since 1890, are shown in Table 4.

TABLE 4.—WATCHES: NUMBER OF ESTABLISHMENTS, 1890 AND 1900, AND INCREASE DURING THE DECADE, BY GEOGRAPHICAL DIVISIONS AND STATES.

STATES.	1900	1890	Increase.
United States	13	19	[1]6
New England states	3	3	.....
Massachusetts	2	2	.....
Connecticut	1	1	.....
Middle states	5	10	[1]5
New York	1	7	[1]6
New Jersey	3	2	1
Pennsylvania	1	1	.....
Central states	5	6	[1]1
Ohio	2	2	.....
Illinois	3	4	[1]1

[1] Decrease.

The net decrease of establishments is shown principally in the Middle states, but for that same group the returns show that two factories were established during the decade. The New England states had neither gain nor loss, and the Central states lost one. This is in accord with the tendency toward concentration in a manufacture where the capital must be large, owing to the costly character of the machinery.

A comparative summary of the capital, in its several subdivisions, with percentages of increase and of the total for each decade, for 1890 and 1900, is presented in Table 5.

TABLE 5.—WATCHES: COMPARATIVE SUMMARY, CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$14,235,191	100.0	$10,106,114	100.0	40.9
Land	572,051	4.0	679,971	6.7	[1]15.9
Buildings	1,686,544	11.8	1,554,510	15.4	8.5
Machinery, tools, and implements	5,405,472	38.0	2,706,786	26.8	99.7
Cash and sundries	6,571,124	46.2	5,164,897	51.1	27.2

[1] Decrease.

The investment in land, as in buildings and in live capital, was a much less proportion of the total in 1900 than in 1890, but the proportion of the value of machinery, tools, and implements was much greater. In this item also was the greatest increase, showing in part the importance and costliness of automatic machinery and the necessity of its frequent replacement with even more ingenious mechanisms. The slight valuation of land is an indication of the surburban location of the manufacture.

The miscellaneous expenses can not be divided for 1890, but they are divided for 1900 in Table 6.

TABLE 6.—WATCHES: MISCELLANEOUS EXPENSES, 1900.

	Amount.	Per cent of total.
Total	$572,080	100.0
Rent of works	300	[1]
Taxes, not including internal revenue	90,300	15.8
Rent of offices, insurance, interest, repairs, advertising, and other sundries	481,480	84.2

[1] Less than one-tenth of 1 per cent.

Naturally, in an industry that must be housed in expensive buildings of a peculiar construction, the expenditure for rent was so small as hardly to be measured statistically. There was no expenditure for contract work, also a natural condition in a manufacture where there is such extensive use of automatic machinery requiring the most careful supervision. The amount for rent of offices, etc., includes a large sum for advertising, which is an essential of the successful manufacture.

An analysis of the cost of materials used in 1900, with a showing, broadly, of their character, is found in Table 7.

TABLE 7.—WATCHES: COST OF MATERIALS, 1900.

	Amount.	Per cent of total.
Total	$1,291,318	100.0
Purchased in partially manufactured form[1]	1,214,770	94.1
Fuel	57,292	4.4
Rent of power and heat	171	[2]
Freight	19,085	1.5

[1] Includes mill supplies and all other materials, which are shown separately in Table 9.
[2] Less than one-tenth of 1 per cent.

In the manufacture of watches the component materials used are wholly of the partly manufactured kind, such as brass, silver, steel, and other metals or alloys. Under the broad classification of materials used are fuel, rent of power and heat, and freight. Of the aggregate cost of all materials, the partly manufactured was 94.1 per cent.

Table 8, one of the most interesting of the series, is a summary, by states, of the kind, quantity, and value of the products of watch factories for 1900.

TABLE 8.—WATCHES: KIND, QUANTITY, AND VALUE OF PRODUCTS, BY STATES, 1900.

STATES.	Aggregate value.	WATCH MOVEMENTS.		WATCH CASES.										All other products.
		Number.	Value.	Total.		Silver.		Gold filled.		Silverene.		Other varieties.		
				Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	
United States	$6,822,611	1,825,769	$6,036,240	296,424	$395,259	25,271	$75,813	38,229	$191,145	209,246	$104,623	23,678	$23,678	$391,112
Illinois	1,839,792	505,468	1,834,328											5,464
New Jersey	551,444	308,421	473,181											78,263
All other states[1]	4,431,375	1,011,880	3,728,731	296,424	395,259	25,271	75,813	38,229	191,145	209,246	104,623	23,678	23,678	307,385

[1] Includes establishments distributed as follows: Connecticut, 1; Massachusetts, 2; New York, 1; Ohio, 2; Pennsylvania, 1.

According to the statistics given in this table the average value, at the shop or factory, of the watch movements made in the United States was $3.31. The combined states included in "all other states" show an average of $3.68, which is practically that of Massachusetts. Illinois shows an average of $3.63, and New Jersey only $1.53. There are other elements of cost before the movement gets to the jobber and retailer; and many additional also in the value of the complete watch, with case, before it reaches the final purchaser. Machine processes have greatly reduced the cost, while, at the same time, the accuracy of the watch has been constantly improved. In addition to the watch movements shown in this table, 298,207, valued at $725,695, were made in other than watch factories, and reported as by-products, raising the total number for the United States to 2,123,976 and the value to $6,761,935.

In this showing are not included low-priced or "dollar" watches; these are made exclusively in clock factories as a by-product, and their value appears under "clocks." This by-product for 1900 was 1,211,662 watch movements, valued at $566,147, and 703,249 watch cases, valued at $74,860.

Table 9 is a detailed summary, by states, for 1900. In this table the cost of materials used is divided into the cost of the partially manufactured, showing the principal component parts, excluding mill supplies and all other materials, in order that these may be shown separately, and into fuel, rent of power and heat, and freight.

TABLE 9.—WATCHES: DETAILED SUMMARY, BY STATES, 1900.

	United States.	Illinois.	New Jersey.	All other states.[1]
Number of establishments	13	3	3	7
Capital:				
Total	$14,285,191	$6,358,411	$910,592	$6,971,188
Land	$572,051	$340,000	$76,051	$156,000
Buildings	$1,686,544	$812,518	$155,125	$718,901
Machinery, tools, and implements	$5,405,472	$2,548,581	$336,410	$2,520,481
Cash and sundries	$6,571,124	$2,652,312	$343,006	$3,575,806

[1] Includes establishments distributed as follows: Connecticut, 1; Massachusetts, 2; New York, 1; Ohio, 2; Pennsylvania, 1.

TABLE 9.—WATCHES: DETAILED SUMMARY, BY STATES, 1900—Continued.

	United States.	Illinois.	New Jersey.	All other states.
Proprietors and firm members	2		1	1
Salaried officials, clerks, etc.:				
Total number	165	56	14	95
Total salaries	$294,449	$69,266	$35,026	$190,157
Officers of corporations—				
Number	21	6	4	11
Salaries	$89,660	$28,600	$21,060	$40,000
General superintendents, managers, clerks, and salesmen:				
Total number	144	50	10	84
Total salaries	$204,789	$40,666	$13,966	$150,157
Men—				
Number	130	47	7	76
Salaries	$196,463	$39,406	$12,218	$144,839
Women—				
Number	14	3	3	8
Salaries	$8,326	$1,260	$1,748	$5,318
Wage-earners, including pieceworkers, and total wages:				
Greatest number employed at any one time during the year	7,534	2,976	586	3,972
Least number employed at any one time during the year	6,462	2,456	448	3,558
Average number	6,880	2,578	525	3,777
Wages	$8,586,723	$1,384,152	$261,135	$1,941,436
Men, 16 years and over—				
Average number	3,381	1,275	289	1,817
Wages	$2,247,617	$857,277	$190,255	$1,200,085
Women, 16 years and over—				
Average number	3,473	1,303	210	1,960
Wages	$1,836,332	$526,875	$68,106	$741,351
Children, under 16 years—				
Average number	26		26	
Wages	$2,774		$2,774	
Average number of wage-earners, including pieceworkers, employed during each month:				
Men, 16 years and over—				
January	3,421	1,460	256	1,705
February	3,411	1,401	286	1,724
March	3,427	1,372	294	1,761
April	3,392	1,318	294	1,780
May	3,308	1,221	295	1,792
June	3,309	1,221	287	1,801
July	3,134	1,074	264	1,796
August	3,390	1,242	299	1,849
September	3,413	1,248	294	1,871
October	3,489	1,253	292	1,894
November	3,461	1,254	303	1,904
December	3,465	1,245	299	1,921
Women, 16 years and over—				
January	3,582	1,540	177	1,865
February	3,529	1,420	200	1,909
March	3,525	1,383	205	1,937
April	3,487	1,359	204	1,924
May	3,424	1,278	208	1,938
June	3,442	1,278	212	1,952
July	3,163	1,033	191	1,939
August	3,483	1,251	214	1,968
September	3,462	1,248	220	1,994
October	3,527	1,275	226	2,026
November	3,546	1,286	229	2,031
December	3,551	1,281	237	2,033
Children, under 16 years—				
January	26		26	
February	26		26	
March	26		26	
April	26		26	
May	26		26	
June	25		25	
July	25		25	
August	26		26	
September	26		26	
October	26		26	
November	26		26	
December	26		26	
Miscellaneous expenses:				
Total	$572,080	$119,040	$95,473	$357,567
Rent of works	$800			$800
Taxes, not including internal revenue	$90,300	$21,137	$1,775	$67,388
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$481,480	$97,903	$93,698	$289,879
Materials used:				
Total cost	$1,291,318	$246,392	$134,259	$910,667
Purchased in partially manufactured form	$934,311	$169,722	$98,521	$666,068
Fuel	$57,292	$23,124	$2,326	$31,842
Rent of power and heat	$171	$171		
Mill supplies	$27,501	$5,537	$11,688	$10,276
All other materials	$252,958	$36,832	$18,674	$197,452
Freight	$19,085	$11,006	$3,050	$5,029
Products:				
Aggregate value	$6,822,611	$1,839,792	$551,444	$4,431,375
Movements—				
Number	1,825,769	505,468	308,421	1,011,880
Value	$6,036,240	$1,834,328	$473,181	$3,728,731
Cases—				
Number	296,424			296,424
Value	$395,259			$395,259
Silver—				
Number	25,271			25,271
Value	$75,813			$75,813
Gold filled—				
Number	38,229			38,229
Value	$191,145			$191,145
Silverene—				
Number	209,246			209,246
Value	$104,623			$104,623
Other varieties—				
Number	23,678			23,678
Value	$23,678			$23,678
All other products	$391,112	$5,464	$78,263	$307,385
Comparison of products:				
Number of establishments reporting for both years	18	3	3	7
Value for census year	$6,822,611	$1,839,792	$551,444	$4,431,375
Value for preceding business year	$5,751,125	$1,440,172	$476,814	$3,835,139

TABLE 9.—WATCHES: DETAILED SUMMARY, BY STATES, 1900—Continued.

	United States.	Illinois.	New Jersey.	All other states.
Power:				
Number of establishments reporting	12	3	3	6
Total horsepower	1,990	880	170	940
Owned—				
Engines, steam—				
Number	16	5	3	8
Horsepower	1,755	650	170	935
Electric motors—				
Number	34	34	.....	.....
Horsepower	228	228	.....	.....
Rented—				
Electric, horsepower	7	2	.....	5
Furnished to other establishments, horsepower	32	20	12	.....
Establishments classified by number of persons employed, not including proprietors and firm members:				
Total number of establishments	13	3	3	7
Under 5	1	.....	.....	1
5 to 20	1	.....	1	.....
21 to 50	1	1	.....	.....
51 to 100	1	.....	.....	1
101 to 250	2	.....	.....	2
251 to 500	3	1	2	.....
501 to 1,000	2	.....	.....	2
Over 1,000	2	1	.....	1

WATCH CASES.

The manufacture of watch cases was not shown separately at the censuses of the United States previous to 1870, and comparable statistics can not, therefore, be given for any decade before that year. Table 10 is a comparative summary from 1870 to 1900, inclusive, with the percentages of increase for each decade.

TABLE 10.—WATCH CASES: COMPARATIVE SUMMARY, 1870 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.				PER CENT OF INCREASE.		
	1900	1890	1880	1870	1890 to 1900	1880 to 1890	1870 to 1880
Number of establishments	30	45	27	43	[1]33.3	66.7	[1]37.2
Capital	$8,119,292	$4,727,100	$1,584,740	$730,500	71.8	198.3	116.9
Salaried officials, clerks, etc., number	235	[2]190	[3]	[3]	23.7	.....	.....
Salaries	$289,366	[2]$219,699	[3]	[3]	31.7	.....	.....
Wage-earners, average number	3,907	3,679	1,758	703	6.2	109.3	150.1
Total wages	$1,924,847	$1,896,587	$976,041	$555,018	1.5	94.3	75.9
Men, 16 years and over	2,929	2,944	1,418	619	[1]0.5	107.6	129.1
Wages	$1,642,939	$1,699,661	[3]	[3]	[1]3.3	.....	.....
Women, 16 years and over	866	710	189	73	22.0	410.8	90.4
Wages	$262,843	$192,800	[3]	[3]	36.3	.....	.....
Children, under 16 years	112	25	201	11	348.0	[1]87.6	1,727.3
Wages	$19,065	$4,126	[3]	[3]	362.1	.....	.....
Miscellaneous expenses	$317,902	$443,175	[4]	[4]	[1]28.3	.....	.....
Cost of materials used	$4,393,647	$5,022,455	$2,812,922	$1,152,979	[1]12.5	78.6	144.0
Value of products	$7,783,960	$8,618,479	$4,589,314	$2,333,840	[1]9.7	87.8	96.7

[1] Decrease.
[2] Includes proprietors and firm members, with their salaries; number only reported in 1900.
[3] Not reported separately.
[4] Not reported.

The increase in the value of products during the thirty years was $5,450,620, or 233.6 per cent, much greater than the increase in the value of watch movements. The percentage of wages of value of products in 1900 was 24.7, and of total wages of total wages and materials 30.5, both of which percentages are less than half those shown for watch movements. The average number of women has increased during the thirty years, but even in 1900 there were few compared with the number in watch factories. That a small number of children were employed is notable also. The manufacture of watch cases requires fewer wage-earners than the manufacture of watch movements; while the value of products in 1900 was 14.1 per cent more, the average number of wage-earners was 43.2 per cent less.

Table 11 is a summary, by states, for 1900.

TABLE 11.—WATCH CASES: SUMMARY BY STATES, 1900.

	United States.	Illinois.	New Jersey.	New York.	All other states.[1]
Number of establishments	30	4	5	13	8
Capital:					
Total	$8,119,292	$730,894	$1,371,137	$2,582,472	$3,434,789
Land	$429,185	$200,685	$28,000	$110,500	$90,000
Buildings	$612,325	$37,550	$193,000	$205,412	$176,363
Machinery, tools, and implements	$1,480,032	$158,941	$320,984	$497,308	$502,804
Cash and sundries	$5,597,750	$333,718	$829,153	$1,769,257	$2,665,622
Salaried officials, clerks, etc., number	235	27	38	69	101
Salaries	$289,366	$18,884	$49,420	$106,358	$114,704
Wage-earners, average number	3,907	407	687	1,075	1,788
Total wages	$1,924,847	$170,919	$305,268	$630,782	$817,878
Men, 16 years and over	2,929	274	515	960	1,180
Wages	$1,642,939	$142,361	$255,900	$596,460	$648,218
Women, 16 years and over	866	101	107	104	554
Wages	$262,843	$23,938	$44,868	$32,177	$161,860
Children, under 16 years	112	32	15	11	54
Wages	$19,065	$4,620	$4,500	$2,145	$7,800
Miscellaneous expenses	$317,902	$21,389	$34,535	$126,751	$135,227
Cost of materials used	$4,393,647	$294,491	$730,871	$2,031,910	$1,336,375
Value of products	$7,783,960	$560,934	$1,258,601	$3,165,512	$2,798,913

[1] Includes establishments distributed as follows: Kentucky, 1; Maryland, 1; Massachusetts, 2; Ohio, 2; Pennsylvania, 2.

In this table, as in the corresponding table for watch movements and for the same reason, the statistics of one of the leading states are necessarily concealed in the classification "all other states." Pennsylvania was a great center of the manufacture, although New York led in value of products. The percentage of wages of wages and materials was largest in "all other states;" but of the states separately shown Illinois led in this respect.

Table 12 shows the number of establishments in 1890 and 1900, with the increase and number established during the decade, by geographical divisions and states.

TABLE 12.—WATCH CASES: NUMBER OF ESTABLISHMENTS, 1890 AND 1900, AND INCREASE DURING THE DECADE, BY GEOGRAPHICAL DIVISIONS AND STATES.

STATES.	1900	1890	Increase.
United States	30	45	[1]15
New England states	2	6	[1]4
Massachusetts	2	5	[1]3
Rhode Island	.....	1	[1]1
Middle states	21	32	[1]11
New York	13	20	[1]7
New Jersey	5	4	1
Pennsylvania	2	7	[1]5
Maryland	1	1	.....
Southern states	1	1	.....
Kentucky	1	1	.....
Central states	6	5	1
Ohio	2	1	1
Illinois	4	3	1
Missouri	.....	1	[1]1
Western states	.....	1	[1]1
Colorado	.....	1	[1]1

[1] Decrease.

The principal decrease shown in this table was, as with watch movements, in the Middle states, and here also were the greatest number of new establishments. The only Western state—Colorado—that had a part in the manufacture in 1890, disappeared from the industry in 1900.

A comparative summary of the capital in its several subdivisions, with percentages of increase, and of the total for 1890 and 1900, is presented in Table 13.

TABLE 13.—WATCH CASES: COMPARATIVE SUMMARY, CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$8,119,292	100.0	$4,727,100	100.0	71.8
Land	429,185	5.3	127,850	2.7	235.7
Buildings	612,325	7.6	404,500	8.6	51.4
Machinery, tools, and implements	1,480,032	18.2	968,641	20.4	53.6
Cash and sundries	5,597,750	68.9	3,231,109	68.3	73.2

The slight decrease in the proportion of machinery, tools, and implements, and the increase in the land investment to the total capital are noticeable features in this table, but the percentage of increase in each subdivision shows that the capital, in all respects, was greater, perhaps necessarily, in 1900 than in 1890.

Miscellaneous expenses can not be divided for 1890, but they are shown for 1900 in Table 14.

TABLE 14.—WATCH CASES: MISCELLANEOUS EXPENSES, 1900.

	Amount.	Per cent of total.
Total	$317,902	100.0
Rent of works	18,218	5.7
Taxes, not including internal revenue	17,480	5.5
Rent of offices, insurance, interest, repairs, advertising, and other sundries	282,204	88.8

That no expenditure for contract work is shown is characteristic of the manufacture of watch cases, which, like that of watch movements, is of a delicate nature and highly specialized in factories with automatic machinery.

A division of the cost of materials is possible for 1900 and is given, with percentages of the total, in Table 15.

TABLE 15.—WATCH CASES: COST OF MATERIALS, 1900.

	Amount.	Per cent of total.
Total	$4,393,647	100.0
Purchased in raw state	326,850	7.4
Purchased in partially manufactured form[1]	4,018,450	91.5
Fuel	36,412	0.8
Rent of power and heat	5,626	0.1
Freight	6,309	0.2

[1] Includes mill supplies and all other materials, which are shown separately in Table 17.

While in the manufacture of watch movements no raw material was used for component parts, in the manufacture of watch cases, as shown in this table, 7.4 per cent of the total material of all kinds (including rent of power and heat, and freight) was purchased in a raw state. This is quite small, however, the partly manufactured reaching 91.5 per cent of the total.

The kind, quantity, and value of watch cases made in 1900 are shown in Table 16.

TABLE 16.—WATCH CASES: KIND, QUANTITY, AND VALUE OF PRODUCTS, BY STATES, 1900.

STATES.	Aggregate value.	WATCH CASES.												All other products.
		Total.		Gold.		Silver.		Gold filled.		Silverene.		Other varieties.		
		Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.	
United States	$7,783,960	1,719,362	$7,175,157	233,993	$3,170,629	171,837	$461,882	748,735	$3,187,103	356,126	$233,391	208,671	$122,152	$608,803
Illinois	560,934	292,162	547,434	8,900	130,500	28,278	42,947	82,843	275,804	10,316	6,515	161,825	91,668	13,500
New Jersey	1,258,601	339,075	1,103,030	18,304	231,000	67,671	175,000	198,615	662,030	54,485	35,000	.....	.....	155,571
New York	3,165,512	322,198	2,838,510	177,170	2,298,908	35,517	114,052	15,823	392,993	93,688	37,557	.....	.....	327,002
All other states[1]	2,798,913	765,927	2,686,183	29,619	515,221	40,371	129,883	451,454	1,856,276	197,637	154,319	46,846	30,484	112,730

[1] Includes establishments distributed as follows: Kentucky, 1; Maryland, 1; Massachusetts, 2; Ohio, 2; Pennsylvania, 2.

Of the states shown separately New Jersey led in quantity but not in value, New York taking precedence in this. The total for "all other states" is made up largely of Pennsylvania's products, and the company having the largest output in the United States was reported from that state. The average value, at the shop or factory, of the watch cases made in the United States in 1900 was $4.17. New York showed the greatest average value—$8.81—and Illinois the least—$1.87; New Jersey's average was $3.25. The gold-filled cases predominated, constituting 43.6 per cent of the number manufactured. Silverene came next with 20.7 per cent, and gold third with 13.6 per cent. Silver had 10 per cent and other varieties quoted 12.1 per cent. Pennsylvania is the home of the gold-filled case, and in 1900 returned the largest number, which is not separately shown, being included under "all other states." Pennsylvania also made the most of the kind called silverene, also variously denominated silveroid, silverore, nickel silver, and nickel—all these alloys having nickel for their base.

The details of the watch-case manufacture for 1900 are shown in Table 17.

TABLE 17.—WATCH CASES: DETAILED SUMMARY, BY STATES, 1900.

	United States.	Illinois.	New Jersey.	New York.	All other states.[1]
Number of establishments	30	4	5	13	8
Capital:					
Total	$8,119,292	$730,894	$1,371,137	$2,582,472	$3,434,789
Land	$429,185	$200,685	$28,000	$110,500	$90,000
Buildings	$612,325	$37,550	$193,000	$205,412	$176,363
Machinery, tools, and implements	$1,480,082	$158,941	$320,984	$497,303	$502,804
Cash and sundries	$5,597,760	$333,718	$829,153	$1,769,257	$2,665,622
Proprietors and firm members	23	3	2	10	8
Salaried officials, clerks, etc.:					
Total number	235	27	38	69	101
Total salaries	$289,366	$18,884	$49,420	$106,358	$114,704
Officers of corporations—					
Number	31	4	5	13	9
Salaries	$115,700	$6,800	$18,200	$45,700	$46,000
General superintendents, managers, clerks, and salesmen—					
Total number	204	23	33	56	92
Total salaries	$173,666	$12,084	$31,220	$60,658	$69,704
Men—					
Number	148	16	26	44	62
Salaries	$150,926	$8,770	$27,450	$56,122	$58,584
Women—					
Number	56	7	7	12	30
Salaries	$22,740	$3,314	$3,770	$4,536	$11,120
Wage-earners, including pieceworkers, and total wages:					
Greatest number employed at any one time during the year	4,215	445	681	1,151	1,938
Least number employed at any one time during the year	3,279	387	423	995	1,474
Average number	3,907	407	637	1,075	1,788
Wages	$1,924,847	$170,919	$305,268	$630,782	$817,878
Men, 16 years and over—					
Average number	2,929	274	515	960	1,180
Wages	$1,642,939	$142,361	$255,900	$596,460	$648,218
Women, 16 years and over—					
Average number	866	101	107	104	554
Wages	$262,843	$23,938	$44,868	$32,177	$161,860
Children, under 16 years—					
Average number	112	32	15	11	54
Wages	$19,065	$4,620	$4,500	$2,145	$7,800
Average number of wage earners, including pieceworkers, employed during each month:					
Men, 16 years and over—					
January	2,656	277	335	933	1,111
February	2,848	281	526	920	1,121
March	2,903	284	535	940	1,144
April	2,937	290	537	943	1,167
May	2,951	288	541	936	1,186
June	2,906	260	535	929	1,182
July	2,944	258	535	971	1,180
August	2,951	261	537	944	1,209
September	3,039	276	539	1,004	1,220
October	3,045	279	540	997	1,229
November	3,031	288	542	997	1,209
December	2,938	251	480	1,008	1,199
Women, 16 years and over—					
January	731	100	69	73	489
February	805	100	109	100	496
March	827	100	109	104	514
April	856	102	110	105	539
May	878	101	110	111	556
June	883	98	110	112	563
July	893	100	111	111	571
August	903	100	111	110	582
September	902	103	112	103	584
October	904	103	112	105	584
November	904	103	114	104	583
December	895	105	102	105	583
Children, under 16 years—					
January	83	27	14	10	32
February	86	27	15	10	34
March	92	27	15	10	40
April	94	27	15	11	41
May	100	27	15	11	47
June	103	27	15	10	51
July	121	35	15	12	59
August	129	35	15	12	67
September	134	37	16	13	68
October	137	37	16	12	72
November	138	37	16	13	72
December	135	37	16	13	69

[1] Includes establishments distributed as follows: Kentucky, 1; Maryland, 1; Massachusetts, 2; Ohio, 2; Pennsylvania, 2.

TABLE 17.—WATCH CASES: DETAILED SUMMARY, BY STATES, 1900—Continued.

	United States.	Illinois.	New Jersey.	New York.	All other states.
Miscellaneous expenses:					
Total	$317,902	$21,389	$34,535	$126,751	$135,227
Rent of works	$18,218	$2,335	$920	$8,338	$6,625
Taxes, not including internal revenue	$17,480	$989	$4,120	$6,856	$5,515
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$282,204	$18,065	$29,495	$111,557	$123,087
Materials used:					
Total cost	$4,393,647	$294,491	$730,871	$2,031,910	$1,336,375
Purchased in raw state	$326,850				$326,850
Purchased in partially manufactured form	$3,830,707	$275,674	$669,628	$1,943,672	$941,733
Fuel	$36,412	$5,346	$5,145	$10,082	$15,839
Rent of power and heat	$5,626	$455	$770	$2,016	$2,385
Mill supplies	$16,594	$1,998	$1,465	$999	$12,132
All other materials	$171,149	$9,905	$52,815	$71,468	$36,961
Freight	$6,309	$1,113	$1,048	$3,673	$475
Products:					
Aggregate value	$7,783,960	$560,934	$1,258,601	$3,165,512	$2,798,913
Cases—					
Total number	1,719,362	292,162	339,075	322,198	765,927
Total value	$7,175,157	$547,434	$1,103,030	$2,838,510	$2,686,183
Gold—					
Number	233,993	8,900	18,304	177,170	29,619
Value	$3,170,629	$130,500	$231,000	$2,293,908	$515,221
Silver—					
Number	171,837	28,278	67,671	35,517	40,371
Value	$461,882	$42,947	$175,000	$114,052	$129,883
Gold filled—					
Number	748,735	82,843	198,615	15,823	451,454
Value	$3,187,103	$275,804	$662,030	$392,993	$1,856,276
Silverene—					
Number	356,126	10,316	54,485	93,688	197,637
Value	$233,391	$6,515	$35,000	$37,557	$154,319
Other varieties—					
Number	208,671	161,825			46,846
Value	$122,152	$91,668			$30,484
All other products	$608,803	$13,500	$155,571	$327,002	$112,730
Comparison of products:					
Number of establishments reporting for both years	24	3	4	10	7
Value for census year	$7,187,311	$541,384	$1,257,001	$2,758,826	$2,630,100
Value for preceding business year	$5,588,510	$465,405	$1,114,099	$2,208,181	$1,800,765
Power:					
Number of establishments reporting	28	4	5	11	8
Total horsepower	1,884	253	304	447	880
Owned—					
Engines—					
Steam—					
Number	15	2	3	5	5
Horsepower	1,555	180	290	385	700
Gas or gasoline—					
Number	1			1	
Horsepower	10			10	
Water wheels—					
Number	1	1			
Horsepower	5	5			
Electric motors—					
Number	7	4			3
Horsepower	86	60			26
Other power—					
Number	2				2
Horsepower	15				15
Rented—					
Electric, horsepower	59	3	6	20	30
Other kind, horsepower	154	5	8	32	109
Furnished to other establishments, horsepower	20			20	
Establishments classified by number of persons employed, not including proprietors and firm members:					
Total number of establishments	30	4	5	13	8
Number of employees	1			1	
Under 5	2			1	1
5 to 20	9	1	2	4	2
21 to 50	5	2	1	1	1
51 to 100	3			3	
101 to 250	4			2	2
251 to 500	3	1	2		
501 to 1,000	2			1	1
Over 1,000	1				1

HISTORICAL AND DESCRIPTIVE.

The watch came to the United States from the Old World perfect in principle. There have been no improvements for many years in arrangement of train, in escapements, or in other parts of movements. Its evolution from the clock with its pendulum, through the table clock with its lever, and thus to the perfect pocket timepiece, is a part of the history of Germany, of Great Britain, of France, and of Switzerland.

The English are said to have been the first successful watchmakers, and about a century and a half ago applied to the industry a division of labor which at one time had multiplied into 102 distinct branches. The Swiss adopted this principle and extended it, giving employment to families—men, women, and children—at their homes. As the price of this labor was very low, and there were few other industries at which employment could be found, the Swiss became the watchmakers of the world, not only furnishing some of the most costly timepieces, but also some of the cheapest and most worthless. While the Swiss still manufacture a great many watches, which are sent to many parts of the world, it is a significant fact that some jobbers, who handled their goods a few years ago under an American name, advertised that the movements were made "by

the most improved American automatic machinery, insuring accuracy and precision." It is said to be a common practice thus to advertise Swiss movements, excepting those of the costliest varieties, upon which the hand work is of the most skillful and painstaking character or expended in fanciful combinations. It is asserted by manufacturers in the United States that the "American" machinery used in Switzerland has been rendered obsolete here by the advance of invention; but its adoption there is a most substantial recognition of the superiority of machine-made watches. It is also asserted that, while the Swiss watch trade fell off a few years ago, this loss has been partly recovered by the adoption of these American machines and American methods.

The earliest watches made in Europe took a year, it is said, in their making, cost the equivalent of $1,500 apiece, and varied in their timekeeping from forty minutes to an hour a day. At the Waltham, Mass., factory nearly 600,000 watch movements were made during the census year 1900, or nearly 2,000 complete movements for each working day—not quite one a day per employee—more than any other factory in the world and a greater yearly production than any other country except Switzerland. The effort is now being made to raise this production to one per day per employee, which would be a total of 3,000 a day, or over 900,000 a year. The cost of these movements varies from $3 to $75, and their timekeeping quality is best shown by the fact that the three American watches, which received the highest award for accuracy of rate at the Centennial Exposition at Philadelphia in 1876, showed an average daily variation of only twenty-three hundredths of a second.

The unanswerable arguments showing the superiority of machine-made watches are now widely known and admitted, but they were made only a few years ago with most disheartening results. Almost everybody preferred a handmade watch, notwithstanding its greater cost, when of any worth as a timepiece, and the lack of interchangeable parts with which it could be cheaply repaired, on the theory that hand work was more accurate; but now conditions are reversed, and an American machine-made watch is preferred by the great number of persons who desire accuracy and durability at a reasonable price. An inventor puts the argument briefly thus: "If one of the qualities demanded in any certain kind of work be the highest attainable degree of uniformity, it will be readily admitted that the individual workman, with the certainty of constantly recurring periods of fatigue, which make imperative corresponding periods of rest, is at a great disadvantage when in competition with an impersonal and tireless machine which is capable of producing work of a like kind. * * * It is also evident that if the large number of required pieces, whose function is the same, can be made with dimensions exactly uniform, there would result a great reduction in cost of manufacture because of the avoidance of any individual or special fitting of the various parts."[1] In the hand system it is impossible that parts, upon which a hundred different personalities have been stamped, should come together with the precision required for such a delicate mechanism as a watch. The further the division of hand labor is carried the greater become the chances of imperfection; but with automatic machinery the most delicate processess are accomplished with complete uniformity and finish.

M. Edouard Favre-Perret states that 40,000 workmen in Switzerland each make an average of 40 watches yearly. But the average in the United States in 1880 was 150; at Waltham in 1900 it was over 250. It takes about five months to complete a single watch of the highest grade; but all processes are going on simultaneously, and the flow of the product is therefore continuous. In a lecture before the Horological Institute of London, more than thirty years ago, an English watchmaker who had visited the Waltham factory remarked: "On leaving the factory, I felt that the manufacture of watches on the old plan was gone."[2]

Various sporadic attempts, beginning, it is said, as early as 1809, had been made in this country to manufacture watches by hand, but all had ended in dismal failure, owing to inability to compete in price with the Swiss-made watch. When competition with Europe was thus found impossible, inventors in the United States thought they might construct them successfully by machinery, and in 1838 Pitkin Brothers established a plant at Hartford, Conn., for the manufacture of watches by machinery. After manufacturing about eight hundred movements, they were compelled to abandon their project. At this time the Swiss were using machines for special operations in making watches. In 1839 Gischot established a factory at Geneva, Switzerland, for making the movements of a watch by machinery, and a few years after F. P. Ingold, another Swiss, elaborated a series of both case and movement machines, but they never made a success of their manufacture in factories.

The systematic beginning of watchmaking by machinery in the United States was in 1851, at Roxbury, Mass., and the machinery then used, while advanced for the times, now seems crude, so great have been the improvements. It is difficult to realize the primitive conditions of fifty years ago, and a half century hence the machines of to-day may likewise seem crude, for at no time have changes been so numerous or so radical as during the last few years. The effort has been not only to make a cheaper watch, but to make it a more accurate timepiece, and in effecting these results the great system of interchangeable mechanism in manufacturing has

[1] The Evolution of Automatic Machinery, by E. A. Marsh, page 11.

[2] Watchmaking in America, Appleton's Journal, July 2 and 9, 1870.

been promoted in a remarkable manner. Prof. W. P. Trowbridge, of the Sheffield Scientific School of Yale University, a chief special agent at the census of 1880, in submitting the report on the manufactures of interchangeable mechanism, compiled under his direction by Mr. Charles H. Fitch, wrote that "it may not be too much to say that, in some respects, this system has been one of the chief influences in the rapid increase of the national wealth;" that "the growth of the system is due to the inventive characteristics of our people, and their peculiar habit of seeking the best and most simple mechanical methods of accomplishing results by machinery, untrammelled by traditions or hereditary habits and customs;" and that "the art of making complete machines or implements, each part of which may be introduced into any machine of the same kind, and especially the adaptation of special tools, by which handwork in fitting the parts is often entirely avoided, is, I believe, of American origin."[1] One of the manufactures briefly treated in that report was the manufacture of watches.

To Aaron L. Dennison, born in Freeport, Me., in 1812, belongs the honor of founding the systematic manufacture of watches by automatic machinery in the United States. He learned the watchmaker's trade, and while a journeyman in Boston became impressed, by his experience with Swiss and English watches, with the necessity of securing greater uniformity of parts. At the United States armory at Springfield, Mass., muskets were made upon the interchangeable plan, and it was while working there that he became confirmed in his belief that a machine-made watch was a possibility. In 1849 he succeeded in impressing Edward Howard, a practical clock maker of Boston, with the importance of his undertaking, and these two interested a capitalist, Samuel Curtis, of the same city, who invested $20,000. Mr. Howard himself says of this interesting beginning: "Mr. Dennison being a watch repairer, and myself a clock maker, we made a good combination to systematize watchmaking, and to invent labor-saving machinery for producing perfect and interchangeable parts. * * * It is almost needless to say that we met with many obstacles. We were told by importers and dealers in watches that we would never be able to carry out our plans, and that our project would be an utter failure. Some of our friends even told us we were crazy to attempt such an undertaking, but we were Yankees, both of us, and had sufficient quantity of the proverbial 'grit,' and at least believed in ourselves, even if others did not have so much faith."[2]

Mr. Dennison went to Europe, where he investigated the English division of hand labor, cheerfully writing back that his theory "of Americans not finding any difficulty in competing with the English, especially if the interchangeable system and manufacturing in large quantities was adopted, may be accepted as reasonable." A factory was built at Roxbury, Mass., and in 1851 a model watch was completed. It was an eight-day watch, but, being found impracticable, was abandoned for the ordinary thirty-six-hour watch. The first hundred movements were finished and put on the market in 1853. The factory at Roxbury was in a dusty place, and this drawback, together with the necessity of more room and the desire to make homes in a pleasant spot for the operatives, led to a removal to the present site at Waltham, on the Charles River, about 10 miles west of Boston.

In 1857 financial embarrassments compelled a sale of the property, which was bought by Mr. Royal E. Robbins, of New York, and others, by whom and their successors it has been conducted ever since through storm to sunshine. Mr. Robbins is still interested in active management as the treasurer of the American Waltham Watch Company.[1] The factory, situated on the edge of the river, is five stories in height, built of brick, having innumerable windows to secure the abundance of light required for such delicate operations. The surrounding grounds are neatly laid out and diversified with shrubbery and flowers. If the annexes were arranged on a line with the main building, the entire frontage would extend more than 2,500 feet, or almost half a mile. Nearly 3,000 operatives are employed in making—by over 3,700 processes—the more than 150 parts contained in a watch movement. Most of the processes are accomplished by the most ingeniously devised and constructed automatic machines. Under one roof, but in a multitude of departments, all parts of a watch movement are made, including the cutting and polishing of the jewels; but the primary or foundation department is the machine shop, where all the machines used in the manufacture are made from designs furnished by the company's own inventors and master mechanics. This latter plan, which in 1850 was a necessity, because of the lack of watch machines and of outside experts capable of designing and constructing them, has continued to be recognized as a desirable feature ever since, perhaps being no less a necessity now than it was then, owing to the delicate evolution of automatic machinery. Although many patents have been issued for designs and processes and for labor-saving machinery in the watch manufacture during the last half century, the number of such patents by no means registers the real activity of inventors in these lines. The watch companies now seldom patent an automatic machine, preferring to trust for protection to a thorough safeguarding of the complexity of the mechanism.

The panic of 1857 worked serious injury to the enterprise at Waltham, but the outlook became better in 1858, and in 1860 a 5 per cent dividend was declared. When the Civil War broke out, the depression deepened again,

[1] Tenth Census of the United States, Manufactures, folio 615.

[2] One Hundred Years of American Commerce, Vol. II, page 541.

[1] History of Middlesex County, Mass., Vol. III, Waltham, pages 738 and 739.

and so disastrously that only the machine shop was continued, and in that a few lathes were built and sold. But as the war went on a large demand sprang up among the soldiers. Had the watches furnished been of the high quality required to-day the demand could not have been met; there were not enough skilled and experienced mechanics available. The watches, such as they were, were made in sufficient quantities, and as prices were high, the manufacture became exceedingly prosperous. In 1868 the surplus was capitalized and the stock distributed to the stockholders as a special dividend.

As a result of the founding of the watch manufacture at Waltham a number of experts from the parent factory started an establishment at Nashua, N. H., but this was not a success and the Waltham Company bought it in 1862 and consolidated it with the home shop, retaining also the services of some of the experts. This Nashua watch was a valuable three-quarter plate movement, highly esteemed by the public. Some of the people who had been interested in the Nashua company went to Chicago and, with other experts, founded the now well-known factory at Elgin, Ill., one of the leading establishments in the manufacture. Other enterprises were offshoots of the Waltham idea, but many of them proved only experiments. It is noteworthy that the centers of the manufacture are still in the states of Massachusetts and Illinois.

The policy of the pioneer company was to utilize the skill and ingenuity of men who had been engaged either in the manufacture of watches or of interchangeable parts of any kind, or who had displayed inventive ability. Among these were Oliver and David Marsh, expert mechanicians and watchmakers of Boston, Charles S. Moseley, a leading inventor and the originator of many of the machines now used in all watch factories, Nelson P. Stratton, who was connected with the watch factory at Hartford in 1838, Ambrose Webster, and James T. Shepard who had been employed at the Springfield Armory, where the system of interchangeable mechanism had attracted Mr. Dennison's attention. Among others called in then or later were George Hunter, who afterwards went to Elgin, Charles W. Fogg, Charles Vander Woerd, Edward A. Marsh, and D. H. Church, all of them notable inventors of automatic machinery. Of these Mr. Moseley and Mr. Church are selected as representatives, "the first as being to a certain extent a pioneer in the field of designing and building watchmaking machinery, and the second as one who has by his fertility and originality in the field of invention, achieved so much in the embodiment of automatic features as to render his recent machines wonders of mechanism."[1]

It is said that the number of scientific and mechanical appliances that have been brought out in the manufacture of watches is greater than in any other industry, with the possible exception of the production and use of electricity. And it is probable that the ingenuity of inventors of automatic machinery is shown to greater advantage in this industry than in any other. The processes required are of the most perfect kind, and some of the products are so small as to be distinguishable in character under the glass only. The watch factories of the United States are filled with these automatic and semiautomatic machines, which not only make large numbers of parts of perfect uniformity at small cost, but have, in many cases, done away with the need of special skill in the individual workman. Frequently an operator can care for six or seven machines, and sometimes, as in the pioneer factory at Waltham, a track is laid on the floor and chairs are provided with grooved rolls, so that the attendant can glide easily and quickly the whole length of the line.

The only practicable way of treating the evolution of automatic machinery in watchmaking is to consider certain representative machines accomplishing certain representative results, and thus going from headland to headland, bridge the half century of progress and triumph in the United States. This Edward A. Marsh, of Waltham, has done. First he presents the "draw-in-chuck" and lathe, tracing their development by Ambrose Webster, Charles V. Woerd, and Charles S. Moseley into the self-closing, three-bearing slide-spindle lathe, with its application to the manufacture of watch plates. Within seven years two wholly automatic machines have been built for plate turning, their novelty being in the number of turnings they perform. Six recesses are turned in the train side of the pillar plate—for the barrel, escape wheel, pallets, balance, and for the center pinion, and a bearing for the intermediate setting wheel. The blank plates, faced on both sides, are taken from a tube at the left end of the machine one at a time by a swinging-carrier arm and placed in spindle after spindle until the six recesses are made, each unlike in size, position, and form. Bossing, when desired, is accomplished through a modification of the tool movement. By a change of chucks the turnings on the dial side of the plate can be made in a similar manner. "The boldness in the conception of this machine will be appreciated when it is realized that the watch plate must be placed in each succeeding chuck in a different position, and that it is required to be placed on three pins which fit in the three dial feet holes."[1] This is the work of one of these machines; the other by a somewhat similar process, utilizing self-closing chucks instead of pins, receives and faces the plates on both sides.

The history of watchmaking in the United States also goes back to the time when the arbors, staffs, and pinions, which constitute the moving parts of the watch, were made by the lathe and slide-rest, the feed screw of which was operated by hand. The first improvement

[1] The Evolution of Automatic Machinery, by E. A. Marsh, pages 149 and 150.

[1] Evolution of Automatic Machinery, pages 25 and 26.

was the semiautomatic turning lathe; then came an improved form in which there was a combination of levers designed to provide for turnings of various lengths without changing feed cams. But the great defect was that each piece had to be affixed by hand to its appropriate dog, making it impossible for one operator to run more than a single lathe; and, owing to the minuteness of the smaller staff blanks, like pallet arbors, only a small amount of metal could be removed at each turning. In some cases ten or twelve turnings were required, and they had to be alternated from end to end to avoid springing. Mr. Woerd some twenty years ago invented an automatic machine to make the rough turnings; but each of the finish turnings still required the application of a driving dog. The evolution of this into the Church battery of staff-turning lathes all on a single bed and driven by a single belt was a noteworthy event, but the dog was still essential. The triumph came within the past five years, when Mr. Church produced a completely automatic machine, adapting it to the most difficult, delicate, and complicated staff in the whole watch movement, namely, the balance staff. Four hundred of these, completely turned from start to finish, including both pivots, are made by each machine each day. This machine is one of the wonders of the Waltham factory, where automatic wonders abound, and it is asserted that "nothing in the way of turning has heretofore been done which could at all compare with the work of these machines in delicacy, complexity, and accuracy."[1] The balance staff is so minute that it can be handled only with great difficulty, having a diameter scarcely larger than that of a No. 9 sewing needle, and requiring a magnifying glass for its inspection.

For the cutting of pinions the Church automatic cutter is a higher development, as it secures axial truth by performing the cutting, in direct connection with the turning, from a long rod of wire. The evolution of the crown-wheel cutter is nearly as interesting a study, while the machines for the manufacture of the minute screws and stud pins, and those for vibrating balances and hairsprings, furnish a rare collection of ingenious American inventions.

Watch hairsprings were imported years ago, but for over a quarter of a century they have been made in the United States. The pioneer machine has been improved into a series of machines now nearly automatic in their action. The wire is drawn to the exact diameter required, then flattened by repeated rollings and polished. It is admitted that the coiling of hairsprings seems to be susceptible of no marked improvement in processes of production. A notable device for forming and confining the overcoil of the Breguet spring so that it can be tempered complete is that of the late John Logan, of Waltham. It is said of Mr. Logan and his brother that they "have probably made more watch hairsprings than all the other makers in the world put together, all of them high-class springs."[1] Until within a few years the adaptation of these hairsprings which requires absolute exactness, an indispensable requisite for correct time, was secured by repeated trials, a spring being found to meet the requirements of the individual balance. Mr. Logan devised a system of tests of springs by a standard balance, and of all balances by a standard spring, and then grading the springs according to strength. Resort to a schedule of gradings indicates at once the proper spring for any balance.

The minuteness of some of the screws made in a watch factory may be measured by the statement that it takes nearly 150,000 of a certain kind to weigh a pound. Under the microscope they appear in their true character—perfectly finished bolts. The pivot of the balance wheel is only one two-hundredths of an inch in diameter, and the gauge with which pivots are classified measures to the ten-thousandth part of an inch. Each jewel hole into which a pivot fits is about one five-thousandths of an inch larger than the pivot to permit sufficient play. The finest screw for a small-sized watch has a thread of 260 to the inch and weighs one one hundred and thirty thousandths of a pound. Jewel slabs of sapphire, ruby, or garnet are first sawed into slabs one-fiftieth of an inch thick, and are shellacked to plates so that they may be surfaced. Then the individual jewels are sawed or broken off, drilled through the center, and a depression made in the convex side for an oil cup. A pallet jewel weighs one one hundred and fifty thousandths of a pound; a roller jewel a little more than one two hundred and fifty-six thousandths. The largest round hairspring stud is four-hundredths of an inch in diameter and about nine-hundredths of an inch in length.

It is only the finishing department of a watch factory in the United States that requires the services of skilled watchmakers. Even the assembling of a watch is done by others, the hairsprings being selected by girls with the aid of machines and put in on the balance, within an error of ten seconds per hour or four minutes per day, which is readily corrected by the time screws of the balance. The finishing department is of most interest to watchmakers, because it is in this that the movement is adjusted, being put through all the tests for heat and cold, from 95° down to 38° or 40°; tests in three vertical positions, and in "dial-up" and "dial-down." The balance in most modern watches is required to make 18,000 vibrations an hour. The change of one beat will cause an error of four and four-fifths seconds at the end of twenty-four hours. This statement indicates the extreme delicacy of the tests and the necessity of the demagnetizing of all the parts of the escapement so that electrical disturbances in whatever form will have

[1] The Evolution of Machinery, page 49.

[1] The Watch Adjusters' Manual, by Charles Edgar Fritts, pages 46 and 47.

no effect whatsoever. Not many years ago a watch would have been ruined by magnetic influences. Now it is made with a balance, roller, hairspring, pallet, and fork of nonmagnetic metals or alloys which are elastic in just the proper proportions to meet the varying conditions of heat and cold.

Between the manufacturers of the higher grades of watch movements and what may be called the "dollar" grade, including case, are a number who make a variety of grades of great utility and of considerable value. Much of the work is done by automatic machinery, but the hand finish is not so complete nor the testing so minute. These manufactures are a development of the cheap watch. Such movements are made largely by regular watch establishments, but in one case at least, possibly in others, are made by clock companies and classed as a by-product.

The rise of the low-priced grade of watches dates from the time of the long-wind Waterbury watch. The foundation patent for this was issued to D. A. A. Buck, May 21, 1878. The feature that made the watch a success was the improvement of the old duplex escapement, by which the parts were simplified so that they could be cheaply stamped out. None of these watches are now made. They have given place to a much higher grade, in which, however, the improved duplex escapement is still used. But the demand they excited continued and had to be satisfied. A number of clock companies now make the low-priced watches, case and all, as a by-product. Whether the evolution can be traced wholly to the Waterbury may be questioned. The clock companies for years have been making clocks of increasingly small dimensions, all with lever movements, such as the marine and the small shelf and alarm clocks. Some of these sizes became quite small for clocks, and at least one was made as an experiment for a pocket piece. It was thick and large, and used as a toy and for advertising purposes, retailing in some instances for $2.50, whereas to-day a much better watch, both in appearance and in accuracy, can be bought for $1, guaranteed for a year. But it was a beginning. The movement was that of a clock, with a pin escapement. Hence the cheap watch is sometimes called a "clock-watch," although it is true that the high-grade watches of to-day are also a development of the clock idea, but at a long remove, the definite line of variation having appeared many years ago. The secretary of a clock company making these low-priced watches writes: "In the evolution of this article from our regular goods, the progress has been so gradual that at no distinct time have we felt that we could draw the line where the 'clock' stopped and the 'watch' began. It is identical in character with our small clocks, and we have felt that the term 'pocket clock' was a legitimate and more accurate description than to class it as a watch. It does not have the element of value and solid construction usually associated with a watch."

The cheap watches are now made as small as ladies' size, are stem-winding, and will last, it is said, five years, including a year or two of fairly accurate timekeeping. The dials are of various colors and designs, the effort now being, in some instances, to make railroad and world's time dials. The remarkable cheapness of the low-grade watch is chiefly due to automatic machinery and the factory system. Not much finish, which is a costly matter, is possible. There are no jewels used against which the pivots may rest, as in the higher grade watches, to insure close accuracy and durability by lessening friction; nearly all parts are stamped out, not cut out; the mainsprings and hairsprings are of the quality required for comparatively rough work, and have been greatly reduced in cost by modern processes of manufacture in the United States; and the time devoted to testing and adjustment is necessarily limited. What can be expected in a movement and case which, perhaps, must be sold at wholesale at the rate of 60 cents the watch? The marvel is that it is possible to give so much.

The manufacture of these watches is limited to Connecticut and New York. At one establishment the maximum daily product is stated to be 2,000 watches. The demand for them in the United States is constant and it is yet far from being fully supplied. They are urged upon the public as really better than the cheapest of Swiss watches, which are so imperfect as frequently to require expensive repairs. Exportations of them have been made ever since the beginning of their manufacture, and the demand has been increased of late, it is said, by the presence of the American soldier abroad. When the home market becomes better supplied manufacturers assert that they will take up the export problem in earnest. The question arises: Will the clock manufacturers, with whom watches are a by-product, come to be watch manufacturers, with clocks as a by-product? The answer to this, as given by a clock manufacturer, is that it is not probable, at least in the immediate future. The destruction of clocks seems to be greater than that of watches. A person gets attached to a watch, even a cheap watch, and will expend much more than its cost in repairs, but when a clock becomes out of order he will buy another. There is, therefore, a greater proportional consumption of clocks than of watches, and, other things being equal, this will keep the cheap watch a by-product when made in a clock factory.

The imports and exports of watches and parts thereof vary with a variety of causes, but it is noteworthy that the net imports decreased from $3,018,447 in 1870, to $1,403,302 in 1900, or 53.5 per cent, while during the same time the domestic exports increased from $4,335 to $787,620, or over one hundred and eighty-fold. Of the imports in 1900, those from Switzerland were valued at $1,023,967 and constituted 73 per cent of the total net imports; France sent a value of $140,067; Germany,

$114,886; and Great Britain, $89,525. Watches from the United States are now exported to most of the countries of the world. In 1900 Canada received a value of $274,537, or 34.9 per cent of the total; Japan, $162,014; South America, $125,692; Great Britain, $82,315; British Australasia, $36,995; British Africa, $32,174; the Philippines, $18,003; China, $9,170; Hawaii, $8,341; and Cuba, $1,006.

When pocket timekeepers first came into general use, the cases were made with exposed glass fronts over the face and hands, now distinguished by the term "open face." That style prevailed in the United States as late as seventy years ago. The style called "hunter's" or "hunting" case was invented to accommodate the demands of Englishmen, whose vigorous riding in the hunting field necessitated better protection for their watches. In the United States a similar necessity arose, particularly among the more active classes—the pioneers and hunters of that period. In consequence of the frequent breaking of the crystal the idea of an entire metallic covering was naturally suggested. But there is a rapidly growing demand for open-face watches, the use of thick beveled-edge glasses rendering the case quite as reliable a protection as the cover of a "hunting" case, beside being more nearly dust proof.

Few, if any, watch cases are now made by the high-grade watch-movement factories, the manufacture having become specialized. Watch movements and watch cases are made for each other according to standard sizes, so that the jobber or dealer may order them to fit, in style according to the caprice of himself or his customer, just as he can order interchangeable parts of the watch movement by number for repair work, with no misgivings as to their fitting. The watch-case industry shows the same kind of evolution as the manufacture of watch movements. The effort has been to lower the cost, improve the quality, and increase the uniformity of the product by automatic machinery and at the same time to furnish a rich variety of effects. In old times crude tools were used, but when the machine-made watch appeared improved methods became necessary to meet the increased demand. Cases were made at first by watch-movement factories, but their manufacture was gradually dropped for the more delicate fabrication. The automatic machines devoted to watch-case making are marvels, and the system of interchangeable parts prevails as in the manufacture of watch movements. The general system of division of labor is similar in the two manufactures. The metal for the cases undergoes several processes, from the furnace where it is melted, mixed, and shaped, through the cutting, rolling, turning, and stamping, until it reaches the several skilled mechanics who finish it in its final beauty of design.

One of the revolutionizing events in the history of the case industry was the invention of the popular filled case, patented in 1859, by James Boss, of Philadelphia, Pa. By this the people are provided with a tasty, serviceable, and durable gold case at about half the cost of a solid gold one. Besides the gold filled, the kinds of cases in most common use are silver, nickel—including silverene, silverore, silveroid, and nickel silver, which are the same under different trade-marks—and German silver. Gun metal is also used, and in the very low-priced grades, brass, nickel plated, is employed.

The gold case gives the artisan excellent opportunities for ornamentation, by its beautiful luster and richness of color. It is often delicately enameled or exquisitely engraved, and ornamented with gems. The prime requisite, however, in selecting material for the case, is to have it of sufficient stiffness to protect the delicate interior from injury by external pressure. The case should also be so constructed as to exclude all dust and moisture, two great hindrances to perfect timekeeping.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 174. WASHINGTON, D. C. MAY 22, 1902.

MANUFACTURES.

MANUFACTURED ICE.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on the manufacture of ice in the United States during the census year, prepared under my direction by Mr. Arthur L. Hunt, of the Census Office.

The statistics included in the report were collected, as in previous censuses, upon the schedule used for the general statistics of manufactures. But in view of the remarkable growth of this industry and the decided impetus it has given to the production of early vegetables and small fruits in different sections of the United States, especially in the South, through the use of refrigerator cars and cold-storage warehouses, it was decided to supplement the canvass made by the enumerators and local special agents, and to give the industry more detailed treatment than is given to manufacturing industries in general, or than this industry has received heretofore.

As explained in the text, the statistics here presented pertain only to establishments engaged in the manufacture of ice for sale, and do not include the returns from establishments which manufacture ice for their own consumption, such as breweries, meat and provision cold-storage houses, dairies, chemical factories, and various other industries in which the production of cold air or the use of refrigerants is necessary for the preservation of their products.

The growth of the manufactured ice industry in the United States during the past decade indicates that the process of manufacture, through the perfection of machinery and apparatus and the general economy of the plant, has reached the point where the manufactured product can be produced at so low a cost that it has virtually displaced the use of natural ice in the South and successfully competes with the natural product in certain sections of the North.

The statistics are presented in 11 tables: Table 1 showing comparative figures for the industry at the several censuses; Table 2 showing the summary for the industry for 1900 as it appears in Parts I and II of the Report on Manufactures, and also the summary of additional establishments, the schedules for which were received too late to be included in the totals for this industry as presented in Parts I and II, Manufactures; Table 3 showing, by states and territories, the number of establishments in operation in 1870, 1880, 1890, and 1900, the increase from 1890 to 1900, the number of plants constructed during the decade, and the number constructed during the census year; Table 4 showing, by states and territories, the total number of establishments in 1900, the number using the compressor and the absorption systems, and the per cent of each to the total number; Table 5 showing the comparative summary of the statistics of capital for 1890 and 1900; Table 6 showing statistics of miscellaneous expenses for 1900; Table 7 showing the cost of materials for 1900; Table 8 showing, by states and territories, the quantity, cost, and average cost per pound of aqua and anhydrous ammonia for 1900; Table 9 showing, by states and territories, the total number of tons and value of ice manufactured, the number of tons of can and plate ice, the average value per ton of each, and the per cent of each to the total for 1900; Table 10 showing the detailed statistics for cities of over 20,000 in population in 1900; Table 11 showing the detailed statistics for the industry in 1900, by states and territories.

Table 1 shows the growth of the industry during the thirty years which terminated with the Twelfth Census. Owing to changes in the method of taking the

census, comparisons between the earlier and later decades, represented in Table 1, should be drawn only in the most general way. Nevertheless, the rate of growth in the manufacture of ice may be fairly inferred from the figures given.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made prior to the census of 1890 to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using twelve, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

In some instances, the number of proprietors and firm members shown in the accompanying tables falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations or cooperative establishments.

The reports show a capital of $38,204,054 invested in the manufacture of ice in the 787 establishments reporting for the United States. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations engaged in this industry. The value of the products is returned at $13,874,513, to produce which involved an outlay of $1,234,803 for salaries of officials, clerks, etc.; $3,424,305 for wages; $1,779,890 for miscellaneous expenses, including rent, taxes, etc.; and $3,339,724 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is in any sense indicative of the profits in the manufacture of ice during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the works. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

Chief Statistician for Manufactures.

MANUFACTURED ICE.

By Arthur L. Hunt.

The following report presents the statistics concerning the establishments engaged in the manufacture of ice for sale during the census year ending May 31, 1900. Ice produced by mechanical or chemical means is commonly, but not very appropriately, designated as "artificial," to distinguish it from ice produced by nature. Artificial refrigeration consists simply in the removal of heat, and is accomplished by the use of ammonia, either aqua or anhydrous, or some other volatile liquid, such as sulphurous dioxide or ether, which absorbs heat upon evaporation.

The manufacture of ice as an industry existed as early as 1866, but has attained commercial importance only within the past fifteen or twenty years. The industry naturally had its inception in the South, where ice is not harvested in commercial quantities, and where the difficulties and loss attending its shipment from the North precludes its general use, and has extended not only throughout all the Southern states but into the majority of the Northern and Western states. The ice industry, in connection with the operation of cold-storage houses and the introduction of refrigerator cars, has aided greatly in the development of the natural resources of different sections of the United States, and forms a most important factor in the industrial development and progress of not only the Southern states but many of the Northern states. Refrigerator cars insure the safe transportation of perishable articles, and cold-storage warehouses obviate the necessity of their shipment as soon as produced or their consumption as soon as delivered, thus allowing the goods to be held before or after shipment until there is a market for them. Artificial refrigeration has thus given a great stimulus to the production of early vegetables and small fruits, especially strawberries, in the South and on the Pacific coast. It has also been of great importance to the slaughtering and meat packing industry, facilitating the storage and the handling of dressed meats and making it possible to carry on the operations of this industry throughout the entire year, whereas previously it had been limited to the winter season.

The statistics presented in this report relate exclusively to establishments which manufactured ice for sale. Many of these establishments, however, operate cold-storage houses in connection with their ice plants, and the receipts for storage are included in the total value of products. The report does not include the statistics of establishments which manufactured ice for their own consumption, such as breweries, meat and provision cold-storage houses, chemical factories, and various other establishments.

Table 1 presents in summarized form the statistics of the industry as returned at the censuses of 1870 to 1900, inclusive, with the percentages of increase for each decade. The totals for 1900 include returns from 12 establishments, the reports for which were not secured in time to be included in the general report upon this industry, and therefore these totals do not agree with those given in Parts I and II, Manufactures. Table 2 shows the totals for the industry for 1900 as given in the general report, and also the totals for the additional reports received, a combination of the two making the totals shown in Table 1.

Table 1.—COMPARATIVE SUMMARY, 1870 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	Date of census.				Per cent of increase.		
	1900[1]	1890	1880	1870	1890 to 1900	1880 to 1890	1870 to 1880
Number of establishments	787	222	35	4	254.5	534.3	775.0
Capital	$38,204,054	$9,846,468	$1,251,200	$434,000	288.0	687.0	188.3
Salaried officials, clerks, etc., number	1,545	[2] 439	([3])	([3])	251.9	.....	.....
Salaries	$1,234,803	[2] $345,191	([3])	([3])	257.7	.....	.....
Wage-earners, average number	6,933	2,826	447	97	145.3	532.2	360.8
Total wages	$3,424,805	$1,096,996	$140,885	$40,600	212.4	677.9	247.0
Men, 16 years and over	6,889	2,811	389	96	145.1	622.6	305.2
Wages	$3,416,844	$1,094,634	([3])	([3])	212.1	.....	.....
Women, 16 years and over	8	.....	50	.....	.....	.....	.....
Wages	$3,592	.....	([3])	.....	.....	.....	.....
Children, under 16 years	36	15	8	1	140.0	87.5	700.0
Wages	$3,869	$1,362	([3])	([3])	184.1	.....	.....
Miscellaneous expenses	$1,779,890	$477,485	([4])	([4])	272.8	.....	.....
Cost of materials used	$3,339,724	$940,699	$158,112	$82,165	255.0	495.0	92.4
Value of products	$13,874,513	$4,900,983	$544,763	$258,250	183.1	799.7	110.9

[1] Exclusive of Hawaii, which reports as follows: Number of establishments, 4; capital, $137,271; salaried officials, clerks, etc., 4; salaries, $6,365; wage-earners, all men, average number, 19; total wages, $12,015; miscellaneous expenses, $5,805; cost of materials, $15,735; value of products, $56,522. The figures reported for 1900 include the statistics for 12 establishments, the schedules for which were received too late to be included in the totals for this industry as presented in the report on Manufactures, Parts I and II.

[2] Includes proprietors and firm members, with their salaries; number only reported in 1900. (See Table 11.)

[3] Not reported separately.

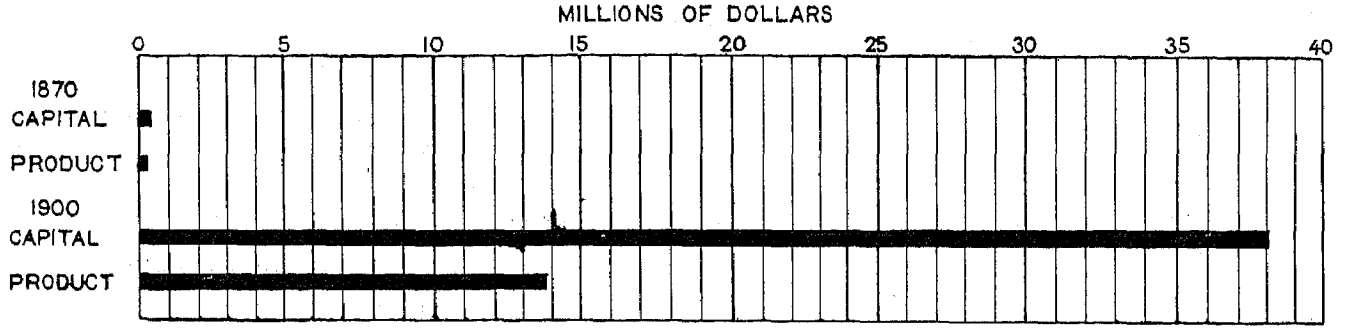
[4] Not reported.

TABLE 2.—SUMMARY, 1900.

	Reported in Manufactures, Parts I and II.	Additional establishments.
Number of establishments	775	12
Capital	$38,019,507	$184,547
Salaried officials, clerks, etc., number	1,631	14
Salaries	$1,226,331	$8,472
Wage-earners, average number	6,880	53
Total wages	$3,402,745	$21,560
Men, 16 years and over	6,838	51
Wages	$3,395,428	$21,416
Women, 16 years and over	8	.....
Wages	$3,592	.....
Children, under 16 years	34	2
Wages	$3,725	$144
Miscellaneous expenses	$1,773,692	$6,198
Cost of materials used	$3,312,393	$27,331
Value of products	$13,780,978	$93,535

Table 1 indicates the remarkable progress which has taken place in this industry during the thirty years ending with 1900. Statistics of the manufacture of ice first appear in the census of 1870, when returns were received from 4 establishments with a capital of $434,000 and products valued at $258,250. In 1900 the number of establishments was 787, the capital $38,204,054, and the value of products $13,874,513. The growth of the industry is perhaps more forcibly illustrated by the following diagram:

COMPARATIVE GROWTH OF CAPITAL AND PRODUCTS, 1870 AND 1900.



During the period from 1870 to 1880 the number of establishments increased from 4 to 35, the capital from $434,000 to $1,251,200, and the value of products from $258,250 to $544,763. A comparison of the figures reported for 1890 with those reported for 1880 indicates that most notable progress occurred in this industry during this decade. The number of establishments increased from 35 to 222; the capital from $1,251,200 to $9,846,468; and the value of products from $544,763 to $4,900,983. During the past decade the industry has made still greater advances, although the per cent of increase is not as large as that shown during the preceding decade. The number of establishments increased from 222 to 787, an increase of 565, or 254.5 per cent; the capital from $9,846,468 to $38,204,054, an increase of $28,357,586, or 288 per cent; and the value of products from $4,900,983 to $13,874,513, an increase of $8,973,530, or 183.1 per cent.

A comparison of the average capital and value of products per establishment for the several censuses sheds further light upon the development of the industry since 1870. In that year the average capital per establishment was $108,500 and the average value of products $64,563. These averages are higher than for any of the subsequent censuses, probably because the four establishments included one which reported products valued at nearly $250,000. This establishment had been erected in New Orleans in 1866 and was the first ice factory of importance built in the United States. At this time nearly all of the natural ice used in New Orleans came from Boston, and, on account of the distance, difficulties of shipping, and loss by melting, the price was excessively high, ranging from $15 to $20 per ton. Although the manufactured ice was crude and often very poor, the cost of production was excessive, owing to the experimental nature of the process, the imperfect knowledge of the operators, and the loss of ammonia by leakage. These circumstances combined with the excessive price of natural ice to keep the price for manufactured ice correspondingly high. In 1880 the average capital per establishment decreased to $35,749 and the average value of products to $15,565. The decade between 1870 and 1880 may be looked upon as the incipient and experimental stage of the industry. A number of small-capacity plants were installed, usually in Southern towns of considerable population, where the manufactured product would have to compete with natural ice only to a very limited extent. In this way a demand for ice was created and supplied. In many instances the surplus was sent to neighboring communities, and led generally to the establishment of plants in these localities also. Later the industry gained a foothold in the cities where natural ice was used to some extent by the wealthy families and by a few of the larger dealers in perishable products.

The decade from 1880 to 1890 witnessed a rapid growth in the industry and demonstrated that it was possible to manufacture ice on a scale commensurate with the needs of the community in which the plant was located. Thus the industry became firmly established. Small establishments began to increase their capacity and to install larger refrigerating machines.

The average capital per establishment increased to $44,353, or 24.1 per cent, and the value of products to $22,077, or 41.8 per cent. The decade from 1890 to 1900 witnessed a still further increase in the productive capacity, resulting in an increase in the average capital per establishment to $48,544, or 9 per cent. There was a decrease, however, in the average value of products from $22,077 to $17,630, or $4,461 per establishment, caused, in part at least, by a decrease in price to the consumer, which resulted from the general reduction in the cost of production, due to the increasing knowledge of refrigerants and refrigerating processes.

The corporate form of organization predominates in this industry. Of the total number of establishments reporting, 469, or 59.6 per cent, were operated by incorporated companies. Of the remainder, 180, or 22.9 per cent, were conducted by individuals, 134, or 17 per cent, by firms or limited partnerships, and the remaining 4 were miscellaneous in character.

Table 3 presents, by states and territories, the number of ice-manufacturing establishments as returned at the censuses of 1870 to 1900, inclusive, together with the increase and number established since 1890, and the number established during the census year.

TABLE 3.—COMPARATIVE SUMMARY, NUMBER OF ACTIVE ESTABLISHMENTS, 1870 TO 1900, INCLUSIVE; INCREASE, 1890 TO 1900; NUMBER ESTABLISHED SINCE 1890; AND NUMBER ESTABLISHED DURING THE CENSUS YEAR; BY STATES AND TERRITORIES; ARRANGED GEOGRAPHICALLY.

STATES AND TERRITORIES.	1900	1890	1880	1870	Increase, 1890 to 1900.	Established since 1890.	Established during census year.
The United States	787	222	35	4	565	544	89
New England states	7	.....	.....	.....	7	5	.....
Rhode Island	2	.....	.....	.....	2	2	.....
Connecticut	5	.....	.....	.....	5	3	.....
Middle states	169	14	.....	.....	155	123	33
New York	41	1	.....	.....	40	36	12
New Jersey	26	1	.....	.....	25	16	6
Pennsylvania	73	5	.....	.....	68	54	12
Delaware	7	1	.....	.....	6	5	1
Maryland	18	5	.....	.....	13	11	2
District of Columbia	4	1	.....	.....	3	1	.....
Southern states	386	165	29	4	221	253	39
West Virginia	8	4	.....	.....	4	3	.....
Virginia	30	8	.....	.....	22	22	2
North Carolina	23	5	.....	.....	18	18	4
South Carolina	13	4	.....	.....	9	8	3
Georgia	32	16	8	.....	16	19	2
Florida	35	9	.....	.....	26	23	2
Kentucky	31	12	1	.....	19	20	3
Tennessee	27	13	.....	1	14	16	2
Alabama	23	18	3	.....	5	14	2
Mississippi	23	8	.....	.....	15	14	2
Arkansas	18	5	1	.....	13	14	2
Louisiana	36	10	4	2	26	31	7
Indian Territory	3	.....	.....	.....	3	3	2
Oklahoma	7	.....	.....	.....	7	5	.....
Texas	77	53	12	1	24	43	6
Central states	152	23	1	.....	129	111	15
Ohio	42	10	.....	.....	32	26	2
Indiana	47	3	.....	.....	44	37	5
Illinois	29	8	.....	.....	21	21	3
Iowa	3	.....	.....	.....	3	3	1
Missouri	31	2	1	.....	29	24	4
Western states	40	7	.....	.....	33	32	.....
Nebraska	1	.....	.....	.....	1	1	.....
Utah	1	.....	.....	.....	1	.....	.....

TABLE 3.—COMPARATIVE SUMMARY, NUMBER OF ACTIVE ESTABLISHMENTS, 1870 TO 1900, INCLUSIVE; INCREASE, 1890 TO 1900; NUMBER ESTABLISHED SINCE 1890; AND NUMBER ESTABLISHED DURING THE CENSUS YEAR; BY STATES AND TERRITORIES; ARRANGED GEOGRAPHICALLY—Continued.

STATES AND TERRITORIES.	1900	1890	1880	1870	Increase, 1890 to 1900.	Established since 1890.	Established during census year.
Western states—continued.							
Colorado	6	1	.....	.....	5	5	.....
Kansas	19	4	.....	.....	15	15	.....
Arizona	9	2	.....	.....	7	7	.....
New Mexico	4	.....	.....	.....	4	4	.....
Pacific states	33	13	5	.....	20	20	2
Washington	4	2	.....	.....	2	1	.....
Oregon	9	4	.....	.....	5	4	.....
California	20	7	5	.....	13	15	2

Table 3 indicates in a striking manner the growth of the industry since 1870. In 1870 all 4 of the establishments reporting were located in the Southern states, and the same is true of nearly all of the 35 plants returned at the census of 1880. From 1880 to 1890 the number of establishments increased rapidly and the industry extended to the Middle, Central, Western, and Pacific states, supplementing the supply of ice furnished by nature. Although, between 1890 and 1900, the number of establishments increased remarkably throughout the South, the greatest and most striking increases occurred in a few of the Middle and Central states, namely, Pennsylvania, Indiana, New York, and Ohio. In 1890 Ohio was the only one of these states which reported as many as 10 ice plants, and the number in each of the other states, with the exception of Pennsylvania, was under 5. At the present census not one of these states reported less than 40 ice-manufacturing plants, and in Pennsylvania the number reached 73. This remarkable growth of the industry in the North is largely accounted for by the fact that the process of manufacture, through the perfection of the refrigerating machines, the mechanical appliances used, and the general economy of the plant, has reached a point where the manufactured product can be produced at a cost which makes it possible to compete successfully with the natural product.

It is interesting to compare the number of establishments in the Southern states with the total number in the United States for 1890 and 1900. These 15 states comprise a little less than one-third of the 52 states and territories of the United States, and the comparison shows the growth of the industry in the North and West. In 1890, 165, or 74.3 per cent of the total number, were located in the South. In 1900 the number in the South increased to 386, an increase of 134 per cent, but formed only 49 per cent of the total number of establishments.

In no state or territory has there been a decrease in the number of establishments. The increase in the total number from 1890 to 1900 was one hundred and

forty-one times the total number reported for 1870, over sixteen times that returned for 1880, and over two and one-half times that reported for 1890. The leading 10 states in 1900, ranked according to the number of establishments, were: Texas, 77; Pennsylvania, 73; Indiana, 47; Ohio, 42; New York, 41; Louisiana, 36; Florida, 35; Georgia, 32; Missouri, 31; and Kentucky, 31. The rapid growth of the industry is still further illustrated by the 89 factories reported as established during the census year. This is over two and one-half times the total number reported for the entire country in 1880, and over one-tenth of the number returned for 1900. The following states reported no ice-manufacturing establishments: Idaho, Maine, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, North Dakota, South Dakota, Vermont, Wisconsin, and Wyoming.

In the manufacture of ice there are two systems used, commonly known as the "compressor" and the "absorption" systems. The compressor system, which is by far the more common of the two, involves three successive steps, respectively called compression, condensation, and expansion. In this system anhydrous ammonia, or ammonia which contains no water, in the gaseous form is subjected to a pressure of from 125 to 175 pounds per square inch, by the use of a pump employing steam or other power. At the beginning the gas contains a certain amount of heat, and substantially none of this is lost by compression. The gas is next reduced to the liquid state by condensation. This is performed by passing the ammonia through coils of pipe, the pipes being in contact with cold water or some other cooling medium. The excess of heat is thus given up, and the ammonia, reduced to the liquid state, is then caused to expand or become gaseous in coils of pipe which are in contact with the water to be frozen. This reduces the temperature of the ammonia gas below the freezing point of water, and the ammonia absorbs from the water to be cooled the heat which was taken from the former during condensation. This of necessity results in the freezing of water, owing to the well-known fact that if two substances of different temperatures are allowed to come in contact with each other, the warmer body will impart its heat to the colder, until the temperatures of the two are equalized. This is the theory of all refrigerating processes. The ammonia, having completed its cooling work, is then returned to the compressor where it may be reused repeatedly. There is, however, a small loss during each cycle of operations, and the supply must be replenished at intervals.

In the absorption system an aqueous solution of ammonia is used, the process involving four successive steps: the generation of gas, condensation, expansion, and absorption. The application of heat to the aqua ammonia converts it into a gas, and raises the pressure to from 120 to 160 pounds per square inch. The ammonia is then condensed, or reduced to liquid form by being conducted through pipes which are in contact with cold water. The next step is the expansion, which is usually accomplished as in the compressor system. The ammonia is now changed from a liquid to a gas, and, being greatly reduced in temperature, absorbs heat from the pipes, thus producing ice or refrigeration.[1]

Table 4 presents, by states and territories, the number of establishments in 1900 using the compressor and the absorption systems, and the per cent of each to the total number.

TABLE 4.—NUMBER OF ESTABLISHMENTS USING THE COMPRESSOR AND THE ABSORPTION SYSTEMS, AND THE PER CENT OF EACH TO THE TOTAL NUMBER, BY STATES AND TERRITORIES; ARRANGED GEOGRAPHICALLY: 1900.

STATES AND TERRITORIES.	Total number of establishments.	COMPRESSOR SYSTEM.		ABSORPTION SYSTEM.	
		Number.	Per cent of total.	Number.	Per cent of total.
The United States	787	571	72.6	216	27.4
New England states	7	7	100.0	.....	.....
Rhode Island	2	2	100.0	.....	.....
Connecticut	5	5	100.0	.....	.....
Middle states	169	158	93.5	11	6.5
New York	41	37	90.2	4	9.8
New Jersey	26	24	92.3	2	7.7
Pennsylvania	73	68	93.1	5	6.9
Delaware	7	7	100.0	.....	.....
Maryland	18	18	100.0	.....	.....
District of Columbia	4	4	100.0	.....	.....
Southern states	386	247	64.0	139	36.0
West Virginia	8	4	50.0	4	50.0
Virginia	30	22	73.3	8	26.7
North Carolina	23	19	82.6	4	17.4
South Carolina	13	7	53.9	6	46.1
Georgia	32	16	50.0	16	50.0
Florida	35	14	40.0	21	60.0
Kentucky	31	12	38.7	19	61.3
Tennessee	27	22	81.5	5	18.5
Alabama	23	14	60.9	9	39.1
Mississippi	23	13	56.5	10	43.5
Arkansas	18	18	100.0	.....	.....
Louisiana	36	13	36.1	23	63.9
Indian Territory	3	3	100.0	.....	.....
Oklahoma	7	5	71.4	2	28.6
Texas	77	65	84.4	12	15.6
Central states	152	105	69.1	47	30.9
Ohio	42	30	71.4	12	28.6
Indiana	47	25	53.2	22	46.8
Illinois	29	20	69.0	9	31.0
Iowa	3	2	66.7	1	33.3
Missouri	31	28	90.3	3	9.7
Western states	40	25	62.5	15	37.5
Nebraska	1	1	100.0	.....	.....
Utah	1	1	100.0	.....	.....
Colorado	6	2	33.3	4	66.7
Kansas	19	10	52.6	9	47.4
Arizona	9	9	100.0	.....	.....
New Mexico	4	2	50.0	2	50.0
Pacific states	33	29	87.9	4	12.1
Washington	4	4	100.0	.....	.....
Oregon	9	9	100.0	.....	.....
California	20	16	80.0	4	20.0

From Table 4 it appears that of the 787 establishments reporting, 571, or 72.6 per cent, used the compressor

[1] Artificial Ice Making and Refrigeration, by Louis M. Schmidt, pages 5–8.

system, and the remainder, 216, or 27.4 per cent, employed the absorption system. These figures show that the compressor system is the one in general use. It is in fact superseding the absorption, which is the older of the two processes. The latter, however, is still used in the smaller plants and warm climates, as its operation requires less machinery and a less complicated arrangement of appliances. In three of the Southern states—Florida, Kentucky, and Louisiana—the number of establishments using the absorption system exceeded the number employing the compressor system. In West Virginia, Georgia, and New Mexico the number employing each system was the same, but in the majority of the remaining states, with the single exception of Colorado, the number using the compressor system was far in excess of the number employing the other system. It will also be noticed that a number of states reported no establishments using absorption machines. The following states reported plants using both systems: Colorado, 1; Kansas, 1; Kentucky, 2; Louisiana, 1; Mississippi, 1; Missouri, 1; Tennessee, 2. These latter establishments were classified according to the number or capacity of the compressor or absorption machines used.

Table 5 is a comparative summary of capital for 1890 and 1900, with the per cent of each item to the total, and the per cent of increase for the decade.

TABLE 5.—COMPARATIVE SUMMARY CAPITAL: 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$38,204,054	100.0	$9,846,468	100.0	288.0
Land	4,679,379	12.3	1,595,360	16.2	193.3
Buildings	7,387,014	19.3	1,338,652	13.6	451.8
Machinery, tools, and implements	22,852,158	59.8	5,939,719	60.3	284.7
Cash and sundries	3,285,503	8.6	972,737	9.9	237.8

As shown by Table 5, the increase between 1890 and 1900 in the total capital employed in the manufacture of ice was $28,357,586, or 288 per cent. Of the total value of capital reported, the value of machinery, tools, and implements, including refrigerating apparatus and machinery, boilers, tanks, air compressors, small engines, pipe coils, ice receptacles, and all other apparatus and accessories required, constituted the principal item both in 1890 and 1900, amounting to $5,939,719 in 1890 and $22,852,158 in 1900, an increase of $16,912,439, or 284.7 per cent. The per cent of this item to the total capital was substantially the same for each year. The value of buildings, the next largest item, increased from $1,338,652 to $7,387,014 during the decade, an increase of $6,048,362, or 451.8 per cent. The value of land increased from $1,595,360 to $4,679,379, an increase of $3,084,019, or 193.3 per cent. It constituted, however, a smaller proportion of the total capital in 1900 than in 1890. The value of buildings, on the other hand, not only exhibited a striking increase, but constituted a larger proportion of the capital in 1900 than in 1890. This increase was probably due to the erection of cold-storage plants operated in connection with the manufacture of ice, to the increase in the ice-storage capacity, and to the generally increased productive capacity of the plants. Cash and sundries, including cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries formed the smallest item of the total capital, amounting to $972,737 in 1890, and to $3,285,503 in 1900, an increase of $2,312,766, or 237.8 per cent, and constituted 8.6 per cent of the total capital in 1900, or nearly the same per cent as in 1890. The above figures do not represent the capital stock of any of the corporations, but include only the actual value of the plants, together with the amount necessary for working capital.

The schedule of inquiry adopted for 1890 was the first which contained questions designed to show the cost of manufacture other than for wages and materials. The questions of the Twelfth Census relating to miscellaneous expenses were made as nearly uniform as possible with those of the previous census, and the returns are shown in Table 6, together with the per cent of each item to the total.

TABLE 6.—MISCELLANEOUS EXPENSES: 1900.

	Amount.	Per cent of total.
Total	$1,779,890	100.0
Rent of works	116,026	6.5
Taxes, not including internal revenue	246,340	13.9
Rent of offices, insurance, interest, repairs, advertising, and other sundries	1,394,180	78.3
Amount paid for contract work	23,344	1.3

The amount paid for rent of offices, insurance, interest, internal-revenue tax and stamps, repairs of buildings and machinery, advertising, and all other sundries not reported under the head of materials, etc., was the principal item, and constituted 78.3 per cent of the total miscellaneous expenses. This amount does not include expenditures for new equipment, machinery, and other apparatus. The amount of interest in this item does not include the interest paid on bonds by incorporated companies, but only the small sums expended during the year for money or credit necessary to conduct the business. The remaining items under miscellaneous expenses formed but a relatively small per cent of the total amount reported.

Table 7 shows the cost of the different materials used in the manufacture of ice in 1900, with the per cent of each item to the total cost of materials.

TABLE 7.—COST OF MATERIALS: 1900.

	Amount.	Per cent of total.
Total	$3,339,724	100.0
Ammonia	359,549	10.8
Anhydrous	279,680	8.4
Aqua	79,869	2.4
All other materials	506,586	15.2
Fuel	2,139,216	64.0
Rent of power and heat	20,336	0.6
Mill supplies	216,383	6.5
Freight	97,654	2.9

The total cost of materials in 1900 was $3,339,724 as compared with $940,699 in 1890, an increase of $2,399,025, or 255 per cent. The quantities and values of the different materials used are presented in detail in Table 11, by states and territories.

The manufacture of ice is peculiar in that practically the only materials which affect the cost are those which do not enter into the product, but are used in the generation of the cold necessary for the production of ice. The principal item of expense is the cost of fuel used to propel the machinery. In 1900 this was $2,139,216, or 64 per cent of the total cost. No attempt was made to ascertain the number of tons of coal represented by this amount. Ammonia, anhydrous and aqua, is the principal material used as a refrigerant. The cost of ammonia was $359,549, or only 10.8 per cent of the total cost of materials used. The cost of anhydrous ammonia was $279,680, or 8.4 per cent of the total cost of materials, and the cost of aqua ammonia was $79,869, or 2.4 per cent of the total cost of materials.

The item "other materials" included the amounts expended for brine, made either with sodium chloride (common salt) or chloride of calcium, and also the amount expended for water consumed, and constituted the remainder of the materials used directly in connection with the production of ice, the common salt and the chloride of calcium assisting in refrigeration, and the water entering into the product. The quantities of sodium chloride, chloride of calcium, and water were not ascertained and the cost of each was not given separately. Included also with "other materials" is the cost of anhydrous sulphurous dioxide and ether, which are used to some extent as refrigerants in place of ammonia in the Pictet machine, so called from its inventor, Professor Pictet, of Geneva, Switzerland. There were 7 establishments using anhydrous sulphurous dioxide, distributed as follows: California, 1; Kentucky, 3; New Jersey, 1; Pennsylvania, 1; Texas, 1. There was only 1 establishment using ether. The total quantity of anhydrous sulphurous dioxide used was 13,870 pounds, costing $2,540, an average of 18.3 cents per pound. The cost of ether was given as $350. A combination of these amounts with the sum expended for ammonia shows that the total amount expended for refrigerants was $362,089, or 10.8 per cent of the total amount expended for materials used in the manufacture of ice.

As stated above, the ammonia used in artificial refrigeration is of two kinds, anhydrous and aqua. In the compressor machines, anhydrous ammonia is used exclusively, but in the absorption machines both aqua and anhydrous ammonia are used. Table 8 shows, by states and territories, the quantity and cost of each variety of ammonia used in 1900, including the anhydrous ammonia used in the compressor system, and the anhydrous and aqua ammonia used in the absorption system, with the average cost of each per pound.

TABLE 8.—QUANTITY AND COST OF AMMONIA USED; QUANTITY, COST, AND AVERAGE COST PER POUND OF ANHYDROUS AMMONIA USED IN THE COMPRESSOR SYSTEM; AND QUANTITY, COST, AND AVERAGE COST PER POUND OF ANHYDROUS AND OF AQUA AMMONIA USED IN THE ABSORPTION SYSTEM; BY STATES AND TERRITORIES; ARRANGED GEOGRAPHICALLY: 1900.

STATES AND TERRITORIES.	AMMONIA USED.									
	Total.		Compressor system.			Absorption system.				
			Anhydrous.			Anhydrous.			Aqua.		
	Pounds.	Cost.	Pounds.	Cost.	Average cost per pound (cents).	Pounds.	Cost.	Average cost per pound (cents).	Pounds.	Cost.	Average cost per pound (cents).
The United States	2,379,989	$359,549	946,666	$249,838	26.4	109,869	$29,842	27.1	1,323,454	$79,869	6.0
New England states	7,113	1,831	7,113	1,831	25.7						
Rhode Island	1,800	460	1,800	460	25.6						
Connecticut	5,313	1,371	5,313	1,371	25.8						
Middle states	400,013	88,108	328,285	81,910	25.0	9,386	2,384	25.4	62,342	3,814	6.1
New York	102,629	23,274	89,129	21,726	24.4	4,000	1,048	26.2	9,500	500	5.3
New Jersey	33,593	6,876	25,693	6,255	24.3	1,000	230	23.0	6,900	391	5.7
Pennsylvania	225,936	48,887	175,608	44,858	25.5	4,386	1,106	25.2	45,942	2,923	6.4
Delaware	6,030	1,580	6,030	1,580	26.2						
Maryland	22,515	5,177	22,515	5,177	23.0						
District of Columbia	9,310	2,314	9,310	2,314	24.9						
Southern states	1,270,026	164,981	333,020	93,562	28.1	66,105	17,893	27.1	870,901	53,476	6.1
West Virginia	74,870	5,573	4,100	975	23.8	3,075	727	23.6	67,695	3,871	5.7
Virginia	88,607	12,928	28,137	8,334	29.6	4,974	1,316	26.5	55,496	3,278	5.9
North Carolina	44,418	6,143	16,338	4,415	27.0	410	115	28.0	27,670	1,613	5.8
South Carolina	58,333	4,439	3,277	857	26.0	336	84	25.0	54,720	3,498	6.4
Georgia	107,925	12,736	26,090	6,773	26.0	3,858	986	25.6	77,977	4,977	6.4
Florida	149,086	13,276	17,831	5,174	29.0	1,905	576	30.2	129,350	7,526	5.8
Kentucky	99,007	12,006	28,527	6,612	23.1	5,980	1,691	28.3	69,500	3,703	5.3
Tennessee	88,573	13,685	28,649	7,478	26.1	12,757	3,438	26.9	47,167	2,769	5.9
Alabama	122,415	12,766	24,989	6,745	27.0				97,426	6,021	6.2
Mississippi	44,115	6,489	10,216	2,541	24.9	8,973	2,330	26.0	24,926	1,618	6.5
Arkansas	20,984	5,910	20,984	5,910	28.2						
Louisiana	191,178	24,424	32,807	9,222	28.1	20,819	5,825	28.0	137,552	9,377	6.8
Indian Territory	1,550	443	1,550	443	28.6						
Oklahoma	10,328	1,883	2,530	733	29.0	2,312	600	26.0	5,486	500	9.1
Texas	168,637	32,280	91,995	27,350	29.7	706	205	29.0	75,936	4,725	6.2
Central states	508,384	69,429	207,754	49,582	23.9	17,335	4,381	25.3	283,295	15,466	5.5
Ohio	141,365	14,756	39,096	9,617	24.6	955	234	24.5	101,314	4,905	4.8
Indiana	144,476	15,809	28,017	7,717	27.5	8,862	2,276	25.7	107,597	5,816	5.4
Illinois	74,829	14,813	49,256	12,324	25.0	5,140	1,350	26.3	20,433	1,139	5.6
Iowa	24,600	1,749	2,100	549	26.1				22,500	1,200	5.3
Missouri	123,114	22,302	89,285	19,375	21.7	2,378	521	21.9	31,451	2,406	7.6
Western states	113,874	17,798	32,915	10,401	31.6	9,043	2,784	30.8	71,916	4,613	6.4
Nebraska	1,035	300	1,035	300	29.0						
Utah	600	210	600	210	35.0						
Colorado	44,264	5,564	5,646	1,714	30.4	5,389	1,693	31.4	33,229	2,157	6.5
Kansas	42,938	5,891	13,019	3,434	26.4	3,354	1,001	29.8	26,565	1,456	5.5
Arizona	10,279	4,133	10,279	4,133	40.2						
New Mexico	14,758	1,700	2,336	610	26.1	300	90	30.0	12,122	1,000	8.2
Pacific states	80,579	17,452	37,579	12,552	33.4	8,000	2,400	30.0	35,000	2,500	7.1
Washington	6,883	2,605	6,883	2,605	37.8						
Oregon	6,043	1,934	6,043	1,934	32.0						
California	67,653	12,913	24,653	8,013	32.5	8,000	2,400	30.0	35,000	2,500	7.1

The total cost of ammonia is given as $359,549 and the total number of pounds as 2,379,989. The cost of the anhydrous ammonia used in the compressor system was $249,838 and the number of pounds 946,666, or 39.8 per cent of the total number of pounds of ammonia reported for both systems. The average cost was 26.4 cents per pound. The cost of anhydrous ammonia used in the absorption system was 27.1 cents per pound. The total cost of the aqua ammonia used was $79,869, an average of 6 cents per pound, and the number of pounds was 1,323,454, or 55.6 per cent of the total. The average price for anhydrous and aqua ammonia was secured from the totals of the whole number of establishments from which reports were received, and therefore does not indicate the price in any one state or section of the country. The cost and also the quantity used vary considerably in different sections of the country. Furthermore, ammonia is sometimes bought delivered, and it was found impracticable to attempt to separate the amount chargeable to freight. The table, however, reflects in a general way the variations in the price of ammonia in different sections of the country. It appears that the average cost of anhydrous ammonia varied from 22 cents to 40 cents per pound, according to the distance from the source of supply, the average cost being lowest in the Middle and Central states and highest in the Pacific states. The average cost of aqua ammonia varied similarly

from 5 to 9 cents per pound. The quantity of ammonia used depends so much upon its strength and density, upon the type of refrigerating machine used and its condition as to leakage, and also upon the care of the engineers, that an establishment may be obliged to use during one year two to three times the quantity required during the previous year. This statement is necessary in order to obviate erroneous deductions from the figures presented in Table 8.

The total value of products, $13,874,513, as given in Table 1, for 1900, as compared with $4,900,983 for 1890, shows an increase of $8,973,530, or 183.1 per cent, during the past decade. The value of the principal product, ice, amounted to $13,303,874, and formed 96 per cent of the total value of product. The value of other products amounted to $570,639, and formed 4 per cent of the total value of products. This item includes amounts received for cold storage and for the manufacture of bottled goods and soda water, but the amount received for each was not separately ascertained.

Practically all of the ice manufactured in the United States is produced by the can system or the plate system. In the can system distilled water is used, since if the water were not distilled the ice would be opaque, and, in most cases, of a brownish color. Distilled water is furnished by condensing exhaust steam from the refrigerating machine or by condensing live steam. In the plate system a clear ice is made without distilling the water.

In the can system ice may be formed either in stationary cells or in removable cans, the latter being the method in more general use at the present time. If stationary cells are used, all the cells in an entire tank must be emptied at the same time, which necessitates the use of more than one tank in order to make the operation continuous. In the other method the water to be frozen is placed in cans, which are in turn immersed in iron or wooden tanks containing cold brine. The cans can be taken out singly, and after the ice is removed can be filled again with water and replaced in the tank. Thus the process is continuous. The ice is removed either by dropping the can into, or sprinkling it with tepid water. The time required for the formation of the ice varies from twenty to sixty-six hours, according to the thickness of the mold containing the water to be frozen and the temperature of the brine.

The following table indicates the weight of blocks, size of can, and the time required for freezing:

STANDARD ICE CANS OR MOLDS.[1]

WEIGHT OF BLOCKS.	Size of can.	Time of freezing (with 18° brine).
Pounds.	Inches.	Hours.
50	6 x 12 x 26	20
100	8 x 16 x 32	36
150	8 x 16 x 42	36
200	11 x 22 x 32	60
300	11 x 22 x 44	60
400	11 x 22 x 57	60

[1] Mechanical Refrigeration and Ice Making, the De La Vergne Refrigerating Machine Company.

In the plate system a hollow iron plate is immersed in a tank containing the water to be frozen, and as the plate contains coils for the freezing medium or is filled with brine, the ice is formed on the two outer surfaces. It may be loosened in several ways, according to the system of refrigeration used. The production of ice by the plate system is much slower than by the can system, and for this reason the use of several plates is necessary for a continuous process. The ice cake may be of several sizes, the standard being 16 feet long, 8 feet wide, and 11 inches thick. This system is used chiefly in connection with electric power where the conditions are such that the cost compares favorably with the cost of steam power.

Table 9 shows, by states and territories, the quantity and value of can ice and of plate ice in 1900, with the average value per ton of each, and the per cent which the production of each variety in each state was of the total production of that variety in the United States. Table 9 also includes the returns for one establishment engaged in the manufacture of spray ice—that is, the water is sprayed on pipes and frozen in that manner. The product of this establishment is included in the totals for can ice.

TABLE 9.—QUANTITY AND VALUE OF ICE MANUFACTURED; THE NUMBER OF TONS OF CAN AND OF PLATE ICE THE AVERAGE VALUE OF EACH PER TON; AND THE PER CENT WHICH EACH FORMS OF THE TOTAL; BY STATES AND TERRITORIES; ARRANGED GEOGRAPHICALLY: 1900.

STATES AND TERRITORIES.	TOTAL.		CAN.				PLATE.			
	Tons.	Value.	Tons.		Value.	Average value per ton.	Tons.		Value.	Average value per ton.
			Number.	Per cent of total.			Number.	Per cent of total.		
United States	4,294,439	$13,303,874	4,139,764	96.4	$12,863,160	$3.11	154,675	3.6	$440,714	$2.85
New England states	40,059	131,376	31,650	79.0	99,804	3.15	8,409	21.0	31,572	3.75
Rhode Island	14,109	36,072	10,000	70.9	26,000	2.60	4,109	29.1	10,072	2.45
Connecticut	25,950	95,304	21,650	83.4	73,804	3.41	4,300	16.6	21,500	5.00
Middle states	1,574,980	3,983,498	1,480,988	94.0	3,787,962	2.52	93,992	6.0	245,536	2.61
New York	457,779	1,025,308	456,279	99.7	1,015,308	2.23	1,500	0.3	10,000	6.66
New Jersey	169,755	379,776	154,615	91.1	341,176	2.21	15,140	8.9	38,600	2.55
Pennsylvania	735,018	2,000,931	684,144	93.1	1,866,770	2.73	50,874	6.9	134,161	2.64
Delaware	26,738	71,240	24,700	92.4	61,050	2.47	2,038	7.6	10,190	5.00
Maryland	120,740	358,668	116,800	96.7	348,083	2.98	3,940	3.3	10,585	2.69
District of Columbia	64,950	147,575	44,450	68.4	105,575	2.38	20,500	31.6	42,000	2.05
Southern states	1,414,158	5,291,523	1,389,601	98.3	5,225,913	3.76	24,557	1.7	65,610	2.67
West Virginia	35,734	119,201	35,734	100.0	119,201	3.34				
Virginia	118,240	417,052	96,458	81.6	362,542	3.76	21,782	18.4	54,510	2.50
North Carolina	61,338	228,305	61,338	100.0	228,305	3.72				
South Carolina	45,228	116,357	44,853	99.2	114,857	2.56	375	0.8	1,500	4.00
Georgia	131,236	455,699	131,236	100.0	455,699	3.47				
Florida	125,184	437,382	125,184	100.0	437,382	3.49				
Kentucky	137,472	375,897	137,472	100.0	375,897	2.73				
Tennessee	158,981	538,107	158,981	100.0	538,107	3.38				
Alabama	55,908	252,675	55,908	100.0	252,675	4.52				
Mississippi	57,207	268,175	57,207	100.0	268,175	4.69				
Arkansas	51,236	225,029	51,236	100.0	225,029	4.39				
Louisiana	179,716	563,561	179,716	100.0	563,561	3.14				
Indian Territory	3,060	19,440	3,060	100.0	19,440	6.35				
Oklahoma	22,218	106,003	22,218	100.0	106,003	4.77				
Texas	231,450	1,168,040	229,050	99.0	1,159,040	5.06	2,400	1.0	9,000	4.00
Central states	986,043	2,640,850	968,326	98.2	2,604,354	2.69	17,717	1.8	36,496	2.06
Ohio	237,750	577,038	220,833	92.9	548,542	2.48	16,917	7.1	28,496	1.68
Indiana	199,184	514,531	199,184	100.0	514,531	2.58				
Illinois	249,813	877,178	249,013	99.7	869,178	3.49	800	0.3	8,000	10.00
Iowa	13,500	36,600	13,500	100.0	36,600	2.71				
Missouri	285,796	635,503	285,796	100.0	635,503	2.22				
Western states	154,055	642,379	154,055	100.0	642,379	4.17				
Nebraska	5,400	15,000	5,400	100.0	15,000	2.78				
Utah	9,000	31,500	9,000	100.0	31,500	3.50				
Colorado	51,545	204,029	51,545	100.0	204,029	3.96				
Kansas	62,486	193,310	62,486	100.0	193,310	3.09				
Arizona	14,709	120,765	14,709	100.0	120,765	8.21				
New Mexico	10,915	77,775	10,915	100.0	77,775	7.13				
Pacific states	125,144	614,248	115,144	92.0	552,748	4.80	10,000	8.0	61,500	6.15
Washington	17,300	103,600	17,300	100.0	103,600	5.99				
Oregon	17,165	95,260	17,165	100.0	95,260	5.55				
California	90,679	415,388	80,679	89.0	353,888	4.39	10,000	11.0	61,500	6.15

The total quantity of ice manufactured in the United States, as returned by the 787 establishments reporting, was 4,294,439 tons, valued at $13,303,874. In addition to this quantity, returns were received from 8 establishments which were engaged primarily in other industries, but which reported the manufacture of ice for sale. These establishments manufactured during the census year 59,206 tons of can ice, valued at $108,259. If these amounts are added to those given in Table 9, the total quantity of ice reported as manufactured for sale in 1900 is shown to be 4,353,645 tons, valued at $13,412,133. This does not represent the total quantity manufactured during the census year, as it is probable that many establishments engaged in the manufacture of ice for sale in connection with other industries failed to state that fact, and reported the value of ice under "all other products." Moreover, as stated above, this total does not include the number of tons produced by companies engaged in other industries but manufacturing ice for their own consumption. Notwithstanding these facts, the number of tons reported may be accepted as fairly representing the quantity of ice manufactured for sale during this period. Of the quantity given in Table 9, 4,139,764 tons, or 96.4 per cent of the total, valued at $12,863,160, was can ice, and 154,675 tons, or 3.6 per cent, valued at $440,714, was plate ice. The average value of can ice was $3.10 per ton and of plate ice $2.85 per ton. In this connection, however, it should be stated that local conditions, cost of production, and the supply of natural ice cause the value of manufactured ice to vary between very wide limits. The average value per ton, as given in

the above table, represents the value at the plant and is computed from the totals of the whole number of establishments from which reports were received. It can not therefore be regarded as the value in any particular section of the country.

It appears from Table 9 that the largest quantity of ice was manufactured in the Middle states, which reported 1,574,980 tons, valued at $3,983,498. The group producing the smallest quantity of ice was the New England states, with 40,059 tons, valued at $131,376. The Southern states, although having nearly one-half of the total number of establishments in the United States, reported a production of only 1,414,158 tons, valued at $5,291,523, or 32.9 per cent of the total quantity produced. This indicates that the plants in the South were, as a rule, smaller than those in other sections of the United States.

The leading state in the manufacture of ice in 1900 was Pennsylvania, with a production of 735,018 tons. New York came next, with 457,779 tons. Missouri ranked third, with 285,796 tons; Illinois fourth, with 249,813 tons; Ohio fifth, with 237,750 tons; Texas sixth, with 231,450 tons; Indiana seventh, with 199,184 tons; Louisiana eighth, with 179,716 tons; New Jersey ninth, with 169,755 tons; and Tennessee tenth, with 158,931 tons. The total quantity of ice produced by these 10 states was 2,905,192 tons, or 67.7 per cent of the total number of tons reported for the United States. The number of tons produced in each of these states is shown in the following diagram:

COMPARATIVE PRODUCTION OF MANUFACTURED ICE IN LEADING TEN STATES: 1900.

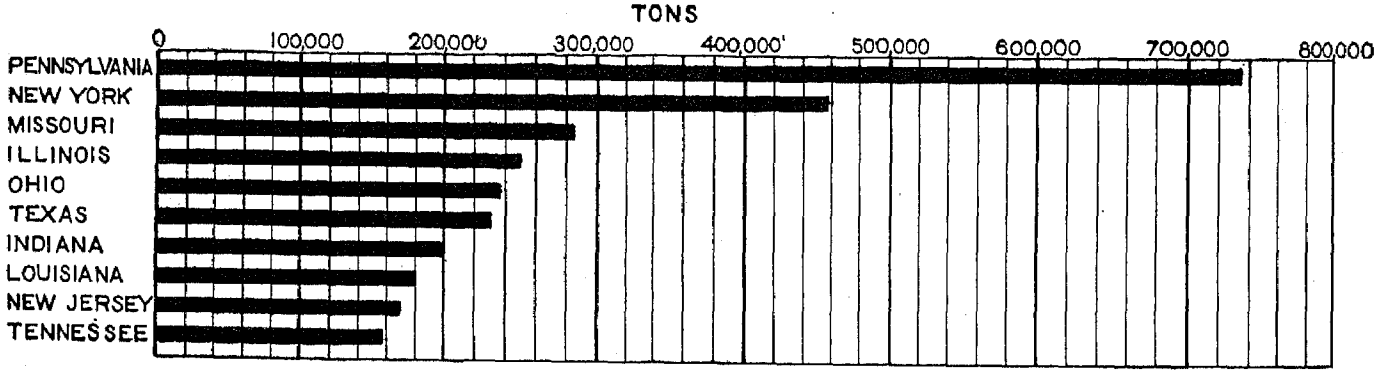


Table 10 presents the statistics of the cities in the United States having a population of over 20,000 in which there were three or more ice-manufacturing establishments in 1900. Estimates of the consumption of natural ice in several of these cities were secured for comparative purposes, but it was found impossible to obtain such information in all cases. In this connection attention is called to the fact that where two or more plants located in the same city or town were controlled by the same corporation, firm, or individual, they were counted as one establishment.

TABLE 10.—STATISTICS OF CITIES OF OVER 20,000 IN POPULATION: 1900.

CITIES.	Rank by number of tons.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	PRODUCTS.			
				Number.	Salaries.	Average number.	Wages.			Total value.	Ice.		All other products, value.
											Tons.	Value.	
Total	.....	281	$25,267,441	910	$801,880	4,055	$2,170,122	$1,279,324	$2,082,224	$8,738,947	3,046,323	$8,334,414	$404,533
New York, N. Y	1	26	2,042,582	45	37,882	256	162,602	160,863	230,507	900,303	410,837	868,239	32,064
Brooklyn borough	.....	10	659,379	18	16,780	82	55,350	38,380	82,057	279,626	135,420	273,626	6,000
Manhattan and Bronx boroughs	.....	8	1,062,767	12	13,020	121	76,317	102,755	116,903	493,510	230,213	467,446	26,064
Richmond and Queens boroughs	.....	8	320,436	15	8,032	53	30,935	19,728	31,547	127,167	45,204	127,167	.....
Philadelphia, Pa	2	20	3,158,914	117	71,435	345	191,465	118,795	204,085	894,592	342,602	894,592	.....
St. Louis, Mo	3	10	1,034,768	28	33,508	129	78,358	47,966	112,419	305,718	180,413	305,718	.....
New Orleans, La	4	10	1,538,280	28	38,180	135	48,610	52,438	116,396	308,683	139,654	308,683	.....
Baltimore, Md	5	5	342,238	4	4,860	63	44,191	12,205	52,499	287,632	86,557	237,632	.....
Memphis, Tenn	6	4	544,572	25	30,770	192	102,881	35,475	45,362	260,000	79,000	260,000	.....
Kansas City, Mo	7	5	207,101	13	12,482	42	29,960	7,217	57,733	138,428	66,350	137,120	1,308
Washington, D. C	8	4	629,992	16	14,310	83	40,603	36,979	61,267	182,575	64,950	147,575	35,000
Newark, N. J	9	4	865,675	10	14,386	62	29,010	19,756	31,275	112,414	61,232	107,598	4,816
Louisville, Ky	10	7	371,821	12	10,140	50	27,372	21,590	35,096	132,395	55,451	118,795	13,600
Norfolk, Va	11	5	489,387	9	7,600	49	25,827	13,530	39,241	115,683	48,975	109,761	5,922
Cleveland, Ohio	12	4	193,654	12	11,020	26	19,203	13,630	30,500	95,100	48,800	95,100	.....
Cincinnati, Ohio	13	5	147,524	8	7,975	37	19,003	11,134	26,133	81,283	40,324	81,283	.....
Nashville, Tenn	14	4	195,284	14	10,616	79	32,690	11,138	27,809	112,277	35,991	112,277	.....
Dallas, Tex	15	3	371,000	52	26,400	68	27,700	14,511	47,275	149,800	32,000	149,800	.....
Indianapolis, Ind	16	7	235,425	11	7,012	67	30,912	12,824	28,387	108,770	31,610	106,775	1,995
San Francisco, Cal	17	3	510,141	30	28,140	50	40,009	21,463	43,753	134,411	31,214	134,411	.....
Atlanta, Ga	18	4	227,238	8	10,100	32	14,946	13,903	30,203	104,913	28,879	104,913	.....
Augusta, Ga	19	3	131,000	8	8,340	37	6,900	9,000	17,800	58,000	24,000	58,000	.....
Camden, N. J	20	3	321,847	3	2,384	17	9,244	7,823	15,499	53,318	23,281	53,318	.....
Evansville, Ind	21	3	291,600	9	7,506	58	26,691	12,678	13,332	76,392	22,719	76,392	.....
Allegheny, Pa	22	4	546,500	8	10,200	70	43,773	13,837	15,380	111,212	21,880	82,400	28,812
Jacksonville, Fla	23	5	159,600	7	6,720	56	27,000	3,720	26,903	87,647	21,609	86,647	1,000
Fort Worth, Tex	24	3	155,500	7	11,400	49	29,800	9,387	20,050	81,000	20,786	81,000	.....
Richmond, Va	25	3	222,500	8	7,680	15	10,800	5,790	14,133	64,932	19,178	59,932	5,000
Little Rock, Ark	26	3	215,713	5	5,400	65	19,400	19,575	12,713	73,234	15,700	73,234	.....
Topeka, Kans	27	3	75,400	6	3,000	16	8,420	3,320	11,000	38,800	14,100	38,800	.....
Portland, Oreg	28	4	106,000	9	13,980	22	15,640	11,685	13,200	91,400	12,600	71,400	20,000
Montgomery, Ala	29	3	40,700	2	1,200	8	3,945	1,190	2,020	20,325	3,935	20,325	.....
All other cities[1]	.....	114	10,395,595	396	347,254	1,877	1,003,167	555,902	700,256	3,607,710	1,071,746	3,352,694	255,016

[1] Includes establishments distributed as follows: Akron, Ohio, 1; Allentown, Pa., 1; Altoona, Pa., 2; Anderson, Ind., 1; Aurora, Ill., 1; Austin, Tex., 2; Birmingham, Ala., 2; Bloomington, Ill., 1; Bridgeport, Conn., 1; Buffalo, N. Y., 2; Canton, Ohio, 1; Charleston, S. C., 2; Chattanooga, Tenn., 2; Chester, Pa., 1; Chicago, Ill., 2; Columbia, S. C., 1; Columbus, Ohio, 2; Covington, Ky., 1; Davenport, Iowa, 1; Dayton, Ohio, 1; Decatur, Ill., 1; Denver, Colo., 2; Des Moines, Iowa, 1; Easton, Pa., 1; East St. Louis, Ill., 1; Elizabeth, N. J., 1; Elmira, N. Y., 1; Erie, Pa., 1; Fort Wayne, Ind., 1; Galveston, Tex., 2; Harrisburg, Pa., 1; Houston, Tex., 1; Johnstown, Pa., 1; Joliet, Ill., 1; Knoxville, Tenn., 2; Lancaster, Pa., 1; Leavenworth, Kans., 1; Lexington, Ky., 2; Lincoln, Nebr., 1; Los Angeles, Cal., 2; McKeesport, Pa., 1; Macon, Ga., 1; Mobile, Ala., 2; Muncie, Ind., 1; New Albany, Ind., 2; New Britain, Conn., 1; Newburg, N. Y., 1; Newcastle, Pa., 1; New Haven, Conn., 1; Newport, Ky., 1; Norristown, Pa., 2; Paterson, N. J., 1; Peoria, Ill., 1; Petersburg, Va., 2; Pittsburg, Pa., 2; Pueblo, Colo., 1; Quincy, Ill., 1; Reading, Pa., 2; Roanoke, Va., 2; St. Joseph, Mo., 1; Salt Lake City, Utah, 1; San Antonio, Tex., 2; Savannah, Ga., 2; Scranton, Pa., 1; Seattle, Wash., 2; Shenandoah, Pa., 1; Sioux City, Iowa, 1; Springfield, Ill., 1; Springfield, Mo., 1; Springfield, Ohio, 1; South Bend, Ind., 1; Tacoma, Wash., 1; Terre Haute, Ind., 1; Trenton, N. J., 1; Waco, Tex., 2; Wheeling, W. Va., 2; Wichita, Kans., 2; Wilkesbarre, Pa., 1; Williamsport, Pa., 1; Wilmington, Del., 2; Wilmington, N. C., 2; Yonkers, N. Y., 1; York, Pa., 2; Youngstown, Ohio, 1; Zanesville, Ohio, 1.

Table 10 indicates that New York city led in the manufacture of ice, having reported 26 establishments and 410,837 tons of ice valued at $868,239, an average of 15,801 tons per establishment, and an average value of $2.11 per ton.

Efforts were made to get estimates of the consumption of natural ice in each of the cities included in Table 10. In all cases except New York and Philadelphia the results were, however, too unreliable to be included in this report. In New York it was estimated that the annual consumption of ice is about 5,000,000 tons.[1] If these figures are approximately correct, the manufactured ice consumed during the census year formed 8.2 per cent of the total consumption. Correspondence with several of the leading ice manufacturers indicates that the average cost of production of manufactured ice was approximately $1.50 per ton and the average wholesale price $2 per ton, and that the average retail price varied from 15 to 30 cents per 100 pounds, according to the season of the year. In Philadelphia the annual consumption of ice was estimated at from 1,000,000 to 1,600,000 tons,[2] 342,602 tons of which was represented by the local production of manufactured ice. The average cost of production was approximately $2 per ton, the average wholesale price $2.25 per ton, and the average retail price ranged from 20 to 40 cents per 100 pounds, according to the season of the year. In San Francisco from 10,000 to 15,000 tons of natural ice were used, brought from the Sierra Nevada Mountains, but, owing to climatic conditions, the consumption of ice in this city is much smaller than in Eastern cities of the same size. No statistics are available for the remaining cities relative to the consumption of natural ice or to the average cost of production per ton of manufactured ice. In New Orleans, Memphis, Norfolk, Nashville, Dallas, Atlanta, Augusta, Jacksonville, Fort Worth,

[1] Ice and Refrigeration, December, 1901, p. 243.

[2] Ice and Refrigeration, December, 1901, p. 243.

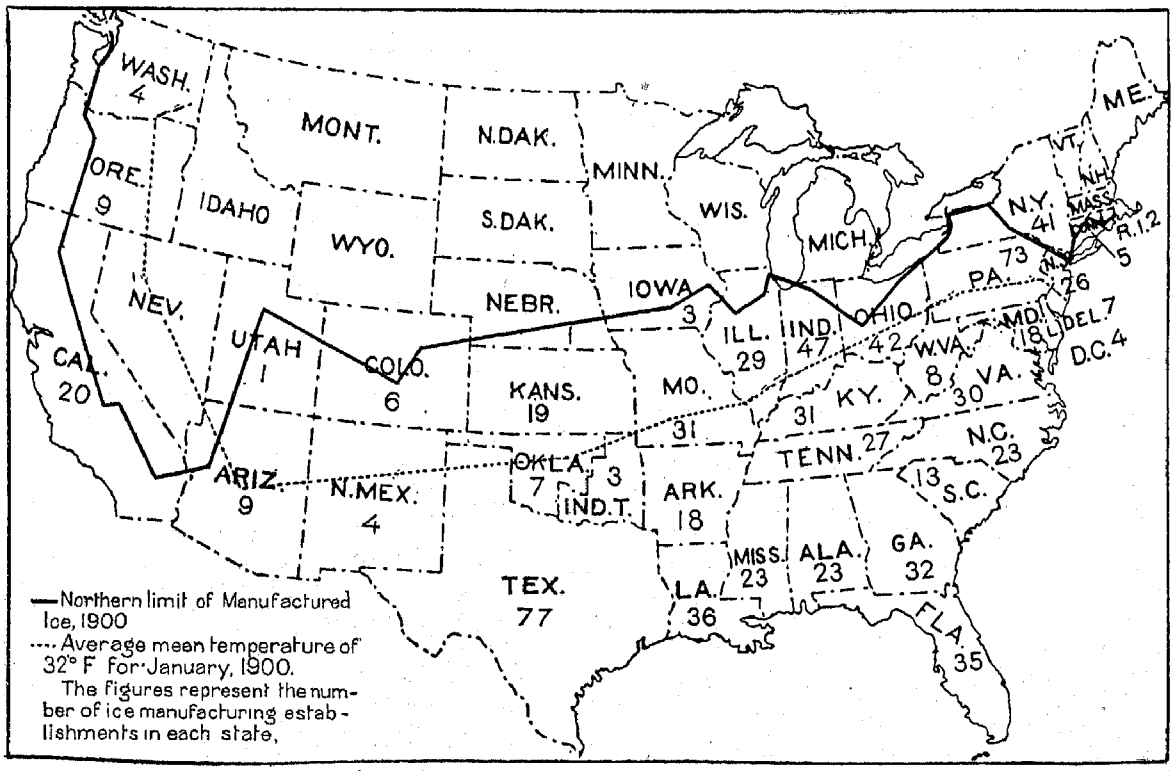
Little Rock, Montgomery, Austin, Birmingham, Charleston, Chattanooga, Columbia, Galveston, Houston, Knoxville, Macon, Mobile, San Antonio, Savannah, Waco, and Wilmington, N. C., manufacturers reported that no natural ice was sold during the census year, the entire quantity consumed being manufactured.

The development of the ice manufacture has naturally had a very close relation to the possibility of procuring natural ice, and there has always been considerable competition between the two products. This is illustrated by the development of the industry in the South. The situation in 1880 is described in the report on the Tenth Census as follows: "For fifteen years efforts have been made to reduce the cost of ice in the South and render her, in a measure, independent of outside sources of supply. Tennessee and Georgia have imported extensively from the Ohio River region by rail. The lower Mississippi has bought in the St. Louis region and Texas has imported by rail. Enterprise has, however, been chiefly in the direction of the manufacture of artificial ice. * * * The cost of production has been reduced to about $5 per ton in most places, which is a trifle below the rate at which ice can be delivered in Tennessee and Georgia by rail from the Ohio River, and considerably below the cost of the article from Maine, delivered in inland Southern towns. With this advantage in its favor, the business of manufacture is steadily growing at all points at a distance from the seacoast. The prospect is fair that they will soon be independent of outside sources of supply, although it will be many years before the cost to small consumers will fall anywhere nearly as low as in the North. On the seacoast Northern ice still has the preference. It can be landed more cheaply than the local article can be made, and by purchasing in Maine or Massachusetts the dealers avoid the heavy risks of experimenting with expensive plants and imperfect methods of manufacture. The solitary exception is the city of New Orleans, which, though still buying Northern ice, is nevertheless manufacturing on an extensive scale."

The above statement is interesting in connection with the status of the manufactured-ice industry in Southern cities at the present time. Correspondence with men prominently identified with the ice industry in the South developed the fact that during the year 1900, with the possible exception of a few coast cities, the South depended entirely for her ice supply upon the manufactured product. In the large Southern cities it was stated that the cost of production was approximately $2 per ton. In the smaller cities and towns, although the cost is in excess of that figure, it is so much reduced that they are now independent of outside sources of supply.

The United States may therefore be divided into three divisions or zones: A southern zone, where the expense of procuring natural ice gave manufactured ice a complete monopoly; a middle zone, where both natural and manufactured ice were sold in competition with each other; and a northern zone, where the low cost of natural ice made its monopoly complete. The southern zone comprises roughly all states south of a line drawn through the northern boundary of North Carolina. The boundary line between the middle and northern zones is indicated by the heavy line upon the accompanying map of the United States.

NORTHERN LIMIT OF MANUFACTURED ICE, 1900.



The most marked change in the industry in recent years has been the exclusion of natural ice from the southern zone and the steadily northward extension of the competitive zone. It is altogether probable that this movement will continue as the cost of production is further reduced. It is stated that under exceptional circumstances ice has been manufactured at as low a cost as 50 or 60 cents per ton. It is probable that at such a cost manufactured ice could compete successfully with the natural product in any part of the country in which there is a demand for ice. The larger plants located in the large cities, during the summer months, when running at full capacity and under favorable conditions, can manufacture ice at from 70 to 90 cents per ton. The average cost for the year, however, will vary from $1.10 to $1.50 per ton. The relation of the present northern limit of ice manufacture to the possibility of obtaining natural ice is shown on the map by the broken line connecting the cities which reported an average temperature of 32° for the month of January, 1900.

HISTORICAL AND DESCRIPTIVE.

The production of cold by artificial means commenced at a much earlier date than is generally supposed. In the warmer climates, especially in the Eastern countries—India, China, and Egypt—where ice and snow were not available, caves, either natural or artificial, were made use of to deposit food and drinks. It was early discovered that porous receptacles would keep the contents cooler than nonporous. In Egypt and East India the vessels containing the water to be frozen were covered with stalks of corn or sugar cane, which was a crude method of artificial refrigeration. A member of the Royal Philosophical Society of England, for some time a resident of the Indies, has described this method of ice making employed in the East, as follows:

> A space of ground of about 4 acres, nearly level, is divided into square plats from 4 to 5 feet wide. The borders are raised by earth taken from the surface of the flat, to about 4 inches; the cavities are filled up with dry straw or sugar-cane haum, laid smooth, on which are placed as many broad shallow pans of unglazed earth as the spaces will hold. These pans are so extremely porous that their outsides become moist the instant water is put into them. They are smeared with butter on the inside to prevent the ice from adhering to them, and this it is necessary to repeat every three or four days. It would otherwise be impossible to remove the ice without either breaking the vessel or spending more time in effecting it than could be afforded where so much is to be done in so short a time. In the afternoon these pans are all filled with water by persons who walk along the borders or ridges. About 5 o'clock in the morning they begin to remove the ice from the pans, which is done by striking an iron hook into the center of it, and by that means breaking it into several pieces. If the pans have been many days without smearing, and it happens that the whole of the water is frozen, it is almost impossible to extract the ice without breaking the pans. The number of pans exposed at one time is computed at about 100,000, and there are employed in filling them with water in the evenings and taking out the ice in the mornings about 300 men, women, and children. The water is taken from a well contiguous to the spot. It is necessary that the straw be dry. When it becomes wet, as it frequently does by accident, it is removed and displaced.[1]

References are found in the works of many ancient Greek authors indicating that some of the principles of artificial refrigeration were understood by the Greeks and practiced by them in cooling wine, water, and various other drinks. It also appears that they understood the present East Indian custom of using porous vessels. The Egyptians were accustomed to allow jars of boiling water to remain on the house roofs over night, and in the morning the jars were moistened with water on the outside, bound with grass or plants, and put in trenches. The discovery of the principle that warm or hot water exposed to the air is susceptible of greater evaporation than cold water, is generally ascribed to Nero, although it appears that Aristotle understood this principle, since he relates that if it was desired to cool water suddenly, it was customary to expose it first to the sun's rays. Medieval history indicates that the custom of cooling drinks spread from Greece and Italy to France and western Europe about the end of the Sixteenth century. At this time it was the custom to preserve snow and ice in cellars, to be used in cooling drinks during the summer months. This custom was at first looked upon as effeminate and luxurious, but by the end of the Seventeenth century the practice must have been common in France, as there were many who made a business of dealing in snow and ice. It is stated that saltpeter for refrigerating purposes was first used by the Italians about 1550. The liquor or liquid to be cooled was put into a little-necked bottle, which was immersed in a receptacle filled with cold water. Saltpeter was then added to the water of the outer vessel, and the bottle containing the water or wine to be cooled was twirled around on its axis. It was considered that the proportion of saltpeter to water should be one to four or five. The practice of mixing snow or ice with saltpeter or other salts to produce cold seems to have been well known early in the Seventeenth century, being referred to by several contemporary writers of that period. It is mentioned by Bacon, who stated that common salt could be used instead of saltpeter.

The development of ice manufacture has always had a very close relation to the possibility of procuring natural ice, and there has, therefore, been considerable competition between the two products. For this reason it is important to notice in this connection the development of the natural-ice industry. Notwithstanding the fact that the custom of icing wines and drinks prevailed among the wealthier Greeks and Romans in ancient times and among Italians and Frenchmen in the Seventeenth century, natural ice as an article of commerce did not obtain importance until the beginning of the Nineteenth century. From the inception of the industry the United States has been the great field for

[1] Ice and Refrigeration, July, 1901, page 3.

both the production and consumption of ice, and the commodity which in the Eighteenth century was rated a luxury has now become almost a necessity. The year 1805 may be looked upon as marking the beginning of the industry in the United States. The pioneer was Frederic Tudor, of Boston, Mass., who in 1805 shipped a cargo of 130 tons of ice to the West Indies. Although the venture resulted in a net loss of about $4,500, the cargo arrived at its destination in excellent condition. Two years later Mr. Tudor shipped a cargo of 240 tons to Havana, but this venture was likewise unprofitable. About the year 1812 he was granted by Great Britain a monopoly of the ice trade with her colonies in the West Indies, and later, 1815–16, he received the same concessions from Spain. From 1817 to 1820 he extended the trade to Charleston, S. C., Savannah, Ga., and New Orleans, La. In this way a large and profitable trade was established with the southern countries and with the southern ports of the United States. The ultimate success of Mr. Tudor prompted competitors to enter the field as exporters. The growth in the exports of ice between 1850 and 1900, shown in the following table, is taken from the reports of the bureau of statistics, Treasury Department:

EXPORTATION OF ICE.

YEAR.	Tons.	Value.
1850	.....	$107,018
1855	41,117	190,793
1860	49,153	183,184
1865	59,927	225,825
1870	65,802	267,702
1875	53,724	208,249
1880	45,666	136,686
1885	38,901	89,420
1890	44,849	111,762
1895	17,295	41,915
1900	13,720	29,501

It appears that the export trade in ice increased steadily until about 1870. After this date the exports of ice steadily decreased until in the year 1900 the number of tons exported was so insignificant that the foreign trade in ice may now be considered as practically extinct.

The growth of the domestic trade was simultaneous with the early increase in the export trade. In New York city ice was used by dealers in perishable goods as early as 1825, and the demand for it gradually developed in all the larger Eastern cities. The Civil War gave a decided impetus to the industry, as large quantities of ice were required for medical purposes in the hospital service. The rapidly increasing demand for ice in recent years is due in large part to the establishment and growth of industries which are dependent upon the use of this product. It has been impossible to obtain data relative to the production of the entire country, but some indication of the growth and extent of the industry may be obtained from the following table, which gives the quantity of ice harvested in the state of Maine and on the Hudson River since 1878. Although these are the great harvesting regions of the country, their annual yield probably does not represent much more than half the ice harvest of the United States.

HARVEST OF MAINE AND HUDSON RIVER ICE SINCE 1878.[1]

YEAR.	Maine.	Hudson River.	Capacity of Hudson River ice houses.
	Tons.	*Tons.*	*Tons.*
1878	.....	2,225,000	2,300,000
1879	.....	2,371,000	2,400,000
1880	1,426,800	800,000	2,500,000
1881	994,800	2,558,000	2,650,000
1882	1,227,200	1,954,700	2,728,700
1883	1,364,500	3,017,500	3,100,000
1884	1,118,000	3,026,000	3,100,000
1885	1,490,400	3,019,500	3,200,000
1886	1,368,400	2,355,500	3,259,000
1887	1,311,100	3,226,000	3,367,000
1888	1,037,000	3,330,500	3,330,500
1889	1,529,600	2,742,000	3,432,000
1890	3,092,400	.....	3,432,000
1891	1,285,000	2,624,000	3,425,000
1892	1,435,900	2,500,000	3,525,000
1893	1,444,000	3,407,839	3,454,400
1894	1,600,800	2,638,500	3,459,500
1895	1,413,500	3,409,000	3,528,500
1896	1,466,000	2,735,500	3,460,400
1897	1,526,500	2,875,033	3,716,381
1898	1,242,500	2,172,400	4,133,434
1899	1,326,430	4,300,293	4,816,331
1900	723,780	1,430,670	4,215,970

[1] Ice Trade Journal.

Some time before the natural-ice industry became a factor of commercial importance attempts had been made to produce ice by abstracting the latent heat from water by artificial means. The first machine for the manufacture of ice was invented in 1755 by Dr. William Cullen, and was based on the principle that the creation of a vacuum increases the evaporation of water and by this means produces ice. Cullen reduced the atmospheric pressure by means of an air pump. About 1810 the chemical affinity of sulphuric acid for water was discovered and ice was produced by its use. The invention of the first machine capable of producing ice in quantities sufficient for commercial use is generally accredited to Mr. Jacob Perkins, an American engineer residing in London. He obtained a patent for his machine in 1834. The refrigerant was ether, and the evaporator containing the same was inclosed in pipes through which brine circulated at a temperature of 5° F. Boxes filled with water were placed in a receptable into which flowed the brine, freezing the water. The brine was then pumped back, and, after being exposed to the ether, could again be used. This machine is generally considered the forerunner of the modern compressor machine.[1] The use of the boxes developed into the use of cans and the manufacture of can ice. In order to describe adequately the development of the modern compressor and absorption machines it is necessary to mention several of the men prominently identified with the invention or improvement of ice-making apparatus.

[1] Ice and Refrigeration, August, 1901, page 46.

Prof. A. C. Twining, of New Haven, Conn., took out a patent for an ice machine in England in 1850 and in the United States in 1853. In 1855 he operated a machine in Cleveland, Ohio, which produced over 1,600 pounds of ice in twenty-four hours, and was operated intermittently until 1857. Although the Perkins machine was the forerunner of the compressor machine of the present time, the Twining machine more nearly represents the complete compressor system of to-day, and for this reason Professor Twining deserves the credit both for the invention of this system and for putting it into practical operation.[1] Professor Twining also discovered that ice frozen at a temperature slightly below the freezing point would be transparent with the exception of the small porous core, while if frozen at a lower temperature it would be opaque and porous throughout. A patent for the manufacture of ice by mechanical means was issued in 1857 to Dr. John Gorrie, of Appalachicola, Fla. The apparatus used by Dr. Gorrie is important in that it was the forerunner of the compressed-air machine later invented by Dr. Alexander Kirk. In 1858–1860 Ferdinand P. E. Carre, a Frenchman, introduced an ice-making and refrigerating apparatus from which has developed the modern ammonia absorption system. It was by means of this machine that the trade in frozen meat was introduced to the world. The Carre machine was also the first to obtain prominence in the ice-making industry of the United States. In the infancy of the industry the ice was opaque, and it was not until about 1868 that transparent ice was made by the use of distilled water. Capt. David Smith, of Chatham, Mass., was the originator of the plate-ice system. He erected in Oakland, Cal., the first machine of this character.

From the inception of the United States Patent Office to January 1, 1902, there have been 4,337 patents granted for various processes of refrigeration. Of this number, 681 have been issued for the manufacture of ice machines. These various inventions prepared the way for the development of the manufactured-ice industry, which has already been described in the pages of the bulletin.

Table 11, which follows, shows in detail the statistics relating to the manufacture of ice, as reported by the 787 establishments engaged in this industry for 1900.

[1] Mechanical Refrigeration, De La Vergne Refrigerating Machine Company, 1887, page 9.

TABLE 11.—ICE MANUFACTURE, BY

		United States.	Alabama.	Arizona.	Arkansas.	California.
1	Number of establishments	787	23	9	18	20
	Character of organization:					
2	Individual	180	4	1	4	2
3	Firm and limited partnership	134	5	4	3	3
4	Incorporated company	469	14	4	11	15
5	Miscellaneous	4	----	----	----	----
6	Established during the decade	544	14	7	14	15
7	Established during the census year	89	2	----	2	2
	Capital:					
8	Total	$38,204,054	$631,667	$228,670	$637,639	$1,305,971
9	Land	$4,679,379	$62,800	$16,050	$59,350	$236,100
10	Buildings	$7,387,014	$79,900	$49,916	$80,365	$166,553
11	Machinery, tools, and implements	$22,852,158	$439,600	$136,000	$415,006	$806,135
12	Cash and sundries	$3,285,503	$49,367	$26,704	$82,918	$97,183
13	Proprietors and firm members	459	13	11	11	7
	Salaried officials, clerks, etc.:					
14	Total number	1,545	43	12	26	64
15	Total salaries	$1,234,803	$35,680	$10,370	$24,330	$62,661
	Officers of corporations:					
16	Number	446	16	2	11	12
17	Salaries	$465,104	$18,280	$3,710	$11,400	$17,566
	General superintendents, managers, clerks, and salesmen:					
18	Total number	1,099	27	10	15	52
19	Total salaries	$769,699	$17,400	$6,660	$12,930	$45,095
	Men:					
20	Number	1,024	26	10	15	50
21	Salaries	$740,292	$17,300	$6,660	$12,930	$44,095
	Women:					
22	Number	75	1	----	----	2
23	Salaries	$29,407	$100	----	----	$1,000
	Wage-earners, including pieceworkers, and total wages:					
24	Greatest number employed at any one time during the year	10,814	249	66	244	265
25	Least number employed at any one time during the year	4,893	155	25	105	131
26	Average number	6,938	168	44	163	190
27	Wages	$3,424,305	$56,251	$30,608	$61,064	$132,023
	Men, 16 years and over:					
28	Average number	6,889	168	44	162	188
29	Wages	$3,416,844	$56,251	$30,608	$60,944	$131,543
	Women, 16 years and over:					
30	Average number	8	----	----	----	2
31	Wages	$3,592	----	----	----	$480
	Children, under 16 years:					
32	Average number	36	----	----	1	----
33	Wages	$3,869	----	----	$120	----
	Average number of wage-earners, including pieceworkers, employed during each month;[2]					
	Men, 16 years and over:					
34	January	3,885	112	19	87	181
35	February	4,058	118	21	96	164
36	March	4,676	120	25	125	162
37	April	6,477	170	41	158	192
38	May	8,570	225	62	196	208
39	June	9,488	218	63	226	187
40	July	9,808	220	64	226	220
41	August	9,794	222	66	229	219
42	September	9,286	218	63	212	193
43	October	7,300	163	53	165	191
44	November	5,124	122	31	122	167
45	December	4,263	107	22	101	175
	Miscellaneous expenses:					
46	Total	$1,779,890	$31,777	$10,408	$30,762	$39,759
47	Rent of works	$116,026	$3,799	$244	$696	$6,160
48	Taxes, not including internal revenue	$246,340	$4,289	$2,470	$4,288	$6,256
49	Rent of offices, interest, insurance, and all sundry expenses not hitherto included	$1,394,180	$23,689	$6,599	$25,478	$27,843
50	Contract work	$23,344	----	$1,095	$300	----
	Materials used:					
51	Aggregate cost	$3,339,724	$53,399	$41,505	$51,700	$119,889
	Ammonia:					
52	Total cost	$359,549	$12,766	$4,133	$5,910	$12,913
53	Total pounds	2,879,989	122,415	10,279	20,984	67,653
	Ammonia, anhydrous:					
54	Cost	$279,680	$6,745	$4,133	$5,910	$10,413
55	Pounds	1,056,535	24,989	10,279	20,984	32,653
	Ammonia, aqua:					
56	Cost	$79,869	$6,021	----	----	$2,500
57	Pounds	1,323,454	97,426	----	----	35,000
58	Fuel	$2,139,216	$28,185	$32,851	$32,118	$68,558
59	Rent of power and heat	$20,336	----	$850	$2	$10,390
60	Mill supplies	$216,383	$4,396	$1,391	$3,824	$4,897
61	All other materials	$506,586	$4,293	$2,295	$7,296	$20,611
62	Freight	$97,654	$3,759	$485	$2,550	$2,520
	Products:					
63	Aggregate value	$13,874,513	$253,475	$132,611	$236,289	$511,197
	Ice:					
64	Total value	$13,303,874	$252,675	$120,765	$225,029	$415,388
65	Total tons	4,294,439	55,908	14,709	51,236	90,679
	Can ice:					
66	Value	$12,863,160	$252,675	$120,765	$225,029	$353,888
67	Tons	4,139,764	55,908	14,709	51,236	80,679
	Plate ice:					
68	Value	$440,714	----	----	----	$61,500
69	Tons	154,675	----	----	----	10,000
70	All other products	$570,639	$800	$11,846	$11,260	$95,809
	Comparison of products:					
71	Number of establishments reporting for both years	551	14	4	10	15
72	Value for census year	$10,379,966	$201,761	$68,900	$168,737	$469,497
73	Value for preceding business year	$9,841,283	$179,406	$56,500	$159,071	$435,706

[1] Includes the statistics for 12 establishments, the schedules for which were received too late to be included in the tables presented in Parts I and II, Manufactures. These establishments are distributed as follows: Alabama, 2; Arkansas, 3; Florida, 2; Louisiana, 2; Mississippi, 2; Oklahoma, 1.

STATES AND TERRITORIES: 1900. (1)

Colorado.	Connecticut.	Delaware.	District of Columbia.	Florida.	Georgia.	Illinois.	Indiana.	Indian Territory.	Iowa.	Kansas.	Kentucky.	Louisiana.	
6	5	7	4	35	32	29	47	3	3	19	31	36	1
.....	.....	2	.....	20	6	3	15	1	.....	6	6	9	2
2	2	.....	1	6	4	9	9	.....	.....	6	7	3	3
4	3	5	3	9	22	17	23	1	3	7	18	23	4
.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	5
5	3	5	1	23	19	21	37	3	3	15	20	31	6
.....	.....	1	.....	2	2	3	5	2	1	.....	3	7	7
$664,360	$316,722	$259,501	$629,992	$740,131	$975,100	$1,689,253	$1,530,603	$62,974	$165,300	$425,199	$1,200,117	$2,265,961	8
$60,721	$47,000	$17,300	$65,000	$45,059	$63,950	$114,930	$138,850	$2,300	$23,000	$24,870	$91,890	$388,779	9
$108,965	$71,843	$42,000	$189,000	$92,400	$128,988	$335,018	$257,000	$19,100	$29,800	$68,500	$241,474	$496,881	10
$465,060	$171,843	$176,700	$355,024	$530,309	$724,050	$1,036,878	$1,040,078	$39,350	$88,000	$295,779	$763,581	$1,276,066	11
$29,614	$26,036	$23,501	$29,968	$72,363	$58,112	$202,427	$94,675	$2,224	$24,500	$36,050	$103,172	$104,235	12
6	5	2	2	26	14	22	35	2	3	18	22	16	13
18	15	8	16	24	48	92	61	4	10	20	52	78	14
$21,235	$17,681	$4,316	$14,310	$21,371	$42,535	$75,210	$43,856	$1,525	$3,055	$13,420	$32,600	$67,132	15
8	5	4	6	6	14	11	27	.....	3	6	19	26	16
$12,350	$8,000	$1,560	$5,150	$4,860	$15,550	$17,420	$23,230	.....	$800	$4,850	$17,850	$33,942	17
10	10	4	10	18	34	81	34	4	7	14	33	52	18
$8,885	$9,681	$2,756	$9,160	$16,511	$26,985	$57,790	$20,626	$1,525	$2,255	$3,570	$14,750	$33,190	19
10	8	4	10	18	34	62	24	4	7	14	33	50	20
$8,885	$8,181	$2,756	$9,160	$16,511	$26,985	$49,058	$17,164	$1,525	$2,255	$8,570	$14,750	$32,390	21
.....	2	.....	.....	.....	.....	19	10	.....	.....	.....	.....	2	22
.....	$1,500	.....	.....	.....	.....	$8,732	$3,462	.....	.....	.....	.....	$800	23
142	60	48	111	315	407	831	574	20	57	183	322	508	24
53	27	21	52	191	209	344	212	11	15	92	148	178	25
93	38	28	83	244	251	624	343	10	33	114	192	299	26
$53,517	$21,041	$12,480	$40,603	$100,533	$86,210	$303,317	$161,902	$4,003	$15,067	$55,427	$84,321	$126,067	27
93	38	27	83	242	250	623	343	10	33	113	188	292	28
$53,517	$21,041	$12,330	$40,603	$100,265	$86,030	$302,615	$161,902	$4,003	$15,067	$55,217	$84,041	$125,265	29
.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	.....	1	30
.....	.....	.....	.....	.....	.....	$702	.....	.....	.....	$210	.....	$240	31
.....	.....	1	.....	2	1	.....	.....	.....	.....	.....	4	6	32
.....	.....	$150	.....	$268	$180	.....	.....	.....	.....	.....	$280	$562	33
53	27	17	39	193	143	389	190	2	10	66	97	148	34
68	29	14	53	196	135	429	186	2	13	76	88	145	35
63	32	14	64	204	150	443	226	4	18	96	108	151	36
75	38	20	94	242	255	538	322	14	21	122	174	233	37
85	36	41	111	256	332	731	385	17	35	148	202	387	38
113	43	42	111	285	383	808	451	16	47	138	270	477	39
133	49	42	111	287	371	826	524	17	52	153	282	469	40
132	48	42	111	288	373	829	531	17	57	151	283	474	41
128	45	39	101	290	353	811	470	19	52	147	269	440	42
114	49	27	71	250	238	655	381	11	41	114	208	315	43
79	37	15	65	211	140	576	252	4	32	79	122	139	44
72	29	14	65	196	131	447	195	2	18	66	99	123	45
$12,611	$11,363	$8,214	$36,979	$21,472	$49,654	$173,895	$67,954	$1,830	$9,014	$15,715	$64,879	$85,103	46
$150	$750	.....	$8,900	$937	$2,005	$1,935	$2,025	.....	$696	$601	$555	$756	47
$4,308	$1,544	$996	$7,240	$5,391	$8,826	$6,735	$12,609	$515	$875	$2,849	$8,961	$15,182	48
$8,153	$9,069	$7,218	$20,839	$14,844	$38,373	$165,225	$53,320	$1,315	$7,443	$12,265	$55,363	$69,165	49
.....	.....	.....	.....	$300	$450	.....	.....	.....	.....	.....	.....	.....	50
$31,446	$16,014	$13,654	$61,267	$131,816	$126,512	$173,850	$121,390	$5,327	$10,530	$55,784	$81,564	$193,241	51
$5,564	$1,371	$1,580	$2,314	$13,276	$12,736	$14,813	$15,809	$443	$1,749	$5,891	$12,006	$24,424	52
44,264	5,313	6,080	9,310	149,086	107,925	74,829	144,476	1,550	24,600	42,938	99,007	191,178	53
$3,407	$1,371	$1,580	$2,314	$5,750	$7,759	$13,674	$9,993	$443	$549	$4,435	$8,303	$15,047	54
11,035	5,313	6,080	9,310	19,736	29,948	54,396	36,879	1,550	2,100	16,373	29,507	63,626	55
$2,157	.....	.....	.....	$7,526	$4,977	$1,139	$5,816	.....	$1,200	$1,456	$3,703	$9,377	56
33,229	.....	.....	.....	129,350	77,977	20,433	107,597	.....	22,500	26,565	69,500	137,552	57
$23,764	$11,166	$9,746	$35,504	$80,258	$80,531	$97,425	$65,680	$3,762	$7,772	$38,441	$58,080	$119,160	58
.....	$300	.....	$900	$800	.....	$720	.....	.....	.....	.....	.....	$125	59
$651	$335	$775	$3,150	$8,936	$9,588	$7,674	$7,992	$430	$607	$4,623	$4,394	$8,009	60
$193	$2,128	$1,548	$18,349	$22,746	$19,169	$50,141	$29,029	$342	$350	$6,129	$6,264	$38,163	61
$1,281	$164	$5	$1,050	$5,805	$4,538	$3,077	$2,880	$350	$52	$700	$820	$3,360	62
$204,029	$95,304	$71,240	$182,575	$438,782	$456,964	$990,827	$544,005	$19,540	$38,400	$196,310	$454,497	$591,500	63
$204,029	$95,304	$71,240	$147,575	$437,382	$455,699	$877,178	$514,531	$19,440	$36,600	$193,310	$375,897	$568,561	64
51,545	25,950	26,738	64,950	125,184	131,286	249,813	199,184	3,060	13,500	62,486	137,472	179,716	65
$204,029	$73,804	$61,050	$105,575	$437,382	$455,699	$869,178	$514,531	$19,440	$36,600	$193,310	$375,897	$568,561	66
51,545	21,650	24,700	44,450	125,184	131,286	249,013	199,184	3,060	13,500	62,486	137,472	179,716	67
.....	$21,500	$10,190	$42,000	.....	.....	$8,000	.....	.....	.....	.....	.....	.....	68
.....	4,300	2,038	20,500	.....	.....	800	.....	.....	.....	.....	.....	.....	69
.....	.....	.....	$35,000	$1,400	$1,265	$113,649	$29,474	$100	$1,800	$3,000	$78,600	$27,939	70
4	4	4	3	21	23	22	37	2	2	13	25	22	71
$158,329	$88,500	$51,800	$149,500	$271,638	$370,663	$638,524	$446,825	$18,100	$97,600	$151,970	$412,397	$411,886	72
$129,353	$78,088	$52,100	$146,000	$264,567	$338,488	$584,373	$452,863	$16,537	$27,600	$152,350	$403,846	$418,046	73

[2]The average number of women, 16 years and over, and children, under 16 years, employed during each month are not included in the table, because of the small number reported.

TABLE 11.—ICE MANUFACTURE, BY

		Maryland.	Mississippi.	Missouri.	New Jersey.	New Mexico.
1	Number of establishments	18	23	31	26	4
	Character of organization:					
2	Individual	5	8	4	6	3
3	Firm and limited partnership	2	6	4	3	.....
4	Incorporated company	11	9	23	17	1
5	Miscellaneous	.....	.....	.....	.....	.....
6	Established during the decade	11	14	24	16	4
7	Established during the census year	2	2	4	6	.....
	Capital:					
8	Total	$649,692	$597,871	$1,885,166	$1,653,028	$118,450
9	Land	$93,191	$93,510	$271,383	$175,700	$10,650
10	Buildings	$100,100	$94,061	$406,088	$396,470	$29,000
11	Machinery, tools, and implements	$421,425	$372,210	$977,152	$970,344	$72,000
12	Cash and sundries	$34,976	$38,090	$180,593	$110,514	$6,800
13	Proprietors and firm members	6	14	13	12	3
	Salaried officials, clerks, etc.:					
14	Total number	19	28	65	52	2
15	Total salaries	$14,535	$23,900	$66,315	$37,999	$2,400
	Officers of corporations:					
16	Number	6	8	26	16	2
17	Salaries	$2,550	$5,500	$33,618	$14,410	$2,400
	General superintendents, managers, clerks, and salesmen:					
18	Total number	13	20	39	36	.....
19	Total salaries	$11,985	$18,400	$32,697	$23,589	.....
	Men:					
20	Number	13	20	35	35	.....
21	Salaries	$11,985	$18,400	$30,593	$23,439	.....
	Women:					
22	Number	.....	.....	4	1	.....
23	Salaries	.....	.....	$2,104	$150	.....
	Wage-earners, including pieceworkers, and total wages:					
24	Greatest number employed at any one time during the year	204	271	476	272	39
25	Least number employed at any one time during the year	113	111	169	148	15
26	Average number	138	162	279	183	22
27	Wages	$74,633	$56,503	$157,006	$94,070	$15,300
	Men, 16 years and over:					
28	Average number	137	160	279	182	21
29	Wages	$74,313	$55,519	$157,006	$93,570	$15,200
	Women, 16 years and over:					
30	Average number	.....	1	.....	1	.....
31	Wages	.....	$960	.....	$500	.....
	Children, under 16 years:					
32	Average number	1	1	.....	.....	1
33	Wages	$320	$24	.....	.....	$100
	Average number of wage-earners, including pieceworkers, employed during each month: [2]					
	Men, 16 years and over:					
34	January	96	60	134	102	12
35	February	76	67	149	128	12
36	March	105	79	178	153	12
37	April	127	133	250	179	15
38	May	151	227	335	220	24
39	June	180	272	381	233	30
40	July	187	275	412	234	31
41	August	188	258	429	241	36
42	September	186	236	379	237	27
43	October	143	171	327	206	19
44	November	104	76	215	136	16
45	December	96	62	157	117	16
	Miscellaneous expenses:					
46	Total	$24,490	$33,730	$72,868	$51,276	$1,983
47	Rent of works	$185	$120	$6,720	$4,325	.....
48	Taxes, not including internal revenue	$5,972	$6,995	$10,224	$7,510	$1,033
49	Rent of offices, interest, insurance, and all sundry expenses not hitherto included	$18,333	$26,615	$55,924	$39,441	$950
50	Contract work	.....	.....	.....	.....	.....
	Materials used:					
51	Aggregate cost	$84,070	$68,520	$226,385	$108,158	$15,480
	Ammonia:					
52	Total cost	$5,177	$6,489	$22,302	$6,876	$1,700
53	Total pounds	22,515	44,115	123,114	33,593	14,768
	Ammonia, anhydrous:					
54	Cost	$5,177	$4,871	$19,896	$6,485	$700
55	Pounds	22,515	19,189	91,068	26,693	2,636
	Ammonia, aqua:					
56	Cost	.....	$1,618	$2,406	$391	$1,000
57	Pounds	.....	24,926	31,451	6,900	12,122
58	Fuel	$56,978	$33,420	$157,612	$74,591	$11,175
59	Rent of power and heat	.....	.....	$2,300	.....	.....
60	Mill supplies	$4,189	$4,687	$9,840	$5,992	$380
61	All other materials	$16,160	$21,273	$33,284	$19,088	$350
62	Freight	$1,566	$2,651	$1,047	$1,611	$1,875
	Products:					
63	Aggregate value	$358,668	$288,739	$641,405	$391,685	$77,775
	Ice:					
64	Total value	$358,668	$268,175	$635,503	$379,776	$77,775
65	Total tons	120,740	57,207	285,796	169,755	10,915
	Can ice:					
66	Value	$348,083	$268,175	$635,503	$341,176	$77,775
67	Tons	116,800	57,207	285,796	154,615	10,915
	Plate ice:					
68	Value	$10,585	.....	.....	$38,600	.....
69	Tons	3,940	.....	.....	15,140	.....
70	All other products	.....	$20,564	$5,902	$11,909	.....
	Comparison of products:					
71	Number of establishments reporting for both years	13	15	24	11	2
72	Value for census year	$318,727	$180,619	$526,067	$257,931	$48,000
73	Value for preceding business year	$190,280	$172,619	$508,866	$223,850	$41,000

[1] Includes establishments distributed as follows: Nebraska, 1; Rhode Island, 2; Utah, 1.

STATES AND TERRITORIES: 1900—Continued.

New York.	North Carolina.	Ohio.	Oklahoma.	Oregon.	Pennsylvania.	South Carolina.	Tennessee.	Texas.	Virginia.	Washington.	West Virginia.	All other states.[1]	
41	23	42	7	9	73	13	27	77	30	4	8	4	1
10	3	12	.....	4	10	3	4	19	8	1	1	.....	2
3	5	3	2	2	16	2	8	8	6	.....	.....	.....	3
28	15	26	5	3	46	8	15	50	16	3	7	4	4
.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	5
36	18	26	5	4	54	8	16	43	22	1	3	3	6
12	4	2	.....	.....	12	3	2	6	2	.....	.....	.....	7
$2,554,722	$523,243	$1,777,430	$194,323	$172,800	$8,259,861	$407,400	$1,103,501	$2,563,888	$1,198,981	$252,360	$413,452	$198,726	8
$341,518	$37,465	$180,742	$11,001	$22,100	$1,233,100	$25,225	$194,950	$267,495	$141,400	$46,000	$58,000	$18,000	9
$595,070	$68,300	$397,900	$44,223	$20,200	$1,539,675	$102,550	$243,176	$545,348	$211,500	$32,000	$77,700	$40,000	10
$1,432,701	$381,956	$1,012,707	$111,168	$107,500	$4,712,816	$241,000	$530,695	$1,581,367	$677,882	$133,500	$250,823	$105,453	11
$185,433	$40,522	$186,081	$27,981	$23,000	$774,270	$38,625	$134,680	$169,678	$168,199	$40,860	$26,929	$35,278	12
17	13	17	7	7	51	7	20	35	20	1	1	.....	13
63	37	79	16	9	246	13	67	171	46	13	19	9	14
$51,789	$32,317	$53,410	$13,080	$13,980	$169,993	$10,182	$58,622	$124,671	$34,984	$13,750	$13,716	$7,923	15
20	12	35	1	1	59	2	18	35	18	3	7	1	16
$17,990	$16,922	$26,304	$300	$4,800	$45,884	$2,100	$24,110	$41,550	$17,240	$5,400	$6,300	$1,208	17
43	25	44	15	8	187	11	49	136	28	10	12	8	18
$33,799	$15,395	$27,106	$12,780	$9,180	$124,109	$8,082	$34,512	$83,121	$17,694	$8,350	$7,416	$6,715	19
41	24	33	14	8	171	11	48	136	27	10	11	8	20
$33,362	$14,915	$22,774	$12,300	$9,180	$119,501	$8,082	$34,152	$83,121	$17,382	$8,350	$6,916	$6,715	21
2	1	11	1	.....	16	.....	1	.....	1	.....	1	.....	22
$437	$480	$4,332	$480	.....	$4,608	.....	$360	.....	$362	.....	$500	.....	23
453	290	501	81	51	1,564	114	600	964	306	48	120	63	24
261	144	198	23	33	780	62	277	375	170	23	51	26	25
319	161	299	51	35	930	73	385	618	205	35	80	41	26
$201,394	$52,647	$154,561	$28,171	$25,235	$537,748	$23,781	$177,461	$305,282	$87,193	$25,700	$39,587	$23,649	27
319	160	297	50	35	930	73	381	607	205	35	80	41	28
$201,394	$52,532	$154,411	$28,096	$25,235	$537,748	$23,781	$177,036	$303,682	$87,193	$25,700	$39,587	$23,649	29
.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	30
.....	.....	.....	.....	.....	.....	.....	.....	$500	.....	.....	.....	.....	31
.....	1	2	1	.....	.....	.....	4	10	.....	.....	.....	.....	32
.....	$115	$150	$75	.....	.....	.....	$425	$1,100	.....	.....	.....	.....	33
182	74	150	18	28	487	43	219	289	91	25	52	45	34
197	102	155	22	28	491	43	242	298	93	25	52	45	35
237	119	184	37	29	564	45	270	390	145	25	54	45	36
312	197	245	55	31	942	65	320	576	194	25	67	35	37
389	253	368	62	35	1,263	101	444	755	251	45	92	38	38
424	230	415	74	42	1,322	103	532	872	293	47	115	40	39
425	205	431	77	50	1,362	102	551	897	311	47	116	49	40
420	202	448	77	49	1,273	109	564	906	310	47	116	49	41
410	197	413	75	38	1,185	101	522	888	299	47	111	40	42
344	148	352	62	30	937	78	395	648	249	38	71	36	43
269	111	218	26	28	710	47	293	495	128	27	60	32	44
218	84	185	16	28	624	41	224	330	94	27	50	32	45
$177,727	$18,042	$71,065	$17,968	$14,502	$290,339	$18,225	$58,878	$132,435	$37,174	$10,735	$11,188	$15,876	46
$31,056	$1,230	$1,558	$4,500	$3,000	$24,474	$460	$130	$5,209	$1,350	$1,500	.....	.....	47
$13,813	$4,676	$20,139	$2,755	$1,097	$24,748	$3,107	$16,345	$22,334	$6,850	$1,285	$3,042	$1,081	48
$112,282	$12,136	$48,783	$10,713	$10,405	$241,079	$14,658	$42,403	$104,892	$28,974	$7,950	$8,146	$14,795	49
$20,576	.....	$585	.....	.....	$38	.....	.....	.....	.....	.....	.....	.....	50
$268,695	$66,291	$138,135	$30,662	$19,155	$892,484	$37,327	$109,505	$320,381	$106,823	$17,318	$22,327	$19,620	51
$23,274	$6,143	$14,756	$1,833	$1,934	$48,887	$4,439	$13,685	$32,280	$12,928	$2,605	$5,573	$970	52
102,629	44,418	141,365	10,328	6,043	225,986	58,333	88,573	168,637	88,607	6,883	74,870	3,436	53
$22,774	$4,530	$9,851	$1,333	$1,934	$45,964	$941	$10,916	$27,555	$9,650	$2,605	$1,702	$970	54
93,129	16,748	40,051	4,842	6,043	179,994	3,613	41,406	92,701	33,111	6,883	7,175	3,436	55
$500	$1,613	$4,905	$500	.....	$2,923	$3,498	$2,769	$4,725	$3,278	.....	$3,871	.....	56
9,500	27,670	101,314	5,486	.....	46,942	54,720	47,167	75,936	55,496	.....	67,605	.....	57
$188,849	$45,114	$89,478	$22,070	$10,930	$235,555	$25,005	$82,321	$203,863	$71,923	$12,362	$12,404	$13,080	58
.....	$1,050	.....	.....	$2,400	.....	.....	.....	$348	$651	.....	.....	.....	59
$15,084	$5,274	$12,753	$2,119	$1,378	$26,437	$2,438	$8,550	$31,547	$9,058	$1,300	$2,182	$1,000	60
$37,762	$8,823	$15,495	$2,340	$2,417	$60,124	$3,610	$4,149	$44,595	$7,187	$971	$1,362	$3,550	61
$4,226	$4,887	$5,653	$2,300	$96	$21,481	$1,835	$800	$7,748	$4,576	$80	$806	$1,020	62
$1,051,372	$228,305	$582,538	$106,003	$116,031	$2,038,504	$116,357	$538,107	$1,184,332	$427,974	$103,600	$119,401	$86,172	63
$1,025,308	$228,305	$577,038	$106,003	$95,260	$2,000,931	$116,357	$538,107	$1,168,640	$417,052	$103,600	$119,201	$82,572	64
457,779	61,338	237,750	22,218	17,165	735,018	45,228	158,931	231,450	118,240	17,300	35,784	28,509	65
$1,015,308	$228,305	$548,542	$106,003	$95,260	$1,866,770	$114,857	$538,107	$1,159,040	$362,542	$103,600	$119,201	$72,500	66
456,279	61,338	220,833	22,218	17,165	684,144	44,853	158,931	229,050	96,458	17,300	35,784	24,400	67
$10,000	.....	$28,496	.....	.....	$134,161	$1,500	.....	$9,600	$54,510	.....	.....	$10,072	68
1,500	.....	16,917	.....	.....	50,874	375	.....	2,400	21,782	.....	.....	4,109	69
$26,064	.....	$5,500	.....	$20,771	$37,573	.....	.....	$15,692	$10,922	.....	$200	$3,600	70
26	15	36	4	6	50	9	20	62	20	3	6	4	71
$806,628	$174,892	$532,480	$61,516	$41,631	$1,172,228	$92,857	$461,727	$970,290	$267,137	$97,600	$106,837	$86,172	72
$789,728	$168,241	$551,678	$59,000	$39,565	$1,167,068	$87,923	$571,453	$870,529	$248,321	$78,000	$105,151	$73,072	73

[1] The average number of women, 16 years and over, and children, under 16 years, employed during each month, are not included in the table, because of the small number reported.

TABLE 11.—ICE MANUFACTURE, BY

		United States.	Alabama.	Arizona.	Arkansas.	California.
	Power:					
74	Number of establishments reporting power	766	22	9	18	17
75	Total horsepower	102,695	1,872	609	2,561	2,343
	Owned:					
	Engines:					
76	Steam, number	1,447	29	14	44	18
77	Horsepower	96,711	1,872	609	2,551	1,420
78	Gas or gasoline, number	9	.....	.....	.....	1
79	Horsepower	193	.....	.....	.....	8
	Water wheels:					
80	Number	23	.....	.....	.....	6
81	Horsepower	807	.....	.....	.....	330
	Electric motors:					
82	Number	85	.....	.....	1	10
83	Horsepower	1,492	.....	.....	10	360
	Other power:					
84	Number	101	.....	.....	.....	.....
85	Horsepower	2,793	.....	.....	.....	.....
	Rented:					
86	Electric, horsepower	389	.....	.....	.....	225
87	Other kinds, horsepower	310	.....	.....	.....	.....
88	Furnished to other establishments	332	.....	.....	.....	.....
	Establishments classified by number of persons employed, not including proprietors and firm members:					
89	Total number of establishments	787	23	9	18	20
90	No employees	4	.....	.....	.....	.....
91	Under 5	93	4	1	3	5
92	5 to 20	534	15	8	12	11
93	21 to 50	130	4	.....	2	3
94	51 to 100	21	.....	.....	1	1
95	101 to 250	3	.....	.....	.....	.....
96	251 to 500	2	.....	.....	.....	.....

STATES AND TERRITORIES: 1900—Continued.

Colorado.	Connecticut.	Delaware.	District of Columbia.	Florida.	Georgia.	Illinois.	Indiana.	Indian Territory.	Iowa.	Kansas.	Kentucky.	Louisiana.	
6	5	7	4	35	31	28	44	3	3	19	30	35	74
292	779	631	1,466	3,049	3,555	4,104	3,620	190	450	2,142	3,232	4,980	75
12	12	11	16	58	61	61	88	3	6	25	60	65	76
292	767	591	1,300	2,563	3,555	4,056	3,507	190	450	2,122	3,201	4,650	77
						1				1			78
						12				20			79
		1	1	1									80
		30	50	4									81
		1				3	3				4	1	82
		10				21	108				31	3	83
				27			1					19	84
				482			5					322	85
	12											5	86
			110			15							87
			5	2					110		20		88
6	5	7	4	35	32	29	47	3	3	19	31	36	89
				1								1	90
		2		4	8	3	9	1		1	2	2	91
2	3	5	1	28	19	18	29	2	2	17	25	27	92
3	2		2	2	4	6	7		1	1	4	5	93
1			1		1	1	2						94
												1	95
						1							96

TABLE 11.—ICE MANUFACTURE, BY

		Maryland.	Mississippi.	Missouri.	New Jersey.	New Mexico.
	Power:					
74	Number of establishments reporting power	18	23	31	26	3
75	Total horsepower	2,151	1,914	7,355	4,253	75
	Owned:					
	Engines:					
76	Steam, number	28	37	62	44	4
77	Horsepower	2,075	1,904	7,177	3,695	75
78	Gas or gasoline, number	1				
79	Horsepower	25				
	Water wheels:					
80	Number	1			1	
81	Horsepower	15			25	
	Electric motors:					
82	Number	2	1	4	9	
83	Horsepower	11	10	88	258	
	Other power:					
84	Number	5			8	
85	Horsepower	25			275	
	Rented:					
86	Electric horsepower			90		
87	Other kinds, horsepower					
88	Furnished to other establishments			37	31	
	Establishments classified by number of persons employed, not including proprietors and firm members:					
89	Total number of establishments	18	23	31	26	4
90	No employees	1				
91	Under 5	1	2	3	2	1
92	5 to 20	13	17	17	21	2
93	21 to 50	3	4	10	3	1
94	51 to 100			1		
95	101 to 250					
96	251 to 500					

STATES AND TERRITORIES: 1900—Continued.

New York.	North Carolina.	Ohio.	Oklahoma.	Oregon.	Pennsylvania.	South Carolina.	Tennessee.	Texas.	Virginia.	Washington.	West Virginia.	All other states.[1]	
41	23	41	7	9	71	11	25	75	30	4	8	4	74
5,487	2,275	6,205	670	720	17,028	1,080	3,612	8,964	3,502	425	635	475	75
75	31	84	9	13	206	13	51	128	56	4	14	5	76
5,357	1,845	5,175	670	605	16,622	744	3,589	8,825	3,288	425	589	355	77
.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	3	78
.....	.....	.....	.....	.....	6	.....	.....	2	.....	.....	.....	120	79
1	.....	.....	.....	.....	1	1	.....	3	6	.....	.....	.....	80
25	.....	.....	.....	.....	18	30	.....	100	180	.....	.....	.....	81
5	.....	7	.....	.....	26	1	2	2	1	.....	2	.....	82
65	.....	55	.....	.....	382	6	23	15	8	.....	28	.....	83
1	11	18	.....	.....	.....	3	.....	7	.....	.....	1	.....	84
10	365	975	.....	.....	.....	300	.....	16	.....	.....	18	.....	85
.....	.....	.....	.....	25	.....	.....	.....	6	26	.....	.....	.....	86
30	65	.....	.....	90	.....	.....	.....	.....	.....	.....	.....	.....	87
5	.....	.....	.....	8	58	.....	.....	56	.....	.....	.....	.....	88
41	23	42	7	9	73	13	27	77	30	4	8	4	89
.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	90
2	2	5	.....	4	7	3	2	8	3	1	1	1	91
34	18	29	6	5	39	8	14	55	25	2	4	1	92
5	1	7	1	.....	20	1	9	11	2	1	3	2	93
.....	2	1	.....	.....	6	.....	.....	3	.....	.....	.....	.....	94
.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	95
.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	96

[1] Includes establishments distributed as follows: Nebraska, 1; Rhode Island, 2; Utah, 1.

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Twelfth Census of the United States.

CENSUS BULLETIN.

NO. 175. WASHINGTON, D. C. MAY 24, 1902.

MANUFACTURES.

GLOVES AND MITTENS—LEATHER.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on the manufacture of leather gloves and mittens in the United States during the census year, prepared under my direction by Mr. Arthur L. Hunt, of the Census Office.

The manufacture of leather gloves and mittens is now for the first time made the subject of a special report by the Census Office, although the industry has been of commercial importance in the United States for nearly a century. The statistics included in the report were collected, as in previous censuses, upon the schedule used for the general statistics of manufactures. But in view of the notable growth of this industry it was decided to supplement the canvass made by the enumerators and local special agents, and to give the industry more detailed treatment than is given to manufacturing industries in general, or than this industry has received heretofore. Except in Tables 1 and 2 the statistics here presented pertain only to establishments engaged in the manufacture of leather gloves and mittens, and do not include the returns from establishments which manufactured gloves and mittens from other materials.

The statistics are presented in 14 tables: Table 1 showing comparative figures for the manufacture of all gloves and mittens, except knit gloves and mittens, at the several censuses; Table 2 showing the statistics of leather gloves and mittens in comparison with the totals of the combined industry, including the statistics of 3 additional establishments, the schedules for which were received too late to be included in the totals for the industry as presented in Manufactures, Parts I and II; Table 3 showing by states and territories the number of establishments in operation in 1900, the number established during the decade, and the number established during the census year; Table 4 showing the statistics of capital for 1900; Table 5 showing a summary of wage-earners and wages by geographic divisions for 1900; Table 6 showing the statistics of miscellaneous expenses for 1900; Table 7 showing the cost of materials for 1900; Table 8 showing the quantities and cost of hides and skins for 1900; Table 9 showing the quantity and value of products for 1900; Table 10 showing the quantity and value of products by states and territories and by geographic divisions for 1900; Table 11 showing the statistics for New York, in comparison with the totals for the United States; Table 12 showing the statistics for cities of over 20,000 population for 1900; Table 13 showing the imports of gloves of kid and other leather from 1890 to 1900, inclusive; and Table 14 showing the detailed statistics for the industry in 1900.

Table 1 shows the growth of the combined glove and mitten industry for the half century which terminates with the Twelfth Census. The manufacturing statistics of the censuses prior to 1850 were too imperfect

and fragmentary in character to make it proper to reproduce them in such a table as a measure of industrial growth in the first half of the century. Owing to changes in the method of taking the census, comparisons between the earlier and later decades, represented in Table 1, should be drawn only in the most general way. Nevertheless, the rate of growth in the manufacture of gloves and mittens may be fairly inferred from the figures given.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class, overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

The reports show a capital of $9,004,427 invested in the manufacture of leather gloves and mittens in the 381 establishments reporting for the United States. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations engaged in this industry. The value of the products is returned as $16,721,234, to produce which involved an outlay of $544,170 for salaries of officials, clerks, etc.; $4,151,126 for wages; $562,870 for miscellaneous expenses, including rent, taxes, etc.; and $9,382,102 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the manufacture of leather gloves and mittens during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the works. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

Chief Statistician for Manufactures.

GLOVES AND MITTENS—LEATHER.

By Arthur L. Hunt.

The following tables, with the exceptions noted below, present the statistics concerning the establishments engaged exclusively in the manufacture of leather gloves and mittens during the census year ending May 31, 1900. The general classification adopted by the Census Office includes every variety of gloves and mittens manufactured, whether of leather or other material, except knit gloves and mittens; therefore it is impossible to present comparative statistics for establishments engaged exclusively in the manufacture of leather gloves and mittens for previous censuses. Inasmuch, however, as the manufacture of gloves and mittens of materials other than leather has formed a comparatively small branch of the combined industry at the several censuses, the statistics for the combined industry fairly indicate the growth in the manufacture of leather gloves and mittens. Table 1 is a comparative summary of the combined industry as returned at the censuses of 1850 to 1900, with the percentages of increase for each decade.

Table 1.—GLOVES AND MITTENS: COMPARATIVE SUMMARY, 1850 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.						PER CENT OF INCREASE.				
	1900[1]	1890	1880	1870	1860	1850	1890 to 1900	1880 to 1890	1870 to 1880	1860 to 1870	1850 to 1860
Number of establishments	397	324	300	221	126	110	22.5	8.0	35.7	75.4	14.5
Capital	$9,127,309	$5,977,820	$3,379,648	$2,840,550	$594,825	$181,200	52.7	76.9	44.4	293.5	228.3
Salaried officials, clerks, etc., number	661	[2]482	[3]	[3]	[3]	[3]	37.1	.....	.....	.....	.....
Salaries	$548,520	[2]$488,664	[3]	[3]	[3]	[3]	25.0	.....	.....	.....	.....
Wage-earners, average number	14,486	8,187	7,097	4,058	1,420	1,033	76.3	6.4	89.7	184.0	[4]26.3
Total wages	$4,217,845	$2,670,344	$1,655,095	$980,549	$330,419	$283,498	58.0	61.3	68.9	196.8	41.5
Men, 16 years and over	4,402	2,998	2,102	1,127	468	322	46.8	42.6	86.5	148.8	37.7
Wages	$2,030,554	$1,506,385	[3]	[3]	[3]	[3]	34.8	.....	.....	.....	.....
Women, 16 years and over	9,754	5,091	5,249	2,894	976	1,609	91.6	[4]3.0	81.4	196.5	[4]39.3
Wages	$2,160,480	$1,150,943	[3]	[3]	[3]	[3]	86.8	.....	.....	.....	.....
Children, under 16 years	280	98	346	37	[3]	[3]	185.7	[4]71.7	835.1	.....	.....
Wages	$36,811	$13,016	[3]	[3]	[3]	[3]	182.8	.....	.....	.....	.....
Miscellaneous expenses	$608,582	$426,937	[5]	[5]	[5]	[5]	38.2	.....	.....	.....	.....
Cost of materials used	$9,554,105	$5,021,144	$4,851,469	$1,884,146	$537,589	$322,837	90.3	15.4	181.0	250.5	66.5
Value of products, including custom work and repairing	$17,048,656	$10,103,821	$7,879,605	$3,998,521	$1,176,795	$708,184	68.7	36.9	84.6	239.8	66.2

[1] The figures reported for 1900 include the statistics for 1 institution and 2 establishments, the schedules for which were received too late to be included in the totals for this industry as presented in the report on Manufactures, Parts I and II.
[2] Includes proprietors and firm members, with their salaries; number only reported in 1900.
[3] Not reported separately.
[4] Decrease.
[5] Not reported.

Table 1 shows the notable growth which has occurred in the glove industry during the past half century. Although the manufacture of gloves and mittens was of commercial importance as early as 1810, the census of 1850 was the first at which the statistics were sufficiently accurate to justify a detailed comparison. In that year returns were received from 110 establishments, reporting a capital of $181,200, and a product valued at $708,184. In 1900, returns were received from 397 establishments, an increase of 287, or 260.9 per cent. The capital increased from $181,200 to $9,127,309, an increase of $8,946,109, while the value of products increased to $17,048,656, an increase of $16,340,472. Reports were received from 126 establishments in 1860, showing an increase of but 14.5 per cent as compared with 1850, while the capital increased to $594,825, an increase of $413,625, or 228.3 per cent, and the value of products increased from $708,184 to $1,176,795, an increase of $468,611, or 66.2 per cent. The increase between 1860 and 1870 was primarily due to the large demand for gloves for the military service during the Civil War. During this period the number of establishments increased 95, or 75.4 per cent; the capital increased $1,745,725, or 293.5 per cent; and the value of products, $2,821,726, or 239.8 per cent. Since 1870 the industry has steadily increased. In 1900 the number of establishments was 397, an increase since 1890 of 73, or 22.5 per cent. During the decade the capital increased from $5,977,820 to $9,127,309, an increase of $3,149,489, or 52.7 per cent, while the value of products increased from $10,103,821 to $17,048,656, or 68.7 per cent.

A comparison of the average capital per establishment for the several decades indicates the changes which have taken place in the industry during the past half century. In 1850 the average capital per establishment was $1,647, and in 1860 it was $4,721, an

increase of $3,074, or 186.6 per cent. This comparatively large increase was probably due to the introduction, in 1852, of the sewing machine for glove manufacturing. Previous to this time all gloves were made by hand and very few people worked in the factories, most of the work being done by "home workers." Between 1860 and 1870 the average capital increased to $10,591, an increase of $5,870, or 124.3 per cent. From 1870 the average capital has shown a steady increase; in 1900 it was $22,991 per establishment. Table 1 indicates that the capital invested in the glove industry by the 110 establishments in 1850 was $181,200, a sum less than the amount of capital employed by several of the large glove factories of the present time. The value of products in 1850 was nearly four times the amount of capital reported. The ratio of capital to product since 1850 has remained comparatively the same. In 1850 the amount paid in wages exceeded the capital, but in each subsequent decade, with the exception of 1860, the amount of wages was less than one-half the amount invested in capital.

Table 2 is a comparative summary of the statistics for gloves and mittens manufactured from all materials, and from leather, with the per cent that the total of leather gloves and mittens formed of the combined total. Table 2 includes the statistics for 1 institution, and also for 2 establishments, the schedules for which were received too late to be included in the totals as given in the general report for the industry as presented in Manufactures, Parts I and II.

TABLE 2.[1]—COMPARATIVE SUMMARY, GLOVES AND MITTENS OF ALL MATERIALS, AND OF LEATHER, WITH THE PER CENT THAT LEATHER GLOVES AND MITTENS FORMED OF THE TOTAL: 1900.

	All materials.	Leather.	Per cent of leather to total.
Number of establishments	397	381	96.0
Capital	$9,127,309	$9,004,427	98.7
Salaried officials, clerks, etc., number	661	637	96.4
Salaries	$548,520	$544,170	99.2
Wage-earners, average number	14,436	14,180	98.2
Total wages	$4,217,845	$4,151,126	98.4
Men, 16 years and over	4,402	4,364	99.1
Wages	$2,080,554	$2,014,134	99.2
Women, 16 years and over	9,754	9,542	97.8
Wages	$2,150,480	$2,101,044	97.7
Children, under 16 years	280	274	97.9
Wages	$36,811	$35,948	97.7
Miscellaneous expenses	$568,582	$562,870	99.0
Cost of materials used	$9,554,105	$9,382,102	98.2
Value of products, including custom work and repairing	$17,048,656	$16,721,234	98.1

[1] Includes the statistics for 1 institution, and also for 2 establishments, the schedules for which were received too late to be included in Manufactures, Parts I and II. These establishments are distributed as follows: New Jersey, 1; New York, 1; Ohio, 1.

It appears that 381 establishments, or 96 per cent of the total number reported, were engaged in the manufacture of leather gloves and mittens during the census year, as compared with 397 establishments, the total for the combined industry. The capital was $9,004,427, or 98.7 per cent of the total capital; 14,180 wage-earners were employed, or 98.2 per cent of the total number reported; the cost of materials was $9,382,102, or 98.2 per cent of the total cost of materials; and the value of products was $16,721,234, or 98.1 per cent of the total. In this connection, however, it should be stated that many establishments use large quantities of jersey cloth and knit goods in the manufacture of the cheaper grades of leather gloves and mittens, and this feature of the industry may be said to be constantly increasing.

The individual form of organization appears to predominate in this industry. Of the total number of establishments, 222, or 58.3 per cent, were conducted by individuals. Of the remaining number 125, or 32.8 per cent, were operated by firms or limited partnerships, 33, or 8.6 per cent, by incorporated companies, and the 1 remaining was miscellaneous in character.

Table 3 presents, by states and territories and geographic divisions, the number of leather glove and mitten establishments from which returns were received in 1900, with the number established during the decade and also the number established during the census year.

TABLE 3.—NUMBER OF ACTIVE ESTABLISHMENTS IN 1900, NUMBER ESTABLISHED SINCE 1890, AND NUMBER ESTABLISHED DURING THE CENSUS YEAR, BY STATES AND TERRITORIES; ARRANGED GEOGRAPHICALLY.

STATES AND TERRITORIES.	Number reporting.	Established since 1890.	Established during the census year.
The United States	381	205	27
New England states	17	9	3
Maine	1	1	.....
New Hampshire	6	.....	.....
Massachusetts	8	7	3
Rhode Island	1	.....	.....
Connecticut	1	1	.....
Middle states	255	135	12
New York	243	130	12
New Jersey	5	2	.....
Pennsylvania	4	3	.....
Maryland	3	.....	.....
Southern states	5	1	.....
West Virginia	1	.....	.....
Virginia	3	.....	.....
Oklahoma	1	1	.....
Central states	72	43	11
Ohio	5	3	3
Michigan	5	3	.....
Indiana	3	2	1
Illinois	24	17	2
Wisconsin	19	12	3
Minnesota	8	5	1
Iowa	6	1	1
Missouri	2	.....	.....
Western states	4	3	.....
Montana	1	.....	.....
Nebraska	1	1	.....
Utah	1	1	.....
Colorado	1	1	.....
Pacific states	28	14	1
Washington	3	3	1
Oregon	2	2	.....
California	23	9	.....

Table 3 indicates the remarkable progress that has occurred in the industry during the decade. Of the total number of establishments, 205, or 53.8 per cent,

were established since 1890, and of this number, 27, or 7.1 per cent, were established during the census year. The greatest development was shown in the Middle states, which reported 135 establishments constructed during the decade, or 52.9 per cent of the total number of establishments reported for the group. Of the number established during the decade, 12, or 8.9 per cent, were constructed during the census year. The Central states reported 43 establishments constructed, or 59.7 per cent of the number reported for the group, of which number 11 were established during the census year. The number of establishments in the Pacific states was 28, of which 14, or 50 per cent, were established during the decade. New York reported 130 factories established during the decade, of which number 12 were established during the census year. Illinois and Wisconsin showed a comparatively large number established during the past ten years; the former reporting 17 and the latter 12. This seems to be due to the growing tendency to manufacture as near as possible to the source of supply, and as sheep pelts and horse and cow hides are now largely dressed for gloves in these states, it is but natural that glove and mitten manufacturers have taken advantage of the opportunity to establish factories in close proximity to the source of the materials required by them. California reported 23 establishments engaged in this industry, of which 9 were established during the decade. Massachusetts reported 8 establishments, 7 of which were established during the decade, and of this number 3 were established during the census year.

Table 4 is a summary of the capital reported for 1900, with the per cent of each item to the total.

TABLE 4.—CAPITAL: 1900.

	Amount.	Per cent of total.
Total	$9,004,427	100.0
Land	286,237	3.2
Buildings	582,095	6.5
Machinery, tools, and implements	675,650	7.5
Cash and sundries	7,460,445	82.8

The total capital invested was given as $9,004,427, and of the several items, cash and sundries, including cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, amounted to $7,460,445, or 82.8 per cent of the total. The preponderance of this item is, in a measure, due to the fact that a number of the larger manufacturers are heavy importers of leather, and the general statement may be made that glove manufacturers keep large quantities of leather on hand, together with costly furs, which are used for linings. The second largest item of capital was that reported for machinery, tools, and implements, and amounted to $675,650, or 7.5 per cent of the total. The value of land and of buildings formed 3.2 and 6.5 per cent of the total capital, respectively. The capital reported does not include the capital stock of any of the corporations, but only the actual capital utilized in the business.

Table 5 shows the total number of wage-earners with wages, the number of men, women, and children with wages, and the per cent of each to the total number, by geographic divisions, for 1900.

TABLE 5.—WAGE-EARNERS, BY GEOGRAPHIC DIVISIONS: 1900.

GEOGRAPHIC DIVISIONS.	Total average number.	Total wages.	MEN.			WOMEN.			CHILDREN.		
			Average number.	Per cent of total average number.	Total wages.	Average number.	Per cent of total average number.	Total wages.	Average number.	Per cent of total average number.	Total wages.
The United States	14,180	$4,151,126	4,364	30.8	$2,014,134	9,542	67.3	$2,101,044	274	1.9	$35,948
New England states	444	169,290	203	45.7	99,142	220	49.6	67,256	21	4.7	2,892
Middle states	10,218	2,814,789	2,937	28.7	1,345,568	7,212	70.6	1,458,995	69	0.7	10,176
Southern states	262	46,450	43	16.4	15,950	192	73.3	28,000	27	10.3	2,500
Central states	2,599	881,718	990	38.1	451,130	1,476	56.8	413,508	133	5.1	17,080
Western states	5	1,476	2	40.0	820	3	60.0	656			
Pacific states	652	237,453	189	29.0	101,524	439	67.3	132,629	24	3.7	3,300

The total number of wage-earners was reported as 14,180, and the total wages as $4,151,126. Of the total number of wage-earners, 4,364, or 30.8 per cent, were men, receiving $2,014,134 for wages. The number of women was 9,542, or 67.3 per cent of the total number, and the wages received were given as $2,101,044. The total number of children was 274, receiving $35,948 as wages. With the exception of the operation of heavy machines for wax-thread work and palming, together with the cutting and preparation of the skin, which is done by the men, glove making is mostly done by women. In this connection it should be stated that, inasmuch as a great majority of the persons employed in this industry are pieceworkers, any deductions from the above table relative to the average rate of wages would be misleading. The making by "home workers" is an important and interesting phase of their manufacture, and since the inception of the industry much of the glove making has been done at the homes of families, the members of which were unable, on account of various household duties, to take employment in a factory. Many of the large glove and mitten manufacturers of Gloversville and Johnstown, N. Y., employ delivery teams to distribute and collect the work of the home

workers. The following extract from a letter received by the division of statistics of the Agricultural Department from a prominent glove manufacturer of Fulton county, who has been intimately associated with the growth and development of the leather glove and mitten industry in this country, illustrates the extent to which gloves and mittens are made by farmers' families.

I have seen all large putters-out of gloves to country makers and from talks with them and manufacturers who have many farmers' families get work directly from them, I think I am very nearly correct in the following estimate of the number of farmers' families who make gloves:

Northville, with the adjoining towns in Hamilton and Saratoga counties	200
Broadalbin and Perth, with adjoining towns in Saratoga county	200
Garoga and Stratford, with adjoining towns in Herkimer county	150
Ephratah and Oppenheim, with adjoining towns in Herkimer county	250
Montgomery county	200
	1,000

This is but a rough estimate, and probably a full count of all families who do but a few dozens of pairs a year would add 100 or more to the above. All stitching on the backs of gloves is done in factories before they are sent out. The price of making varies from 20 cents per dozen for the cheapest gloves to $1 per dozen for full outseam. The earnings vary as greatly. A general average would be about $10 per month, although many women average 75 cents per day. There is not as much work sent out to farms as twenty years ago, but our two cities have grown up by farmers' families moving in and taking work daily from the factories. Only the high-priced work is made in factories, where not as many female operators are employed as there were ten years ago. I would estimate the total earnings of farmers' families in glove making to be about $125,000 per year. A farmer's daughter usually learns making on her mother's machine and then buys one costing about $35 for herself. Any girl naturally handy at sewing can learn to make common gloves in a week. All silk and thread are furnished by the manufacturers.

The schedule of inquiry adopted for 1890 was the first which contained questions designed to show the cost of manufacture other than for wages and materials. The questions of the Twelfth Census relating to miscellaneous expenses were made as uniform as possible with those of the previous census. The returns for 1900 are shown in Table 6, together with the per cent of each item to the total.

TABLE 6.—MISCELLANEOUS EXPENSES: 1900.

	Amount.	Per cent of total.
Total	$562,870	100.0
Rent of works	85,888	15.2
Taxes, not including internal revenue	23,466	4.2
Rent of offices, insurance, interest, repairs, advertising, and other sundries	359,721	63.9
Contract work	93,795	16.7

The amount paid for rent of offices, insurance, interest, internal-revenue tax and stamps, ordinary repairs of buildings and machinery, advertising, and all other sundries not reported under the head of materials, was $359,721, or 63.9 per cent of the total. This item does not include expense incurred for new equipment, machinery, and other apparatus, but only the amount expended for general repairs of buildings and machinery, and other minor expenses incident to the conduct of the business. The remaining items reported under miscellaneous expenses formed but a relatively small per cent of the total amount reported.

Table 7 shows the cost of the different materials used in the manufacture of leather gloves and mittens, with the per cent each item formed of the total for 1900.

TABLE 7.—COST OF MATERIALS: 1900.

	Amount.	Per cent of total.
Total	$9,382,102	100.0
Hides and skins	7,356,433	78.4
Fuel	42,280	0.5
Rent of power and heat	19,919	0.2
Mill supplies	12,619	0.1
All other materials	1,904,778	20.3
Freight	46,123	0.5

The aggregate cost of materials was $9,382,102, of which $7,356,433, or 78.4 per cent, represented the cost of hides and skins; the remaining $2,025,669, or 21.6 per cent, was made up of the cost of fuel, rent of power and heat, mill supplies, freight, and all other materials. Of these latter, the cost of all other materials was the largest item, amounting to $1,904,778, or 20.3 per cent of the total. Under this head is the amount expended for furs of all descriptions, silk, thread, buttons, fasteners, and numerous other incidentals which are required for a complete glove or mitten.

Table 8 shows the quantities and cost of the different varieties of hides and skins used, the average cost per dozen, and the per cent of each variety to the total quantity and cost, for 1900.

TABLE 8.—QUANTITIES AND COST OF HIDES AND SKINS USED: 1900.

	QUANTITY.		COST.		
	Dozens.	Per cent of total.	Total.	Per cent of total.	Average per dozen.
Total	826,416	100.0	$7,356,433	100.0	$8.90
Deerskins	89,596	10.8	1,146,808	15.6	12.80
Mochas, Arabian sheepskins	105,372	12.7	1,071,636	14.6	10.17
Cabretta, Brazilian sheepskins	6,432	0.8	47,899	0.6	7.37
Roans, all kinds of domestic sheepskins	422,481	51.1	2,256,511	30.7	5.34
Horse and cow hides	30,180	3.7	1,352,148	18.4	44.80
Kid, imported	70,824	8.6	740,170	10.1	10.45
Kid, domestic	97,245	11.8	708,800	9.6	7.29
All other varieties	4,286	0.5	32,961	0.4	7.69

It appears from Table 8 that 826,416 dozens of hides and skins, valued at $7,356,433, were used. This is an average cost of $8.90 per dozen. Roans, including all kinds of domestic sheepskins, formed the principal material from which gloves and mittens were manufactured; 422,481 dozen skins of this variety were used, costing $2,256,511, or 30.7 per cent of the total cost of leather, the average cost being $5.34 per dozen. The mochas formed the second principal material used in point of number of dozens, although the cost of both horse and cow hides and deerskins exceeded the cost of the mochas. Relative to the quantity of horse and cow hides, it should be stated that as a rule they were reported by manufacturers as purchased by the square foot. However, in order to make them comparable with the other varieties of hides and skins, they were reduced to dozens. A horse or cow hide is generally split up the back, being two sides to the skin. The large users estimated 15 square feet to the side, or 30 square feet to the hide. The number of dozens reported was computed by considering the two sides as composing a hide. The number of square feet was given as 10,864,607. The cost of imported kid skins used exceeded that of domestic, although the quantity of the latter was larger. Under "all other varieties" are included a number of different varieties of skins, such as seal, hog, and dog. Attention should here be directed to the fact that the average cost is computed from the totals of the whole number of establishments from which reports were received, and therefore must not be assumed to be indicative of the actual cost in any particular section of the country.

In addition to the materials reported in Table 8, there were 7 establishments, engaged in other industries, which manufactured leather gloves and mittens as a by-product. These establishments reported $106,114 for materials used for glove manufacture, as follows: Deerskins, 1,962 dozen, costing $25,799; mochas, 191 dozen, costing $2,091; cabretta, 35 dozen, costing $274; roans, 3,490 dozen, costing $18,159; kid, imported, 1,000 dozen, costing $11,981; kid, domestic, 2,116 dozen, costing $14,698; and 734 dozen horse and cow hides, costing $33,112. In this connection it is interesting to note the grade of gloves and mittens into which each variety of leather is cut. Mocha and imported kid are used for men's, women's, and children's fine lined and unlined gloves and mittens, and the domestic kid is made into the more common varieties. The cabretta and Brazilian sheepskin are cut into men's medium-grade gloves for driving. The roans, or domestic sheepskins, are made into men's low-grade gloves and mittens, the cheapest leather gloves made. The deerskins are cut into men's gloves and mittens; the horse and cow hides and the goat and seal skins are used as a substitute for deerskins in the manufacture of men's imitation buck gloves and mittens. In a general way the quantity of the different hides and skins reported for each state reflects the quality of gloves and mittens manufactured in that state. Reference to Table 14 shows that New York led in the consumption of every variety of hides and skins except horse and cow hides. Illinois led in the consumption of horse and cow hides, followed by New York, Wisconsin, and California, in the order named. In the consumption of domestic sheepskins New York ranked first, followed by Illinois, Indiana, California, and Wisconsin, in the order named.

Table 9 is a summary of the value of products, the number of dozens of pairs, and the value of the different varieties of gloves and mittens, the per cent of each variety to the total quantity and value of gloves and mittens, and the average value per dozen pairs, for 1900.

TABLE 9.—QUANTITIES AND VALUES OF PRODUCTS: 1900.

	Quantity (dozens of pairs).	VALUE.		PER CENT OF TOTAL, GLOVES AND MITTENS.	
		Total.	Average per dozen pairs.	Quantity.	Value.
Aggregate	.....	$16,721,234	.....	.....	.....
Gloves and mittens	2,895,661	16,039,168	$5.54	.....	.....
All other products	.....	682,066	.....	.....	.....
Total, gloves and mittens	2,895,661	16,039,168	5.54	100.0	100.0
Men's	2,267,327	12,418,258	5.48	78.3	77.4
Lined	952,820	4,959,902	5.21	32.9	30.9
Unlined	1,314,507	7,458,356	5.67	45.4	46.5
Women's	323,826	2,461,760	7.60	11.2	15.3
Lined	78,783	538,362	6.83	2.7	3.4
Unlined	221,039	1,772,746	8.02	7.7	11.0
Gauntlets	24,004	150,652	6.27	0.8	0.9
Boys' and youths'	247,465	926,059	3.74	8.5	5.8
Lined	148,493	548,556	3.69	5.1	3.4
Unlined	98,972	377,503	3.81	3.4	2.4
Misses' and children's	57,043	233,091	4.09	2.0	1.5
Lined	39,873	160,998	4.04	1.4	1.0
Unlined	17,170	72,093	4.20	0.6	0.5
Lined	1,219,969	6,207,818	5.09	42.1	38.7
Unlined	1,651,688	9,680,698	5.86	57.1	60.4
Gauntlets	24,004	150,652	6.27	0.8	0.9

Table 9 shows that the total value of products was $16,721,234. Of this amount, $16,039,168, or 95.9 per cent of the total, was the value of 2,895,661 dozens of pairs of gloves and mittens, while $682,066, or 4.1 per cent of the total, was reported as the value of all other products, including the amounts received for custom work and repairing.

Table 9 shows the proportions of the different varieties of gloves and mittens manufactured, and indicates that men's gloves and mittens formed over 75 per cent of the total quantity and value.

Of the total quantity and value of gloves and mittens, 1,219,969 dozens of pairs, valued at $6,207,818, or 42.1 per cent of the total quantity and 38.7 per cent of the total value, were lined, with an average value of $5.09 per dozen pairs; 1,651,688 dozens of pairs, valued at $9,680,698, or 57.1 per cent of the total quantity and 60.4 per cent of the total value, were unlined, with an average value of $5.86 per dozen pairs. It is interest-

ing to note the relative percentages of lined to unlined gloves and mittens. It has been customary to line the heavier and coarser working gloves and also some varieties of street gloves for winter wear, but it was not until about 1899 that silk linings for the finest grades of gloves came into general use; since then they have become decidedly popular, especially with the mocha glove. Gauntlets formed less than 1 per cent of the total quantity and value of gloves and mittens reported. Attention should also be called to the fact that the values are those obtained at the factory, and as the averages are computed from the totals of the entire number of establishments reporting, and as the varieties, styles, and grades of gloves and mittens are legion, the figures reported must not be taken as indicative of the price in any particular locality or of any specific grade of glove or mitten.

In addition to the above, the 7 establishments already referred to manufactured 32,971 dozen pairs of gloves and mittens, valued at $217,157, divided as follows: 25,327 dozen pairs of men's gloves and mittens, valued at $171,105, of which 15,788 dozen pairs, valued at $118,715, were unlined, and 9,539 dozen pairs, valued at $52,390, were lined; 6,024 dozen pairs of unlined women's gloves, valued at $39,771; also 1,620 dozen pairs of boys' and youths' gloves and mittens, valued at $6,281, of which 1,215 dozen pairs, valued at $4,894, were lined, and 405 dozen pairs, valued at $1,387, were unlined. A combination of the number of pairs manufactured by glove establishments and those reported as a by-product of other leather industries shows that there were 35,142,852 pairs of gloves and mittens of all descriptions manufactured during the census year, valued at $16,256,325. This was nearly equivalent to one pair for every two persons in the United States.

Table 10 is a summary of the quantity and value of gloves and mittens manufactured in each state and in each group of states for 1900.

TABLE 10.—QUANTITY AND VALUE OF GLOVES AND MITTENS, BY STATES AND TERRITORIES, ARRANGED GEOGRAPHICALLY: 1900.

STATES AND TERRITORIES.	TOTAL.		MEN'S.					
			Total.		Lined.		Unlined.	
	Dozens of pairs.	Value.	Dozens of pairs.	Value.	Dozens of pairs.	Value.	Dozens of pairs.	Value.
The United States	2,895,661	$16,039,168	2,267,327	$12,418,258	952,820	$4,959,902	1,314,507	$7,458,356
New England states	85,680	574,996	57,077	340,214	14,972	100,203	42,105	240,011
New Hampshire	49,085	281,186	44,385	256,636	10,800	76,200	33,585	180,436
Massachusetts	34,673	286,210	11,092	77,478	2,622	18,403	8,470	59,075
Other states[1]	1,922	7,600	1,600	6,100	1,550	5,600	50	500
Middle states	1,759,396	10,800,089	1,318,772	7,999,894	650,911	3,593,419	662,861	4,406,475
New York	1,721,831	10,507,789	1,280,595	7,731,868	643,440	3,547,825	637,155	4,184,043
New Jersey	18,755	171,065	16,697	152,931	1,004	9,564	15,693	143,367
Pennsylvania	9,223	38,500	8,223	35,625	4,910	22,050	3,313	13,575
Maryland	9,587	82,685	8,257	79,470	1,557	13,980	6,700	65,490
Southern states[2]	41,776	202,973	41,109	198,725	15,208	91,375	25,901	107,350
Central states	879,760	3,516,987	749,009	3,076,610	259,361	1,078,875	489,648	1,997,735
Ohio	43,386	95,390	43,286	94,940	18,770	39,190	24,516	55,750
Michigan	15,225	54,725	15,176	54,275	550	4,600	14,625	49,675
Illinois	573,411	2,324,698	472,483	2,010,629	105,546	520,558	366,937	1,490,071
Wisconsin	95,285	493,375	89,255	461,922	58,790	253,287	30,465	208,635
Minnesota	2,873	20,628	2,873	20,628	2,088	12,490	785	8,138
Iowa	52,403	238,400	41,370	172,600	4,750	30,000	36,620	142,600
Other states[3]	97,167	289,771	84,567	261,616	68,867	218,750	15,700	42,866
Western states[4]	2,048	13,391	1,966	12,781	526	3,430	1,440	9,351
Pacific states	127,001	930,782	104,394	790,034	11,842	92,600	92,552	697,434
California	121,301	887,289	98,969	748,091	11,692	91,100	87,277	656,991
Other states[5]	5,700	43,543	5,425	41,943	150	1,500	5,275	40,443

[1] Includes establishments distributed as follows: Maine, 1; Rhode Island, 1; Connecticut, 1.
[2] Includes establishments distributed as follows: West Virginia, 1; Virginia, 3; Oklahoma, 1.
[3] Includes establishments distributed as follows: Indiana, 3; Missouri, 2.
[4] Includes establishments distributed as follows: Montana, 1; Nebraska, 1; Utah, 1; Colorado, 1.
[5] Includes establishments distributed as follows: Washington, 3; Oregon, 2.

TABLE 10.—QUANTITY AND VALUE OF GLOVES AND MITTENS, BY STATES AND TERRITORIES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES AND TERRITORIES.	WOMEN'S.							
	Total.		Lined.		Unlined.		Gauntlets.	
	Dozens of pairs.	Value.	Dozens of pairs.	Value.	Dozens of pairs.	Value.	Dozens of pairs.	Value.
The United States	323,826	$2,461,760	78,783	$538,362	221,039	$1,772,746	24,004	$150,652
New England states	24,216	212,282	37	300	24,159	211,782	20	200
New Hampshire	500	2,750	.....	.....	500	2,750	.....	.....
Massachusetts	23,581	208,732	.....	.....	23,581	208,732	.....	.....
Other states[1]	135	800	37	300	78	300	20	200
Middle states	265,007	2,006,862	70,647	497,178	177,266	1,406,758	17,094	102,926
New York	262,129	1,986,918	70,139	492,044	174,896	1,391,948	17,094	102,926
New Jersey	2,058	18,134	508	5,134	1,550	13,000	.....	.....
Pennsylvania	.....	.....	.....	.....	.....	.....	.....	.....
Maryland	820	1,810	.....	.....	820	1,810	.....	.....
Southern states[2]	363	3,025	180	1,365	155	1,240	28	420
Central states	20,656	133,535	6,069	28,379	11,967	89,446	2,620	15,710
Ohio	.....	.....	.....	.....	.....	.....	.....	.....
Michigan	50	450	50	450	.....	.....	.....	.....
Illinois	10,501	61,165	3,593	15,065	4,758	33,050	2,150	13,050
Wisconsin	1,965	15,520	976	6,564	979	8,896	10	60
Minnesota	.....	.....	.....	.....	.....	.....	.....	.....
Iowa	8,040	56,000	1,450	6,300	6,230	47,500	360	2,200
Other states[3]	100	400	.....	.....	.....	.....	100	400
Western states[4]	72	588	40	240	.....	.....	32	348
Pacific states	13,512	105,468	1,810	10,900	7,492	63,520	4,210	31,048
California	13,412	104,568	1,810	10,900	7,392	62,620	4,210	31,048
Other states[5]	100	900	.....	.....	100	900	.....	.....

STATES AND TERRITORIES.	BOYS' AND YOUTHS'.						MISSES' AND CHILDREN'S.					
	Total.		Lined.		Unlined.		Total.		Lined.		Unlined.	
	Dozens of pairs.	Value.	Dozens of pairs.	Value.	Dozens of pairs.	Value.	Dozens of pairs.	Value.	Dozens of pairs.	Value.	Dozens of pairs.	Value.
The United States	247,465	$926,059	148,493	$548,556	98,972	$377,503	57,043	$233,091	39,873	$160,998	17,170	$72,093
New England states	4,300	22,200	1,050	6,200	3,250	16,000	87	300	44	150	43	150
New Hampshire	4,200	21,800	1,000	6,000	3,200	15,800	.....	.....	.....	.....	.....	.....
Massachusetts	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Other states[1]	100	400	50	200	50	200	87	300	44	150	43	150
Middle states	128,088	575,650	87,629	374,900	40,459	200,750	52,529	217,633	36,982	152,125	15,547	65,508
New York	126,578	571,370	86,419	371,575	40,159	199,795	52,529	217,633	36,982	152,125	15,547	65,508
New Jersey	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pennsylvania	1,000	2,875	900	2,475	100	400	.....	.....	.....	.....	.....	.....
Maryland	510	1,405	310	850	200	555	.....	.....	.....	.....	.....	.....
Southern states[2]	227	874	102	374	125	500	77	349	27	149	50	200
Central states	107,235	297,943	57,682	159,680	49,553	138,263	2,860	8,899	2,820	8,574	40	325
Ohio	100	450	100	450	.....	.....	.....	.....	.....	.....	.....	.....
Michigan	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Illinois	87,572	244,029	40,515	113,550	47,057	130,479	2,855	8,875	2,815	8,550	40	325
Wisconsin	4,010	15,909	3,032	12,325	978	3,584	5	24	5	24	.....	.....
Minnesota	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Iowa	3,053	9,800	2,035	6,600	1,018	3,200	.....	.....	.....	.....	.....	.....
Other states[3]	12,500	27,755	12,000	26,755	500	1,000	.....	.....	.....	.....	.....	.....
Western states[4]	10	22	10	22	.....	.....	.....	.....	.....	.....	.....	.....
Pacific states	7,605	29,370	2,020	7,380	5,585	21,990	1,490	5,910	.....	.....	1,490	5,910
California	7,455	28,770	2,020	7,380	5,435	21,390	1,465	5,810	.....	.....	1,465	5,810
Other states[5]	150	600	.....	.....	150	600	25	100	.....	.....	25	100

[1] Includes establishments distributed as follows: Maine, 1; Rhode Island, 1; Connecticut, 1.
[2] Includes establishments distributed as follows: West Virginia, 1; Virginia, 3; Oklahoma, 1.
[3] Includes establishments distributed as follows: Indiana, 3; Missouri, 2.
[4] Includes establishments distributed as follows: Montana, 1; Nebraska, 1; Utah, 1; Colorado, 1.
[5] Includes establishments distributed as follows: Washington, 3; Oregon, 2.

Table 10 indicates that of the total quantity of gloves and mittens, 1,759,396 dozens of pairs, or 60.8 per cent, were manufactured in the Middle states, and 879,760 dozens of pairs, or 30.4 per cent, were manufactured in the Central states. The quantity reported in the Pacific states formed 4.4 per cent of the total quantity. The leading 5 states, ranked according to the quantity of gloves and mittens manufactured, with the number of dozens of pairs reported by each, are as follows: New York, 1,721,831; Illinois, 573,411; California, 121,301; Wisconsin, 95,235; and Indiana, 92,300. The combined output of these states was 2,604,078 dozens of pairs, or 89.9 per cent of the total number manufactured in the United States.

Table 11 shows the totals for Fulton county in comparison with the state of New York, and also the totals for that state in comparison with the totals for the United States.

TABLE 11.—COMPARATIVE SUMMARY OF STATISTICS FOR FULTON COUNTY, N. Y., NEW YORK STATE, AND THE UNITED STATES: 1900.

	United States.	NEW YORK.		FULTON COUNTY.							
		Total.	Per cent of United States total.	Total.	Per cent of United States total.	Cities.				Outside of cities	Per cent of county total.
						Gloversville.	Per cent of county total.	Johnstown.	Per cent of county total.		
Number of establishments	381	243	63.8	166	43.6	101	60.9	49	29.5	16	9.6
Capital	$9,004,427	$6,219,647	69.1	$5,517,850	61.3	$3,660,383	66.3	$1,686,604	30.6	$170,863	3.1
Salaried officials, clerks, etc., number	637	328	51.5	250	39.2	171	68.4	72	28.8	7	2.8
Salaries	$544,170	$294,574	54.1	$244,522	44.9	$177,551	72.6	$64,114	26.2	$2,857	1.2
Wage-earners, average number	14,180	9,907	69.9	7,931	55.9	5,183	65.4	2,316	29.2	432	5.4
Total wages	$4,151,126	$2,723,702	65.6	$2,381,160	57.4	$1,695,035	71.2	$580,146	24.4	$105,979	4.4
Men, 16 years and over	4,864	2,843	65.1	2,295	52.6	1,497	65.2	670	29.2	128	5.6
Wages	$2,014,134	$1,299,595	64.5	$1,158,193	57.5	$822,201	71.0	$287,875	24.9	$48,117	4.1
Women, 16 years and over	9,542	7,001	73.4	5,601	58.7	3,674	65.6	1,625	29.0	302	5.4
Wages	$2,101,044	$1,415,156	67.4	$1,214,993	57.8	$868,422	71.5	$288,997	23.8	$57,574	4.7
Children, under 16 years	274	63	23.0	35	12.8	12	34.3	21	60.0	2	5.7
Wages	$35,948	$8,951	24.9	$7,974	22.2	$4,412	55.3	$3,274	41.1	$288	3.6
Miscellaneous expenses	$562,870	$341,486	60.7	$237,446	42.2	$153,275	64.6	$60,172	25.3	$23,999	10.1
Cost of materials used	$9,382,102	$6,328,036	67.4	$5,689,613	60.6	$3,900,897	68.5	$1,506,198	26.5	$282,523	5.0
Products:											
Total value	$16,721,234	$10,854,221	64.9	$9,548,603	57.1	$6,487,227	67.9	$2,576,048	27.0	$485,328	5.1
Gloves and mittens:											
Dozens of pairs	2,895,661	1,721,831	59.5	1,484,579	51.3	926,440	62.3	398,657	26.9	160,482	10.8
Value	$16,039,168	$10,507,789	65.5	$9,379,560	58.5	$6,350,809	67.7	$2,554,717	27.2	$474,034	5.1
All other products, value	$682,066	$346,432	50.8	$169,043	24.8	$136,418	80.7	$21,331	12.6	$11,294	6.7

Table 11 shows the extent to which the industry is local and peculiar to the state of New York, and especially to Fulton county. Of the total number of establishments in the leather glove and mitten industry, New York reported 243, or 63.8 per cent, with a capital of $6,219,647, or 69.1 per cent of the total capital. They employed 9,907 wage-earners, or 69.9 per cent of the total number. The cost of materials was $6,328,036, or 67.4 per cent, and the value of products $10,854,221, or 64.9 per cent, of the total for the United States. Of the total quantity of gloves and mittens reported, 1,721,831 dozens of pairs, or 59.5 per cent, were manufactured in New York. Table 11 also shows the degree to which the industry was centralized in Fulton county, and in Gloversville and Johnstown. Fulton county returned 166 establishments, or 43.6 per cent of the total number reported. Their capital was $5,517,850, or 61.3 per cent of the total, and the number of wage-earners constituted 55.9 per cent of the total number reported. This relatively large per cent of the total capital and the number of wage-earners reported for Fulton county as compared with the per cent of the total number of establishments, in a measure indicates that the larger glove and mitten factories are located in Fulton county. The value of products was $9,548,603, or 57.1 per cent of the total, and the quantity of gloves and mittens was 1,484,579 dozens of pairs, or 51.3 per cent of the total, valued at $9,379,560. Table 11 further indicates that over 60 per cent of the glove and mitten establishments of Fulton county were located in Gloversville. This localization of the industry is not due to economic conditions, such as low price of coal or to advantageous freight rates, but it may be attributed to the nature of the industry itself, and to the circumstances connected with its inception in the United States. As indicated in the historical sketch which follows, gloves and mittens were first manufactured in the United States in what is now Fulton county. As the industry became of commercial importance the number of families that depended upon it for a livelihood increased, until nearly every man, woman, and child in the surrounding country became proficient in the making of some special part of the glove or mitten. Foreign cutters coming to this country naturally settled in Fulton county. In this way the industry became localized, and contemporaneously came the development of the tanning industry and the establishment of factories engaged in making glove and mitten dies.

Nearly all the factories are owned or controlled by local men, most of whom have at some time been employed in other factories in the country, and who by thrift and industry have risen from the cutter's table

to the management or ownership of a factory. Naturally everything tends to make the industry local; the expert and skilled laborers in most cases own their own homes; the manufacturer is able to depend upon the farmers' families for a great deal of work, and is himself interested in the development of local enterprises.

There are, however, large numbers of leather gloves and mittens manufactured, not only outside of Fulton county, but also outside of New York. They were made in the early part of the century, and are still made, at Littleton and Plymouth, N. H. In 1900, as shown by Table 3, they were manufactured in 27 states, but, outside of Fulton county, N. Y., the product was mostly of the coarser and cheaper grades, as it is impossible to induce the expert labor to emigrate to another section of the country.

Table 12 shows the statistics of the leather glove and mitten industry for cities of over 20,000 population for 1900.

TABLE 12.—STATISTICS OF CITIES OF OVER 20,000 POPULATION: 1900.

CITIES.	Rank by value of products.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		AVERAGE NUMBER OF WAGE-EARNERS AND TOTAL WAGES.			
						Total.		Men, 16 years and over.	
				Number.	Salaries.	Average number.	Wages.	Average number.	Wages.
Total		124	$1,780,328	238	$195,411	3,317	$1,250,966	1,195	$609,350
Chicago, Ill	1	21	615,439	79	75,407	1,532	598,982	656	313,528
San Francisco, Cal	2	15	297,650	50	40,392	400	158,304	129	72,184
New York, N. Y	3	34	245,410	27	24,780	483	191,851	104	74,021
Milwaukee, Wis	4	6	85,423	3	2,299	124	43,429	53	23,649
Boston, Mass	5	5	71,000	4	1,500	138	63,126	47	34,163
Buffalo, N. Y	6	4	63,666	19	12,898	54	18,844	25	10,320
Syracuse, N. Y	7	5	19,203	3	1,275	31	9,179	11	3,839
Binghamton, N. Y	8	3	12,926	.....	.....	20	6,687	10	3,351
Minneapolis, Minn	9	4	3,855	.....	.....	10	2,210	1	570
All other cities[1]	.....	27	365,756	53	36,860	525	158,404	159	73,175

CITIES.	AVERAGE NUMBER OF WAGE-EARNERS AND TOTAL WAGES.				Miscellaneous expenses.	Cost of materials used	PRODUCTS.			
	Women, 16 years and over.		Children, under 16 years.				Total value.	Gloves and mittens.		All other products, value.
	Average number.	Wages.	Average number.	Wages.				Dozens of pairs.	Value.	
Total	1,997	$624,193	125	$17,423	$163,213	$2,326,206	$4,761,203	942,615	$4,553,232	$207,971
Chicago, Ill	795	274,430	81	11,024	59,518	1,074,569	2,209,529	554,360	2,207,279	2,250
San Francisco, Cal	262	84,820	9	1,300	35,865	819,226	664,131	83,428	634,371	29,760
New York, N. Y	378	117,655	1	175	38,189	235,998	586,061	46,595	417,143	168,918
Milwaukee, Wis	65	19,006	6	774	3,062	178,774	252,182	60,660	251,532	650
Boston, Mass	91	28,963	.....	.....	5,142	101,390	230,262	25,553	230,262	.....
Buffalo, N. Y	28	7,934	1	90	2,336	55,126	106,000	17,000	106,000	.....
Syracuse, N. Y	20	5,290	.....	.....	3,340	32,958	56,437	14,958	55,957	480
Binghamton, N. Y	10	3,286	.....	.....	258	24,046	36,263	11,615	36,263	.....
Minneapolis, Minn	8	1,560	1	80	768	3,937	9,628	1,822	9,378	250
All other cities[1]	340	81,249	26	3,980	14,740	300,182	610,710	121,029	605,047	5,663

[1] Includes establishments distributed as follows: Oakland, Cal., 1; San Jose, Cal., 2; Denver, Colo., 1; Rockford, Ill., 1; Fort Wayne, Ind., 2; Des Moines, Iowa, 1; Salem, Mass., 1; Detroit, Mich., 2; Kalamazoo, Mich., 1; St. Louis, Mo., 1; Omaha, Nebr., 1; Jersey City, N. J., 2; West Hoboken, N. J., 1; Auburn, N. Y., 1; Elmira, N. Y., 1; Kingston, N. Y., 2; Rochester, N. Y., 2; Cincinnati, Ohio, 1; Portland, Oreg., 2; Seattle, Wash., 1.

Table 12 indicates the extent to which the industry was carried on in large cities in 1900. The 124 establishments in these cities constituted 57.7 per cent of all the establishments outside of Fulton county. The capital invested was $1,780,328, or 51.1 per cent; the number of wage-earners 3,317, or 53.1 per cent; and the value of products $4,761,203, or 66.4 per cent. The number of gloves and mittens manufactured was 942,615 dozens, valued at $4,553,232, or 66.8 per cent. Chicago led the cities of over 20,000 population in value of products as well as in the number of dozen pairs of gloves and mittens manufactured, although New York city led in number of establishments. Chicago reported 554,360 dozen pairs of gloves and mittens, valued at $2,207,279, or 58.8 per cent of the total quantity and 48.5 per cent of the total value for the cities. San Francisco followed Chicago, both in quantity and value of products, and New York city ranked third. Milwaukee was next to New York in value of products, but exceeded it in the number of dozen pairs. This is due to the fact that a large amount was reported as the value of custom work and repairing in New York. Boston ranked fifth in both value of products and number of dozens. The totals of the remaining cities formed a comparatively small per cent of the totals for the cities. This rapid growth of the industry is due to improvements that have been made during the past twenty years. As already stated, the first mittens manufactured in the United States were used for the protection of the hands during the harvest. Later on, coarse gloves were made

for laborers who, from the nature of their employment, were exposed to the inclemency of the weather. Gradually the manufacture became diversified and manufacturers began to improve upon the quality and to turn their attention to gloves for street wear. It was subsequent to 1880, however, that the attempt was made to manufacture fine gloves. As the quality improved the demand increased, resulting in the establishment of new factories. At the present time the development of the industry in the United States has reached a point where the manufacturer is able to reproduce the best points of all the foreign makes and to combine them with his own. In men's fine gloves he can produce an article that is equal if not superior to any foreign manufacture. The American glove is more durable, is better made, and fits more satisfactorily. This great advance has been accomplished mainly by the improved facilities for tanning, coloring, and finishing, and the expert knowledge of the glove makers and leather dressers, who have come to this country in great numbers from all of the glove-producing countries of Europe.

Table 13 shows the value of gloves of kid and other leather imported each year, 1890 to 1900, inclusive, and from what countries imported, according to the reports of the bureau of statistics of the Treasury Department.

Table 13 indicates that the importations of gloves and mittens have not increased to any great extent during the decade; in fact, during 1898 and 1899, the value of

TABLE 13.—VALUE OF GLOVES, OF KID OR OTHER LEATHER, IMPORTED FROM 1890 TO 1900, INCLUSIVE.

COUNTRIES.	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890
Total	$6,107,765	$5,398,125	$5,384,168	$6,486,813	$6,763,082	$6,463,872	$4,412,597	$6,925,876	$5,830,380	$5,627,964	$5,501,336
EUROPE.											
Austria-Hungary	124,616	198,921	298,421	600,763	366,421	111,264	169,977	239,863	97,572	161,634	170,581
Belgium	275,340	264,186	286,237	372,096	410,608	458,654	267,142	357,025	203,582	400,924	361,791
Denmark	1,891	1,626	24	466	15	488	16	18	15	32	220
France	2,260,697	2,064,603	1,625,276	2,271,669	2,499,644	2,621,224	1,702,981	3,201,407	2,806,821	2,465,442	2,548,375
Germany	2,785,103	2,347,827	2,683,924	2,610,175	2,894,465	2,768,978	1,826,623	2,565,011	2,217,809	2,117,012	2,077,917
Gibraltar										7	
Italy	223,241	150,274	170,120	211,106	187,058	217,482	150,068	176,171	181,472	252,581	285,870
Netherlands	98		4	55	2,473	102	7,567	36,338	58,398	10	66
Russia—Baltic and White seas							65				
Spain						38					13
Sweden and Norway	14,336	7,883	9,048	6,390	6,248	3,864	1,468	5,168	1,679	1,783	734
Switzerland	7,990	1,454	1,622	6,492	1,017	6			12	8,157	187
Turkey in Europe											9
United Kingdom	413,622	360,750	309,036	407,416	390,948	281,256	286,612	344,694	262,818	222,149	254,713
NORTH AMERICA.											
Bermuda								6			
Dominion of Canada:											
Nova Scotia, New Brunswick, etc	245	143	76	81	19				2	2,908	122
Quebec, Ontario, Manitoba, etc	125	82	302	94	880	419	57	151	70	288	488
British Columbia	350	108	19	3	11	43	6	10	6	2	135
Newfoundland and Labrador			1			1					
Mexico	106	11	7	7	93	53	12	14	123	27	115
West Indies:											
British		1								8	
Cuba	5										
Danish		256									
French					3,156						
SOUTH AMERICA.											
Argentina			6								
ASIA.											
Chinese Empire			29								
Japan			9		7				1		
Turkey in Asia					19		3				
OCEANIA.											
British Australasia			7								

imports of gloves was less than the amount reported for 1890, 1891, or 1892. The increase from 1890 to 1900 is insignificant compared with the increase in the output of domestic factories. France and Germany have always been the largest exporters of gloves and mittens to the United States. In 1900 the value of the imports from these two countries amounted to $5,045,800, or 82.6 per cent of the total. The United Kingdom followed, with $413,622; Belgium was fourth, with $275,340; and Italy fifth, with $223,241. The imports from the remaining countries, with the exception of those from Austria-Hungary, amounting to $124,616, were insignificant. The imports were almost exclusively of the finer grade of gloves and, presumably, the greater per cent represented ladies' fine gloves.

The manufacture of ladies' fine gloves has not yet been attempted to any considerable extent in the United States. This is due to the fact that thus far glove manufacturers here have been unable to secure the finest grade of skins; the foreign manufacturers seem to have the monopoly of these, only the inferior grades being exported to this country. In the course of time, however, through competition and an increased local demand, it may be expected that the manufacturer in

the United States will be able to obtain as good a grade of skins as his European rival. Also, owing to the low wages paid in foreign countries, the manufacturer in this country can not yet compete with the foreign producer in these finer grades. Moreover, the character of the labor is another factor favoring the foreign manufacturer. The making of the best gloves not only requires expert skill and knowledge, but also extreme patience, as the finest work must be slowly executed. The economic conditions are so different in foreign countries, wages are so low, and employment so difficult to secure, that the glove makers, in order to retain their employment, are obliged to do exceedingly careful and painstaking work, which means that they are able to accomplish only a comparatively small amount of work a day. In the United States, on the other hand, the glove maker is accustomed to better living, better clothes, and more amusement than his European coworker, and, of necessity, he must receive higher wages. Accordingly he prefers to make the cheaper grade of gloves, as he can cut and make more during the day than if he were employed on the finer grades. All of these factors combine to seriously handicap the manufacturer in the United States. It is probable, however, that the ingenuity of inventors will bring to perfection labor-saving machines, which will result in producing artistic work surpassing the best possible handwork. At any rate, the glove manufacturers of the United States will not be satisfied until they furnish every pair of gloves and mittens worn by the people of this country.

From the inception of the United States Patent Office to January 1, 1902, in connection with the manufacture of gloves and mittens there have been issued 340 patents, classified as follows:

Glove fastenings	54
Glove-sewing machines	46
Gloves	179
Mittens	61
Total	340

Probably the most notable of the glove-making machines is the multiple-needle machine, for stitching the back of gloves, which sews two, three, four, and even six rows at the same time. The automatic trimmer, which is attached to the head or needle bar of the machine, was introduced in 1893, and has greatly facilitated the making of outseam gloves, and it also trims the leather much better than do shears. Among the other machines which have given satisfaction are the ornamental stitch, the zigzag stitch, and the overstitch, the latter being used to close the edges of the seam from the outside.

HISTORICAL AND DESCRIPTIVE.

At various periods and in different countries the glove has been the theme for many fanciful and poetic theories. It has been a customary offering on occasions of joy and sorrow; the pledge of friendship, of love, and of safety; the symbol of hatred and defiance, of humiliation and honor; the token of loyalty, and the tenure by which estates have been granted and held.

The origin of the glove is unknown, and its material history is not aided to any extent by the history of the word itself. It is evident, however, that the farther back the word can be traced, the longer must gloves have been in existence; and while the etymologists invariably reach different conclusions regarding the origin of the word, their careful researches have demonstrated that the antiquity of the glove is certainly remote. From all evidence that is obtainable, it probably constituted a part of man's dress from time immemorial. If recent discoveries in the geological world are to be credited, it formed a part of the costume of the prehistoric cave dwellers. It is supposed that the gloves of the cave dwellers were made from roughly dressed skins and sewed with needles made of bone, and were not of ordinary size, but reached to the elbows, thus anticipating the multi-button glove of the Victorian era.[1] They were known to the Greeks and also to the Persians and Romans. Among the Greeks they were chiefly used by the laborers as a protection for the hands in gathering harvests. Among the Persians and Romans they were also worn as ornaments, chiefly by the higher orders, particularly the clergy and military.

It is more than likely that they were always worn by the northern people of Europe for protection from the inclemency of the weather, as the early history and the literature of the Anglo-Saxon race contain references to their use. But with the English, as with other nations of Europe during the dark ages, their use was confined to and formed a part of the regalia of kings, princes, and other attendants on royal occasions. That great importance was paid to their quality even during this period may be inferred from an old proverb, "For a glove to be good, three nations must contribute to it: Spain to dress the leather, France to cut it, and England to sew it."[2]

During the Eighth and Ninth centuries it was an article of much importance, but was largely confined to the higher orders, the royalty, military, and clergy. Charlemagne, about the year 790, granted the abbot and monks of Sithin the unlimited right of hunting, so that they could make their gloves and girdles and

[1] Gloves, Their Annals and Associations, by S. William Beck, page 13.

[2] The History of the Glove Trade by William Hull, jr., page 11.

covers for their books from the skins of the deer they might kill. For centuries the glove continued to be an essential adjunct to the regalia of royalty. It was worn at the coronation of kings and at their funeral ceremonies. The church, in its efforts to teach principles and truth by sight, endowed gloves with hidden significance, and in this way they played an important part in ecclesiastical rites and ceremonies. They were a part of the dress worn at the consecration of bishops, and were placed on their hands at burial, and in the Fourteenth century the inferior clergy and attendants also were allowed to wear them at religious ceremonies. Their use and elegance, however, became so extravagant that the church was compelled to pass sumptuary restrictions regarding them. It is stated that they were not generally worn by women until about the period of the Reformation.

During the middle ages gloves were in general use among those vested with authority, possessing special significance when worn by justices. Another peculiar and interesting use of gloves, which to some extent gives proof of their antiquity, was in hawking. This sport had its origin about the Fourth century, and it may safely be inferred that the wearing of gloves was coeval with it, since some covering would seem to be necessary to protect the hands from the sharp talons of the hawk. They were also used in archery.

The Germans were probably the first people to adopt the custom of wearing gloves to any considerable extent, and their manufacture was introduced into Germany by French refugees from Grenoble. The gloves worn by ladies were of fine material and workmanship, and were usually adorned on the back with a number of stones or jewels. Those worn by the men had a thumb stall, but left the fingers free as do mittens; in workmanship and material they were not as fine as the gloves worn by ladies.

In England they were introduced as ornaments by the Normans after the conquest, and were then made quite long, reaching to the elbows, and ornamented at the top with embroidery. Their use was at that time confined to men, but in the Fourteenth century they were adopted to some extent by ladies of rank. At the time of John they were not a part of the dress of the commonalty, and were worn only by the higher classes. The cheverill gloves were in common use in the Sixteenth century. "Cheverill" is derived from the French chèvre, or goat. The skin of the goat, on account of its pliability, made better gloves than the skins which had been used before that time. In 1550 or thereabouts the use of gloves was common to all classes and conditions of men. Those worn by the higher classes during the Sixteenth century have been well described, as follows:

> The magnificent embroidery on the cuff of the glove can hardly be done justice to in description. Every flower, the columbine and pink in particular, the butterflies, and even a little goldfinch in the middle of the cuff, are rendered in natural colors with an exquisite fidelity, and with such skill as to make them veritable needle paintings, in which, too, the needle well holds its own against the brush. The work is done in fine silk and the shading is eloquent of the skill of early dyers, for the range of colors admitting of such indefinable gradations must have been very extensive. * * * The glove is nearly 13 inches in total length. The whole cuff, 4½ inches in depth, is lined with crimson silk, and the side bands of cloth-of-gold ribbon, edged with gold fringe, were probably attached to the glove to confine the wide sleeves, and allow the ornamentation of the gauntlets unhindered admiration.[1]

Gloves for ordinary everyday wear were made of substantial leather and were not altogether destitute of ornament. More elaborate gloves were made of tan-colored doeskin, with a white kid lining, and with red silk turned up over the edge in the cuff. During the Stuart period in England, according to the dictates of fashion, the sleeves gradually became shorter, and as the sleeve receded the glove advanced in length. The varieties worn by the gay cavaliers were usually made of white leather and overloaded with ornaments. Lace was freely used at this period, and a glove which became very fashionable during the first half of the Eighteenth century, was made with broad black lace ruffles and heavy fringe. From this time on it receded in length and became more and more simple in construction and more and more immaculate in fit.

The industry owes much of its importance to a society of handcraftsmen known as "glovers." They were organized in France as early as 1190, and in Scotland the glovers of Perth were incorporated in 1165. This society not only promoted the growth of the trade, but contributed largely to improvements in the construction and material of the glove. It took upon itself the task of insuring honesty in workmanship and of aiding in the regulation of the trade. As early as the Fifteenth century these "glovers" secured the enactment of laws favorable to the glove trade in their respective countries. In the early part of the Seventeenth century a company of glovers was organized in London, and from that time this city has been a center of the glove industry. In Ireland the manufacture of gloves was formerly very extensive, Limerick, Cork, and Dublin having thousands of people employed in this occupation. The "Limerick" glove was of most exquisite texture and was manufactured principally from the skin of the very young calf, lamb, or kid. So delicate was the material that it is said that one of these gloves could be placed within a walnut shell. The industry, after enjoying a very prosperous era, declined and is now of no importance. Gloves have been manufactured in France for many centuries, Paris, Grenoble, Nicot, and Montpelier each having an extensive trade. Following the example of England, protection was afforded to the home manufacture by the enactment of favorable laws. The industry in France has always

[1] Gloves, Their Annals and Associations, by S. William Beck, page 121.

been very prosperous, and that country is to-day among the foremost of nations in the production of gloves. This success has resulted largely, perhaps, from persistent efforts to secure excellence in material and workmanship.

The manufacture of gloves and mittens in the United States dates from about the year 1760, when Sir William Johnson, chief agent of King George with the North American Indians, brought over from Scotland many families as settlers on his grants. Several families came from Perthshire and settled in the eastern part of what is now Fulton county, N. Y., calling the town Perth. Many of these settlers had been glove makers and members of the glove guild in Scotland, and brought with them glove patterns and the proper needles and threads for glove making. The first gloves and mittens were used chiefly by the farmers and woodchoppers as a protection for the hands while engaged in the rough and laborious work incident to their occupation. The entire output of the industry for many years was probably disposed of in the immediate vicinity. It was not until about 1809 that gloves were manufactured for more distant markets, and it is stated that Talmadge Edwards, a storekeeper of Johnstown, N. Y., was the pioneer in the manufacture of gloves in commercial quantities. Mr. Edwards took a bag of them on horseback to Albany when making a trip for the purpose of renewing his stock of merchandise. Finding a good demand for these articles, he had leather dressed in quantities, and secured farmers' girls to come to his factory to cut gloves, which were then sent out to farmers' wives to be sewed. In this manner the glove and mitten industry of the United States was established.[1] During the incipient stages of this industry the goods produced were really mittens, and not gloves. A glove, as distinguished from a mitten, is a covering for the hand in which each finger is separately inclosed, the part above the hand varying in length according to fashion or convenience. About the year 1810 a glove manufacturer, who had been associated with Mr. Edwards, sold a part of his output by the dozen, and this is said to be the first instance in which they were sold by the quantity. The local demand continued to increase, and each year some enterprising manufacturer would venture to make an extended trip to dispose of his product. In 1825 Elisha Johnson, of Gloversville, N. Y., went to Boston with a load of gloves in a lumber wagon, making the journey in six weeks. This is said to have been the longest trip that had been made in connection with the industry up to that time, and the results were highly gratifying to those interested.[2]

The early process of glove making differed from modern methods. In the first place, a skin was put on a table, and a pattern cut from pasteboard or a shingle and having spaces between the fingers wide enough to admit a flat pencil, was placed on the skin. The gloves were then marked out or traced with sharp pointed pieces of lead, commonly called "plummets" (which were often made by pouring melted lead into a crack in the kitchen floor), and then cut out with shears. They were then matched with fourchettes and thumb pieces, and tied with a buckskin string in lots of a dozen pairs, with thread, needles, and silk, and a handful of scraps for weltings. The cutting was usually done by men, the sewing or making by women. In the early days the manufacturer did not have his gloves and mittens sewn in his factory, but gave them out to the country people, who came to him from miles around and took the gloves home with them in bags. A small skein of silk was put in with the better class of goods, to be used in working a vine on the back of the glove as its only ornament. The maker threaded a square pointed needle with heavy linen thread, double tied a knot in the end, waxed it, placed a strip of buckskin between the edges as a welt, and sewed up the seams. The lighter gloves had no welt, but were backstitched, and it was possible for an expert to make a neat, close-fitting glove. The welted gloves, if well made, gave very satisfactory service. As each glove was completed it was placed between folds of pasteboard and the maker sat on it while engaged in sewing the next glove. This "patent pressing process," as it was jocularly called, partially served the purpose of the modern "laying-off" table, as it straightened out the glove and had a tendency to make it soft and flexible.

After a time dies of clumsy construction and wooden mauls were introduced to take the place of shears. These became of great service, and their construction has been greatly simplified. They are now in constant use. At first two sets were used—one for cutting the leather to size and one for cutting to shape. These were soon abandoned, however, as unprofitable, their use necessitating the waste of large quantities of leather. For a time a right and left die were used, but it was soon found that the same results could be obtained with one die by turning the skin.

The introduction and development of the sewing machine has been an important factor in the development of the glove industry. It was first used in 1852. The first machines were large, crude, cumbersome, and difficult to operate, both needle bar and shuttle being driven by cogwheels. They were used only in stitching the thin binding on the tops of gloves and mittens. In 1854 a machine was introduced to stitch the laps and bindings. In this branch of the business the sewing machine entirely superseded hand work. In 1856 a machine was introduced to make some grades of light goods throughout.

Although the wax thread was used in 1858, its use was not general until after the Civil War. Thousands

[1] M. S. Northrup, ex-secretary American Glove Association.

[2] History of Fulton County, N. Y., by Washington Frothingham, page 157.

of sewing machines are now in use in this industry, not only of American, but also of French and German make. A number of machines are used for special purposes, as for silking and palming, and making the prick and pique and other seams.

The industry received a decided stimulus during the Civil War, as large quantities of gloves, especially gauntlets, were required for military service. Both gloves and skins shared in the general rise of prices which took place during this period. Steam power was introduced for running sewing machines in 1875, and since that time the direct factory output has greatly increased. The variety of material used in glove making is limited, the most common material being leather. Many varieties of skins are now used which for a long time were thought valueless. In the infancy of the industry in the United States, deer were abundant and their skins were the chief material used. The deerskin glove, although necessarily crude, gave excellent protection to the hands. As the demands of the trade grew, the home product of deerskins became insufficient, and sheepskins were pressed into use. This leather, however, was not very suitable for glove making, being weak and pulpy, and as no process of tanning was as yet perfected to render the leather durable in all weather, deerskins began to be imported. At the present time, however, as indicated by Table 8, sheep and lamb skins, both domestic and imported, are more extensively used in the manufacture of gloves and mittens than any other skin, as, by means of the various processes of tanning and coloring, these skins can be made into different grades and qualities of leather. The domestic skins come principally from Chicago and St. Louis. The imported skins are received under the name of "fleshers," a term signifying that the skins have been split, and the flesh side, after the removal of the grain, is used for bindings.[1] Modern methods in tanning have brought into use for glove making many new kinds of leather. Buckskin in its various forms is the best material for heavy gloves, but this variety is also made of cowhide and horsehide. The finer gloves for street wear are made from the skins of the goat, kid, lamb, antelope, calf, colt, Arabian sheep, South American kid, chamois, and reindeer. Most of these skins are imported in the raw state and dressed in American tanneries. Deerskins are supplied by Mexico, Central and South America, and by all parts of the United States in which they can be found. The celebrated "Jacks," a variety of the Para deerskins, come from the country around the mouth of the Amazon.

The skin of the Mocha, a variety of sheep, native of Arabia, Abyssinia, and the region around the headwaters of the Nile, is at present much used in the manufacture of fine gloves, and it is interesting to note the origin of this branch of the glove industry. In 1868 one of the large glove manufacturers of Johnstown, N. Y., engaged in the manufacture of castor gloves, mostly from vat-liquor-dressed antelope skins. After the extermination of the buffalo, the supply of antelope skins was also greatly diminished, and experiments were made with various other light skins in order to find a suitable substitute. In 1877 two bales of skins of unknown variety were found with a shipment of Mocha coffee shipped to Boston, Mass., from Hodeidah, a port on the Arabian side of the Red Sea. They appeared to be haired sheepskins and were sent to be dressed, and as they dressed out well, a Boston house was induced to import more. Two years later, a New York importer sent an agent to Aden, in southern Arabia, to collect these sheep. The name Mocha came from the fact that the first bales came with Mocha coffee, and as this name seemed as appropriate as any, it has continued to be used.

The skins of which gloves are made are put through an exhaustive variety of processes. In the early days of the industry the manufacturers dressed their own leather, and many of the larger manufacturers still continue this practice, as it allows them to produce the grade and quality desired. In general, however, the tanning and dressing of skins is a distinct and separate industry.

During the early period of the industry the Indian process of tanning was exclusively employed. The distinguishing feature of this process was the use of the brain of the deer, which insured a durable as well as a soft and pliable leather. Somewhat later an attempt was made to substitute the brain of the hog, but the results were not entirely satisfactory, as it lacked certain essential properties possessed by the deer brain. At the present time the sheep and lamb skins used are received in what is termed "salt pickle," which is applied to the skin after the removal of the hair. As soon as received they are thoroughly washed, to remove the salt and to extract the pickle, after which they remain in an alum bath for nearly twelve hours. They are then staked, a process which involves the stretching or the drawing of the skin over a thin round-face iron attached to a piece of wood about the height of a man's knee. This is done partly by the hand and partly by the knee of the operator. The process is generally termed "knee staking," in contradistinction to a similar process known as "arm staking," to which the leather is subjected after reaching the glove factory. The skins are then dried in the open air or in artificial dry rooms, the temperature of which is regulated according to the nature of the skin, and the time required to dry it, after which they are again carefully washed, staked, and dried.

As a rule, the skins are next sorted according to size and quality, and are then submerged in an egg bath

[1] History of Fulton County, page 165.

consisting of a preparation of 10 parts of salt with 90 parts of egg yolk. By revolving the skins in a drum the egg yolk is thoroughly absorbed, and the leather becomes soft and pliable. They are next colored, by placing them flesh side down on zinc or lead tables, and applying the color with a brush. After the color is set and the skins are thoroughly dried they are dampened, rolled up in bundles, flesh side out, and stored away to season for a varying length of time.[1] The milling of oil-dressed skins involves a somewhat different process. After the skins are soaked in vats from three days for water frizzing to four weeks for lime frizzing, they are scraped by the beam workers to remove the grain, then dried into parchment, soaked in water, and milled in oil. They are again placed on the beam and scoured of oil and natural grease through the agency of soda ash, being repeatedly dried during these various processes, after which they are subjected to the braking machine, and then staked with a blunt tool, which renders them pliable. They are next put on the "buck-tail," or emery wheel, and cut down for a face, and then returned to the water for a clean scouring, wrung out and dried, spread upon the grass for the night dew to bleach, and again staked, finished, and smoked or colored, after which they are ready for the glove maker.[2]

As soon as the skin is received by the glove maker it is immediately staked by the hand stake, which consists of two upright and two horizontal bars, one of the latter being movable to admit the skin, which is held in position by a wedge inserted at the end of the bar. The stretching is then done by pressing over the skin so placed, a blunt iron, like a spade, having round corners and a handle which fits under the arm. The oil-dressed skins are then split even in a belt-splitting machine, and the kid skins are shaved either by "mooning" or by placing them on a marble slab with the flesh side up, and shaving the surface with a broad chisel or so-called dowling knife. By this process the skin is reduced to the desired thinness, and the inequalities of the flesh side are removed. "Mooning" is done with a round steel shaped like a plate and having the center cut out and a handle placed across the opening; the skin is then hung on an elastic pole and the moon-shaped knife is drawn over the flesh until the desired result is secured. The skin is then ready to go to the cutters, of which there are two classes, the block and the table cutter, each class, as a rule, having separate rooms. The block cutters, most of whom are of American parentage, are engaged in cutting the cheaper and coarser grade of gloves.

The skin is placed on a block made of hard-wood planks placed on end and bolted together, and the die of the required shape and style is placed carefully on the skin and given a blow with the maul. In the table cutters' room tables instead of blocks are used. The skin is dampened, then stretched over the end of the table until it will stretch no more, and then cut off the length of the glove; next stretched to width and cut off, after which the fingers and opening are put in with the die and press.

A table-cut glove, inasmuch as it is more elastic and will conform to the shape of the hands, will give a much better fit than a glove cut on the block.[3] In the cheaper and heavier grades, however, a perfect fit is not absolutely essential. The table cutters in the glove and mitten factories of the United States are of many nationalities, including French, English, German, Swedish, and, in fact, they include representatives of every country in which gloves are manufactured. The foreign cutters are, so to speak, born in the glove industry, as for generations their families and relatives have obtained a livelihood by cutting gloves. To be a good table cutter requires an apprenticeship of at least three years, and even after this period not more than one out of three can be considered an excellent workman. The fingers of the cutter must possess the habit and nimbleness which can only be acquired by long practice. He must make a careful examination of each skin and so shape it that he may get the greatest number of pairs of gloves and yet avoid the flaws. In the cutting of Mocha leather, young men who have served apprenticeship in this country have proven to be equal to the best cutters from Europe. From the cutters' room the leather, which has assumed the shape of the glove, is sent to the "silkers," who embroider the back, and then to the "makers." Some make the gloves, that is, they sew the fingers and put the thumbs in; others, called "welters," are engaged in welting or hemming the glove around the edge at the wrist; still others, called "pointers," work the ornamental lines on the back.

After the glove has reached this stage of completion, the fourchettes and the thumb are put in place; the back is then embroidered and the end of the silk is pulled out and tied, and the glove closed by beginning either at the upper end of the long seam and sewing toward the little finger, or at the end of the index finger and finishing with the long seam. The glove is now ready to be bound, hemmed, or banded, the buttonhole made, or the lacings or fastener adjusted. Each maker has his particular part of the work to do, and before a glove is finished it must pass through a number of hands. After the gloves are made they are drawn over metal hands heated by steam, a "laying-off" process, as it is termed, and by means of which the glove is shaped and given its finished appearance. The gloves are now ready for inspection, and are assorted according to grades and sizes, and finally forwarded to the stock room, ready for shipment.

Table 14 shows the detailed statistics, by states and territories, for the industry as returned for 1900.

[1] History of Fulton County, pages 167 and 170.
[2] M. S. Northrup, ex-secretary American Glove Association.
[3] Glove Trade Directory, O. H. Bame, publisher.

TABLE 14.—GLOVES AND MITTENS, LEATHER, BY STATES AND TERRITORIES: 1900.

		United States.	California.	Illinois.	Indiana.	Iowa.	Maryland.	Massachusetts.
1	Number of establishments	381	23	24	3	6	3	8
	Character of organization—							
2	Individual	222	15	8	1	1	2	3
3	Firm and limited partnership	125	7	6	1	3	1	3
4	Incorporated company	33	1	10	1	2	.....	2
5	Miscellaneous	1	.....	.....	.....	.....	.....	.....
6	Established during the decade	205	9	17	2	1	.....	7
7	Established during the census year	27	.....	2	1	1	.....	3
	Capital:							
8	Total	$9,004,427	$432,966	$781,719	$148,994	$266,708	$50,541	$109,150
9	Land	$286,287	$4,010	$55,250	$9,000	$22,000	$100	$1,000
10	Buildings	$582,095	$7,250	$81,938	$26,000	$35,000	$500	$5,000
11	Machinery, tools, and implements	$675,660	$32,820	$98,333	$12,453	$20,700	$5,434	$10,615
12	Cash and sundries	$7,460,445	$388,916	$546,198	$101,541	$189,008	$44,507	$92,535
13	Proprietors and firm members	508	30	22	4	13	5	9
	Salaried officials, clerks, etc.:							
14	Total number	687	65	108	7	42	8	7
15	Total salaries	$544,170	$52,952	$93,782	$10,300	$30,948	$6,175	$3,960
	Officers of corporations—							
16	Number	35	4	18	2	.....	.....	.....
17	Salaries	$52,635	$3,120	$26,040	$4,500	.....	.....	.....
	General superintendents, managers, clerks, and salesmen—							
18	Total number	602	61	90	5	42	8	7
19	Total salaries	$491,535	$49,842	$67,742	$5,800	$30,948	$6,175	$3,960
	Men—							
20	Number	513	51	74	5	33	8	4
21	Salaries	$451,700	$46,030	$59,764	$5,800	$26,670	$6,175	$2,760
	Women—							
22	Number	89	10	16	.....	9	.....	3
23	Salaries	$39,835	$3,752	$7,978	.....	$4,278	.....	$1,200
	Wage-earners, including pieceworkers, and total wages:							
24	Greatest number employed at any one time during the year.	17,441	693	2,032	245	215	89	229
25	Least number employed at any one time during the year.	11,739	553	1,478	169	117	89	147
26	Average number	14,180	622	1,752	226	152	89	194
27	Wages	$4,151,126	$224,953	$653,237	$49,627	$53,348	$14,276	$85,410
	Men, 16 years and over—							
28	Average number	4,864	176	741	40	47	23	61
29	Wages	$2,014,134	$94,924	$342,478	$18,047	$28,110	$5,800	$42,913
	Women, 16 years and over—							
30	Average number	9,542	422	920	163	98	63	127
31	Wages	$2,101,044	$126,729	$298,930	$28,172	$24,788	$8,761	$41,597
	Children, under 16 years—							
32	Average number	274	24	91	23	7	3	6
33	Wages	$35,948	$3,300	$11,829	$3,408	$450	$225	$900
	Average number of wage-earners, including piece-workers, employed during each month:							
	Men, 16 years and over—							
34	January	4,179	171	677	40	52	23	55
35	February	4,359	168	691	39	49	23	56
36	March	4,405	171	711	42	49	23	64
37	April	4,600	176	761	43	50	23	62
38	May	4,625	175	773	45	50	23	59
39	June	4,360	170	746	45	44	23	62
40	July	4,293	167	762	44	43	23	59
41	August	4,394	179	785	34	43	23	57
42	September	4,419	181	786	31	45	23	58
43	October	4,426	182	767	40	43	23	64
44	November	4,321	183	743	42	46	23	67
45	December	3,956	184	697	43	46	23	67
	Women, 16 years and over—							
46	January	8,582	414	816	171	81	63	103
47	February	9,234	410	881	165	84	63	111
48	March	9,698	413	892	174	90	63	131
49	April	9,858	417	952	168	91	63	132
50	May	9,947	416	961	164	95	63	130
51	June	9,680	411	973	168	74	63	131
52	July	9,448	414	963	175	123	63	119
53	August	9,771	426	934	151	123	63	124
54	September	9,825	430	951	149	123	63	139
55	October	9,905	430	946	165	123	63	140
56	November	9,739	441	968	153	98	63	137
57	December	8,524	437	828	146	72	63	133
	Children, under 16 years—							
58	January	241	24	77	24	2	3	6
59	February	243	24	77	24	5	3	6
60	March	266	24	83	24	5	3	6
61	April	279	24	92	24	5	3	6
62	May	286	24	99	24	5	3	6
63	June	288	24	101	24	5	3	6
64	July	295	24	105	24	10	3	6
65	August	300	24	106	19	10	3	6
66	September	280	24	90	19	10	3	6
67	October	283	24	86	24	10	3	6
68	November	273	24	90	24	10	3	6
69	December	261	24	80	24	10	3	6
	Miscellaneous expenses:							
70	Total	$562,870	$68,189	$69,432	$12,456	$14,611	$3,936	$6,938
71	Rent of works	$85,888	$15,500	$8,310	$120	$1,354	$850	$3,690
72	Taxes, not including internal revenue	$23,466	$1,845	$3,723	$808	$1,057	$225	$476
73	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$359,721	$50,644	$57,274	$11,528	$12,150	$2,861	$1,772
74	Contract work	$93,795	$200	$125	.....	$50	.....	$1,000
	Materials used:							
75	Aggregate cost	$9,382,102	$436,512	$1,224,339	$173,195	$118,963	$54,098	$123,185
	Hides and skins—							
76	Total number of dozens	826,416	28,407	128,487	15,087	9,741	3,863	11,785
77	Total cost	$7,356,483	$372,136	$1,076,922	$157,263	$79,414	$41,630	$102,845
	Deerskins—							
78	Dozen	89,596	9,211	670	.....	375	100	260
79	Cost	$1,146,808	$154,596	$12,844	.....	$4,254	$700	$4,000
	Mochas—Arabian sheepskins—							
80	Dozen	105,372	332	75	.....	700	.....	6,345
81	Cost	$1,071,686	$4,000	$565	.....	$7,550	.....	$68,000

TABLE 14.—GLOVES AND MITTENS, LEATHER, BY STATES AND TERRITORIES: 1900.

Michigan.	Minnesota.	New Hampshire.	New Jersey.[1]	New York.[1]	Ohio.	Pennsylvania.	Virginia.	Washington.	Wisconsin.	All other states.[2]	
5	8	6	5	243	5	4	3	3	19	13	1
5	5	5	3	148	3	2	2	2	10	7	2
.....	3	.....	2	88	.....	2	1	.....	5	3	3
.....	.....	1	.....	7	2	.....	.....	1	4	2	4
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	5
3	5	.....	2	130	3	3	.....	3	12	8	6
.....	1	.....	.....	12	3	.....	.....	1	3	.....	7
$29,241	$13,437	$351,492	$65,894	$6,219,647	$113,791	$28,950	$136,300	$8,250	$219,789	$27,528	8
.....	.....	$21,200	$3,500	$150,677	$900	$500	$7,800	.....	$6,250	$1,050	9
.....	.....	$33,200	$9,600	$331,820	$1,700	$4,500	$29,100	.....	$14,987	$1,550	10
$2,180	$3,158	$25,975	$7,100	$345,902	$63,550	$4,650	$8,400	$1,700	$26,090	$6,590	11
$27,061	$10,279	$271,117	$42,694	$5,391,248	$47,641	$19,300	$91,000	$6,550	$172,512	$18,388	12
5	11	5	9	344	3	6	4	2	23	18	13
3	2	7	.....	328	3	3	23	3	24	4	14
$700	$550	$9,150	.....	$294,574	$3,600	$1,800	$13,700	$720	$17,989	$3,310	15
.....	.....	1	.....	5	2	.....	.....	.....	3	.....	16
.....	.....	$2,000	.....	$13,000	$1,200	.....	.....	.....	$2,775	.....	17
3	2	6	.....	323	1	3	23	3	21	4	18
$700	$550	$7,150	.....	$281,574	$2,400	$1,800	$13,700	$720	$15,164	$3,310	19
3	2	6	.....	277	1	3	19	3	20	4	20
$700	$550	$7,150	.....	$260,771	$2,400	$1,800	$12,500	$720	$14,540	$3,310	21
.....	.....	.....	.....	46	.....	.....	4	.....	1	.....	22
.....	.....	.....	.....	$20,803	.....	.....	$1,200	.....	$624	.....	23
43	37	281	220	12,289	273	47	255	17	405	71	24
33	19	222	155	7,908	267	36	255	14	219	48	25
38	23	243	179	9,907	69	43	255	15	319	54	26
$12,206	$4,497	$82,080	$67,002	$2,723,702	$22,030	$9,759	$43,900	$6,360	$78,473	$20,326	27
9	5	140	55	2,843	28	16	40	8	112	20	28
$1,148	$1,470	$55,329	$35,873	$1,299,595	$10,080	$4,800	$14,700	$4,000	$41,997	$10,370	29
27	16	89	121	7,001	41	27	188	7	199	33	30
$7,746	$2,922	$24,959	$30,129	$1,415,156	$11,950	$4,959	$26,700	$2,330	$35,500	$9,756	31
2	2	14	3	63	.....	.....	27	.....	8	1	32
$312	$105	$1,792	$1,000	$8,951	.....	.....	$2,500	.....	$976	$200	33
10	2	145	50	2,763	6	16	40	8	100	21	34
10	2	144	49	2,919	6	16	40	8	118	21	35
10	4	142	48	2,932	6	16	40	8	118	23	36
10	6	136	46	2,956	127	16	40	8	118	23	37
8	6	141	53	2,964	123	16	40	8	122	19	38
8	6	142	50	2,854	6	16	40	8	112	19	39
8	6	147	62	2,774	6	16	40	8	110	18	40
9	7	138	68	2,850	6	16	40	8	113	18	41
10	7	134	67	2,879	6	16	40	7	110	19	42
10	7	136	52	2,901	6	16	40	7	112	20	43
10	7	137	54	2,816	6	16	40	8	106	17	44
10	5	140	58	2,505	6	16	40	8	99	14	45
27	12	87	114	6,569	20	26	188	7	153	31	46
25	12	87	112	6,869	20	26	188	7	202	31	47
25	12	89	116	7,218	20	26	188	7	200	34	48
27	14	89	108	7,187	145	26	188	7	206	38	49
25	14	90	116	7,230	155	25	188	7	214	34	50
25	14	91	137	7,114	20	27	188	7	206	31	51
23	15	92	131	6,840	20	23	188	7	225	27	52
23	18	84	137	7,184	20	27	188	4	233	32	53
31	23	88	134	7,202	20	28	188	5	219	32	54
31	24	90	115	7,291	20	29	188	8	199	34	55
31	20	91	117	7,160	20	27	188	7	184	34	56
27	18	90	116	6,162	20	29	188	7	151	37	57
2	1	13	3	51	.....	.....	27	.....	6	2	58
2	1	12	3	48	.....	.....	27	.....	11	.....	59
2	2	16	3	58	.....	.....	27	.....	11	2	60
2	2	15	3	63	.....	.....	27	.....	11	2	61
2	2	12	3	65	.....	.....	27	.....	12	2	62
2	1	14	3	67	.....	.....	27	.....	9	2	63
2	1	12	3	67	.....	.....	27	.....	9	2	64
2	2	16	3	71	.....	.....	27	.....	9	2	65
2	2	15	3	71	.....	.....	27	.....	6	2	66
2	2	16	3	73	.....	.....	27	.....	5	2	67
2	2	14	3	61	.....	.....	27	.....	5	2	68
2	1	16	3	58	.....	.....	27	.....	5	2	69
$1,762	$2,130	$10,728	$1,971	$341,486	$2,332	$883	$11,660	$629	$9,474	$4,313	70
$1,160	$909	$50	$260	$47,115	$832	$223	.....	$480	$2,883	$2,152	71
$72	$72	$1,078	$256	$11,208	$30	$40	$1,120	$39	$549	$268	72
$580	$1,149	$9,000	$1,455	$197,343	$1,470	$620	$5,480	$110	$5,442	$893	73
.....	.....	.....	.....	$85,820	.....	.....	$5,000	.....	$600	$1,000	74
$27,980	$11,677	$171,302	$79,975	$6,328,036	$66,590	$20,757	$174,190	$9,735	$319,167	$42,471	75
4,918	464	10,505	6,696	536,982	8,144	1,961	8,116	540	18,392	2,488	76
$26,650	$8,052	$134,760	$69,932	$4,759,070	$53,120	$16,454	$146,517	$8,500	$269,397	$33,771	77
.....	273	5,473	.....	67,688	167	.....	1,475	174	3,102	672	78
.....	$4,837	$79,537	.....	$804,613	$2,500	.....	$16,040	$2,640	$49,824	$10,393	79
70	18	.....	42	97,228	83	.....	466	.....	2	16	80
$750	$116	.....	$600	$982,467	$1,000	.....	$6,352	.....	$36	$200	81

[1] Includes 1 establishment the schedule for which was received too late to be included in the general report as presented in Manufactures, Parts I and II.
[2] Includes establishments distributed as follows: Colorado, 1; Connecticut, 1; Maine, 1; Missouri, 2; Montana, 1; Nebraska, [illegible] 1; Oregon, 2; Rhode Island, 1; Utah, 1; West Virginia, 1.

TABLE 14.—GLOVES AND MITTENS, LEATHER, BY STATES AND TERRITORIES: 1900—Continued.

		United States.	California.	Illinois.	Indiana.	Iowa.	Maryland.	Massachusetts.
	Materials used—Continued.							
	Hides and skins—Continued.							
	Total cost—Continued.							
	Cabretta—Brazilian sheepskins—							
82	Dozen	6,482	677	1,000				
83	Cost	$47,399	$5,300	$5,000				
	Roans—All kinds of domestic sheepskins—							
84	Dozen	422,481	11,720	111,565	13,215	6,477	670	3,664
85	Cost	$2,256,511	$64,936	$500,786	$69,514	$32,700	$4,250	$15,250
	Horse and cow hides—							
86	Dozen	30,180	2,361	11,559	1,872	337	33	
87	Cost	$1,352,148	$108,234	$526,211	$87,749	$16,600	$1,680	
	Kid, imported—							
88	Dozen	70,824	913	1,285		1,242	2,500	860
89	Cost	$740,170	$12,350	$[illegible]3,536		$11,300	$30,000	$10,595
	Kid, domestic—							
90	Dozen	97,245	2,481	706		443	500	650
91	Cost	$708,800	$16,220	$6,500		$2,980	$5,000	$5,000
	All other varieties—							
92	Dozen	4,286	712	1,577		167		
93	Cost	$32,961	$6,500	$12,500		$4,000		
94	Fuel	$42,230	$935	$6,527	$1,132	$1,800	$39	$400
95	Rent of power and heat	$19,919	$1,939	$650	$60	$248		$955
96	Mill supplies	$12,619	$215	$810	$803	$465	$5	$110
97	All other materials	$1,904,778	$59,830	$136,010	$13,587	$33,386	$12,197	$17,775
98	Freight	$46,128	$1,457	$3,420	$350	$3,650	$227	$1,000
	Products:							
99	Aggregate value	$16,721,234	$920,624	$2,454,252	$264,271	$273,000	$86,675	$286,210
	Gloves and mittens—							
100	Total dozens of pairs	2,895,661	121,301	573,411	92,300	52,463	9,587	34,673
101	Total value	$16,039,168	$887,239	$2,324,698	$264,271	$238,400	$82,685	$286,210
	Men's—							
	Lined—							
102	Dozens of pairs	952,820	11,692	105,546	67,500	4,750	1,557	2,622
103	Value	$4,959,902	$91,100	$520,558	$210,250	$30,000	$13,980	$18,403
	Unlined—							
104	Dozens of pairs	1,314,507	87,277	366,937	12,300	36,620	6,700	8,470
105	Value	$7,458,356	$656,991	$1,490,071	$26,266	$142,600	$65,490	$59,075
	Women's—							
	Lined—							
106	Dozens of pairs	78,783	1,810	3,593		1,450		
107	Value	$538,362	$10,900	$15,065		$6,300		
	Unlined—							
108	Dozens of pairs	221,039	7,392	4,758		6,280	820	23,581
109	Value	$1,772,746	$62,620	$33,050		$47,600	$1,810	$208,732
	Gauntlets—							
110	Dozens of pairs	24,004	4,210	2,150		360		
111	Value	$150,652	$31,048	$13,050		$2,200		
	Boys' and youths'—							
	Lined—							
112	Dozens of pairs	148,493	2,020	40,515	12,000	2,035	310	
113	Value	$548,556	$7,380	$113,550	$26,755	$6,600	$850	
	Unlined—							
114	Dozens of pairs	98,972	5,435	47,057	500	1,018	200	
115	Value	$377,503	$21,390	$130,479	$1,000	$3,200	$555	
	Misses' and children's—							
	Lined—							
116	Dozens of pairs	39,873		2,815				
117	Value	$160,998		$8,550				
	Unlined—							
118	Dozens of pairs	17,170	1,465	40				
119	Value	$72,093	$5,810	$325				
120	All other products, including custom work and repairing	$682,066	$33,385	$129,554		$34,600	$3,990	
	Comparison of products:							
121	Number of establishments reporting for both years	305	22	22	3	5	3	6
122	Value for census year	$13,831,038	$891,624	$2,428,518	$264,271	$267,000	$86,675	$231,010
123	Value for preceding business year	$11,426,896	$734,049	$1,877,120	$227,441	$226,000	$73,375	$180,600
	Power:							
124	Number of establishments reporting	192	14	15	3	5	1	6
125	Total horsepower	2,137	40	170	62	281	6	62
	Owned—							
	Engines—							
	Steam—							
126	Number	45		4		3	1	1
127	Horsepower	1,336		93		255	6	50
	Gas or gasoline—							
128	Number	34	4	7	2	2		
129	Horsepower	388	17	44	52	13		
	Water wheels—							
130	Number	2						
131	Horsepower	80						
	Electric motors—							
132	Number	4		2		1		
133	Horsepower	23		11		10		
	Other power—							
134	Number	1						
135	Horsepower	1						
	Rented—							
136	Electric horsepower	218	20			3		
137	All other horsepower	141	3	22	10			12
138	Furnished to other establishments, horsepower	205				4		
	Establishments classified by number of persons employed, not including proprietors and firm members.							
139	Total number of establishments	381	23	24	3	6	3	8
140	No employees	17		2				1
141	Under 5	55	5	3			1	
142	5 to 20	120	6	3	1	3	1	2
143	21 to 50	96	6	7		1		4
144	51 to 100	48	5	2	1	1	1	1
145	101 to 250	35	1	5	1	1		
146	251 to 500	5		1				
147	501 to 1,000	5		1				

TABLE 14.—GLOVES AND MITTENS, LEATHER, BY STATES AND TERRITORIES: 1900—Continued.

Michigan.	Minnesota.	New Hampshire.	New Jersey.	New York.	Ohio.	Pennsylvania.	Virginia.	Washington.	Wisconsin.	All other states.	
.....	.....	.....	25	4,619	106	.....	.....	.....	.....	5	82
.....	.....	.....	$221	$35,828	$1,000	.....	.....	.....	.....	$50	83
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
4,400	115	4,220	400	242,428	7,508	1,778	2,133	273	10,665	1,250	84
$17,893	$620	$25,913	$2,000	$1,337,004	$44,000	$7,850	$67,125	$1,360	$58,033	$6,697	85
149	49	563	.....	9,007	74	183	630	93	2,962	308	86
$6,995	$2,329	$27,419	.....	$371,884	$3,600	$8,604	$30,092	$4,500	$141,495	$14,756	87
49	9	.....	5,729	55,421	.....	.....	1,300	.....	1,516	.....	88
$512	$110	.....	$64,111	$566,291	.....	.....	$14,200	.....	$18,165	.....	89
250	5	.....	500	89,166	100	.....	2,112	.....	145	187	90
$500	$40	.....	$3,000	$653,733	$700	.....	$12,708	.....	$1,244	$1,175	91
.....	.....	249	.....	1,425	106	.....	.....	.....	.....	50	92
.....	.....	$1,891	.....	$7,250	$320	.....	.....	.....	.....	$500	93
$75	$165	$1,439	$365	$21,405	$890	$203	$5,418	$25	$1,569	$343	94
$838	$40	$25	$180	$14,679	.....	.....	.....	$20	$720	$65	95
$15	$10	$240	$20	$7,455	$180	$79	$2,000	.....	$195	$17	96
$500	$3,140	$29,466	$9,454	$1,498,909	$12,400	$2,976	$20,225	$990	$45,901	$8,032	97
$402	$270	$5,372	$24	$26,518	$500	$1,025	$30	$200	$1,385	$243	98
$54,850	$24,328	$296,557	$171,065	$10,854,221	$111,050	$42,286	$265,925	$24,685	$507,495	$83,790	99
15,225	2,873	49,085	18,755	1,721,831	43,386	9,223	41,075	2,060	95,235	13,178	100
$54,725	$20,628	$281,186	$171,065	$10,507,789	$95,890	$38,500	$196,925	$18,400	$493,375	$77,682	101
550	2,088	10,800	1,004	643,440	18,770	4,910	15,200	150	58,790	3,451	102
$4,600	$12,490	$76,200	$9,564	$3,547,825	$39,190	$22,050	$91,200	$1,500	$253,287	$17,705	103
14,625	785	33,585	15,693	637,155	24,516	3,313	25,400	1,635	30,465	9,031	104
$49,675	$8,138	$180,436	$143,367	$4,184,043	$55,750	$13,575	$103,000	$15,800	$208,635	$55,944	105
50	.....	.....	508	70,139	.....	.....	25	.....	976	232	106
$450	.....	.....	$5,134	$492,044	.....	.....	$150	.....	$6,564	$1,755	107
.....	.....	500	1,550	174,896	.....	.....	150	100	979	83	108
.....	.....	$2,750	$13,000	$1,391,948	.....	.....	$1,150	$900	$8,896	$390	109
.....	.....	.....	.....	17,094	.....	.....	25	.....	10	155	110
.....	.....	.....	.....	$102,926	.....	.....	$350	.....	$60	$1,018	111
.....	.....	1,000	.....	86,419	100	900	100	.....	3,032	62	112
.....	.....	$6,000	.....	$371,575	$450	$2,475	$350	.....	$12,325	$246	113
.....	.....	3,200	.....	40,159	.....	100	100	150	978	75	114
.....	.....	$15,800	.....	$199,795	.....	$400	$400	$600	$3,584	$300	115
.....	.....	.....	.....	36,982	.....	.....	25	.....	5	46	116
.....	.....	.....	.....	$152,125	.....	.....	$125	.....	$24	$174	117
.....	.....	.....	.....	15,547	.....	.....	50	25	.....	43	118
.....	.....	.....	.....	$65,508	.....	.....	$200	$100	.....	$150	119
$125	$3,700	$15,371	.....	$346,432	$15,060	$3,736	$69,000	$6,285	$14,120	$6,108	120
5	5	6	4	190	3	3	.....	3	15	10	121
$54,850	$20,500	$296,557	$126,065	$8,520,142	$64,300	$40,936	.....	$24,685	$445,715	$68,190	122
$39,700	$16,050	$269,251	$92,452	$7,139,109	$59,500	$29,250	.....	$20,500	$384,435	$58,064	123
2	1	1	1	126	4	2	1	.....	8	2	124
3	1	405	6	922	38	10	20	.....	88	23	125
.....	.....	1	.....	29	1	1	1	.....	2	1	126
.....	.....	225	.....	612	10	5	20	.....	40	20	127
.....	.....	2	.....	9	3	.....	.....	.....	5	.....	128
.....	.....	180	.....	29	28	.....	.....	.....	25	.....	129
.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	130
.....	.....	.....	.....	25	.....	5	.....	.....	.....	.....	131
.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	132
.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	133
.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	134
.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	135
3	.....	.....	6	163	.....	.....	.....	.....	28	.....	136
.....	1	.....	.....	90	.....	.....	.....	.....	.....	3	137
.....	.....	200	.....	.....	.....	1	.....	.....	.....	.....	138
5	8	6	5	243	5	4	3	3	19	13	139
.....	1	.....	.....	6	.....	.....	.....	.....	3	4	140
2	3	.....	1	29	1	1	.....	2	4	3	141
3	4	5	.....	78	1	2	1	1	4	6	142
.....	.....	.....	2	68	1	1	.....	.....	5	1	143
.....	.....	.....	2	31	1	.....	1	.....	2	.....	144
.....	.....	1	.....	23	1	.....	1	.....	1	.....	145
.....	.....	.....	.....	4	.....	.....	.....	.....	.....	.....	146
.....	.....	.....	.....	4	.....	.....	.....	.....	.....	.....	147

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 176. WASHINGTON, D. C. MAY 31, 1902.

MANUFACTURES.

BICYCLES AND TRICYCLES.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on the manufacture of bicycles and tricycles for the census year 1900, prepared under my direction by Mr. Axel Josephsson, of the Census Office.

The statistics included in the report were collected, as in the previous census, upon the schedule used for general statistics of manufactures. But owing to the extraordinary development of the bicycle industry during the last decade, it was decided to supplement the canvass made by the enumerators and local special agents with a special report. The manufacture of bicycles and tricycles was first reported as a separate industry at the census of 1890, and this is the first time it is made the subject of a special report.

The accompanying bulletin presents, in addition to the statistics collected at the census of 1900, a concise history of the bicycle and its manufacture. It is a noteworthy fact that, while previous to 1890 most of the bicycles used in America were imported from England, now the American manufacturer annually exports hundreds of thousands.

The statistics are presented in 9 tables: Table 1 showing the comparative figures for the industry at the censuses of 1890 and 1900; Table 2 showing, by states, the number of establishments in operation in 1890 and 1900, and the increase during the decade; Table 3 showing statistics for the industry by states for 1900; Table 4 showing a summary of the number of establishments, capital, and product by geographical divisions for 1900; Table 5 showing statistics of capital for 1890 and 1900; Table 6 showing the kinds, quantity, and value of products manufactured in the factories engaged exclusively in the manufacture of cycles for 1900; Table 7 showing the number of establishments reporting cycles as a by-product and the quantity and value of their cycle product, 1900; Table 8 showing the combined quantity and value of products shown in Tables 6 and 7, the per cent of each kind to the total number, and of the value of each kind to the total value; and Table 9 presenting the detailed statistics for the industry, by states, for 1900.

As the methods of taking the censuses of 1890 and 1900 were almost identical, with the exceptions noted below, the rate of growth in the manufacture of bicycles and tricycles may be practically inferred from the figures given in Table 1. In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with the prior census. Comparison may be made safely with respect to all the items of inquiry except those relating to salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in opera-

tion. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

The number of proprietors and firm members, shown in the accompanying tables, falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations or cooperative establishments. The number of salaried officials, clerks, etc., is the greatest number reported employed at any one time during the year.

The reports for 1900 show a capital of $29,783,659 invested in the manufacture of bicycles and tricycles in the 312 establishments reporting for the United States. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the corporations engaged in this industry. The value of the product is returned at $31,915,908, to produce which involved an outlay of $1,753,235 for salaries of officials, clerks, etc.; $8,189,817 for wages; $2,252,604 for miscellaneous expenses, including rent, taxes, etc.; and $16,792,051 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the manufacture of bicycles and tricycles during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the works. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

The statistics contained in this report, it should be noted, do not include the reports from the 6,328 establishments engaged in bicycle and tricycle repairing, which returned products to the value of $13,766,033. The general statistics for these establishments will be found in the Report on Manufactures, Parts I and II, under the classification "Bicycle and tricycle repairing."

Very respectfully,

S. N. D. North

Chief Statistician for Manufactures.

BICYCLES AND TRICYCLES.

By Axel Josephsson.

Table 1 is a comparative summary of the statistics for the cycle industry as returned at the censuses of 1890 and 1900, with the percentages of increase for the decade.

Table 1.—COMPARATIVE SUMMARY, 1890 AND 1900, WITH PER CENT OF INCREASE FOR THE DECADE.

	1900	1890	Per cent of increase.
Number of establishments	312	27	1,055.6
Capital	$29,783,659	$2,058,072	1,347.2
Salaried officials, clerks, etc., number	2,084	[1] 128	1,489.1
Salaries	$1,753,235	[1] $123,714	1,317.2
Wage-earners, average number	17,525	1,797	875.3
Total wages	$8,189,817	$982,014	734.0
Men, 16 years and over	16,700	1,747	855.9
Wages	$7,952,257	$971,539	718.5
Women, 16 years and over	517	15	3,346.7
Wages	$175,028	$3,729	4,593.7
Children, under 16 years	308	35	780.0
Wages	$62,532	$6,746	826.9
Miscellaneous expenses	$2,252,604	$242,018	830.8
Cost of materials used	$16,792,051	$718,848	2,236.0
Value of products	$31,915,908	$2,568,326	1,142.7

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900. (See Table 9.)

The census of 1890 was the first at which the manufacture of bicycles and tricycles was returned as a separate industry. Previous to the decade ending with 1880 the manufacture of cycles was spasmodic and intermittent, the only important periods being in 1819 and 1869. In the censuses prior to 1890 the statistics of the manufacture of cycles were included with those for carriages and wagons. The comparative figures presented in Table 1 cover, therefore, only the period from 1890 to 1900. During this decade, taken as a whole, the industry made extraordinary progress; but the climax was reached about the middle of the period, and since then there has been a decided decline.

During the decade from 1890 to 1900 the number of establishments increased from 27 to 312, or 285; capital from $2,058,072 to $29,783,659, or $27,725,587; the number of wage-earners from 1,797 to 17,525, or 15,728; their wages from $982,014 to $8,189,817, or $7,207,803; miscellaneous expenses from $242,018 to $2,252,604, or $2,010,586; the cost of materials used from $718,848 to $16,792,051, or $16,073,203; and the value of products from $2,568,326 to $31,915,908, or $29,347,582.

The average capital, which in 1890 was $76,225, had in 1900 increased to $95,460. This increase in the average capital is a consequence of the crisis at the end of the decade, when many of the smaller concerns were forced out of the business. It is to be noted that each of the 35 plants belonging to the American Bicycle Company reported as an individual establishment. The cost of materials used shows the largest percentage of increase. In 1890 it was $718,848, or 28 per cent of the product, and in 1900 $16,792,051, or 52.6 per cent. Of this amount $16,161,638, or 96.2 per cent, was expended for principal materials, and $630,413, or 3.8 per cent, for fuel, freight, etc. This increase in the proportion between materials and product was largely caused by the keen competition among cycle manufacturers and the attendant decrease in prices of finished products.

Table 2 presents, by states, the number of active establishments from which returns were received in 1890 and 1900 and the increase during the decade.

Table 2.—COMPARATIVE SUMMARY: NUMBER OF ACTIVE ESTABLISHMENTS IN 1890 AND 1900, WITH INCREASE, BY STATES, ARRANGED GEOGRAPHICALLY.

States.	1900	1890	Increase.
United States	312	27	285
New England states	55	9	46
Maine	1	.....	1
New Hampshire	1	.....	1
Massachusetts	25	7	18
Rhode Island	4	.....	4
Connecticut	24	2	22
Middle states	98	8	90
New York	66	4	62
New Jersey	7	1	6
Pennsylvania	24	3	21
Maryland	1	.....	1
Southern states	1	.....	1
Kentucky	1	.....	1
Central states	152	9	143
Ohio	34	2	32
Michigan	11	1	10
Indiana	19	1	18
Illinois	60	5	55
Wisconsin	23	.....	23
Minnesota	4	.....	4
Iowa	1	.....	1
Western states	2	.....	2
Nevada	1	.....	1
Colorado	1	.....	1
Pacific states	4	1	3
Oregon	.....	1	[1] 1
California	4	.....	4

[1] Decrease.

Table 2 shows the territorial extension of the industry. In 1890 it was carried on in 10 states by 27 establishments; in 1900 it had extended into 20 states, with 312 establishments. The greatest gain was shown in New York, where the number of establishments increased from 4 in 1890 to 66 in 1900, of which 7 were established during the census year. Illinois followed next with an increase of 55, of which 5 were established in the census year; and then Ohio with a gain of 32. Other states showing a large increase in number of establishments were Wisconsin from none to 23, Connecticut 2 to 24, Pennsylvania 3 to 24, Indiana 1 to 19, and Massachusetts 7 to 25. Oregon was the only state which showed a decrease, having 1 in 1890 and none in 1900. Twenty-two of the 285 plants were added during the census year. In 1900, in addition to the 312 active establishments, there were 5, having a capital of $103,500, reported as idle.

Table 3 is a summary, by states, of the general statistics of the industry for 1900.

TABLE 3.—SUMMARY BY STATES: 1900.

	United States.	California.	Connecticut.	Illinois.	Indiana.	Massachusetts.	Michigan.
Number of establishments	512	4	24	60	19	25	11
Capital	$29,783,659	$19,254	$4,215,399	$7,694,658	$2,061,560	$2,646,498	$757,021
Salaried officials, clerks, etc., number	2,034	.....	263	642	123	139	53
Salaries	$1,753,235	.....	$251,091	$522,477	$96,996	$117,242	$39,643
Wage-earners, average number	17,525	19	2,139	4,358	1,481	1,581	311
Total wages	$8,189,817	$11,080	$1,160,736	$2,144,897	$613,840	$815,028	$141,639
Men, 16 years and over, number	16,700	19	1,995	4,143	1,352	1,543	294
Wages	$7,952,257	$11,080	$1,107,455	$2,078,334	$570,858	$798,504	$138,457
Women, 16 years and over, number	517	.....	104	104	126	38	17
Wages	$175,028	.....	$84,662	$38,276	$42,150	$16,524	$3,182
Children, under 16 years, number	308	.....	40	141	3	.....	.....
Wages	$62,532	.....	$8,589	$28,287	$832	.....	.....
Miscellaneous expenses	$2,252,604	$3,144	$323,620	$630,442	$121,260	$125,076	$59,485
Cost of materials used	$16,792,051	$25,470	$1,720,249	$4,836,585	$1,221,786	$1,807,900	$345,725
Value of products	$31,915,908	$47,670	$3,672,225	$8,960,421	$2,115,901	$2,715,310	$627,658

	Minnesota.	New Jersey.	New York.	Ohio.	Pennsylvania.	Rhode Island.	Wisconsin.	All other states.[1]
Number of establishments	4	7	66	34	24	4	23	7
Capital	$38,205	$204,465	$3,326,943	$4,074,576	$1,550,957	$24,300	$2,337,975	$831,843
Salaried officials, clerks, etc., number	2	24	267	209	110	6	160	36
Salaries	$2,820	$23,457	$216,120	$197,406	$91,681	$8,600	$134,067	$57,195
Wage-earners, average number	47	183	2,103	2,380	947	17	1,572	357
Total wages	$8,440	$71,343	$988,052	$1,017,061	$431,369	$6,100	$625,149	$165,083
Men, 16 years and over, number	47	170	2,032	2,340	891	17	1,500	357
Wages	$8,440	$68,185	$970,043	$998,218	$419,958	$6,100	$611,512	$165,088
Women, 16 years and over, number	.....	12	46	40	29	.....	1	.....
Wages	.....	$2,972	$11,009	$18,843	$7,280	.....	$180	.....
Children, under 16 years, number	.....	1	25	.....	27	.....	71	.....
Wages	.....	$186	$7,000	.....	$4,131	.....	$13,507	.....
Miscellaneous expenses	$1,673	$19,548	$266,561	$247,382	$128,931	$1,309	$170,266	$51,008
Cost of materials used	$30,997	$147,317	$1,856,065	$2,251,358	$1,065,461	$23,195	$1,586,592	$423,351
Value of products	$66,505	$295,226	$3,842,020	$4,099,980	$1,855,043	$43,382	$2,795,236	$779,331

[1] Includes establishments distributed as follows: Colorado, 1; Iowa, 1; Kentucky, 1; Maine, 1; Maryland, 1; Nevada, 1; New Hampshire, 1.

In 1890 returns were received from 10 states, only 4 of which had three or more establishments; in 1900 the returns were from 20 states, 13 of which had three or more establishments. In order to avoid disclosing the operations of individual establishments, states having less than three establishments are grouped under "all other states."

Table 4 presents a summary, by geographical divisions, of the statistics for 1900 of the number of establishments, capital, and value of products, and the per cent for each of these items that the several divisions and states bear to the total thereof.

TABLE 4.—SUMMARY BY STATES, ARRANGED GEOGRAPHICALLY: 1900.

STATES.	ESTABLISHMENTS.		CAPITAL.		PRODUCTS.	
	Number.	Per cent of total.	Amount.	Per cent of total.	Value.	Per cent of total.
The United States	512	100.0	$29,783,659	100.0	$31,915,908	100.0
New England states	55	17.6	7,046,197	23.7	6,567,292	20.6
Massachusetts	25	8.0	2,646,498	8.9	2,715,310	8.5
Connecticut	24	7.7	4,215,399	14.2	3,672,225	11.5
All other New England states[1]	6	1.9	184,300	0.6	179,757	0.6
Middle states	98	31.4	5,701,613	19.1	6,517,665	20.4
New York	66	21.1	3,326,943	11.2	3,842,020	12.0
Pennsylvania	24	7.7	1,550,957	5.2	1,855,043	5.8
All other Middle states[2]	8	2.6	823,713	2.7	820,602	2.6
Central states	152	48.7	16,974,995	57.0	18,675,701	58.5
Ohio	34	10.9	4,074,576	13.7	4,099,980	12.8
Michigan	11	3.5	757,021	2.5	627,668	2.0
Indiana	19	6.1	2,061,560	6.9	2,115,901	6.6

[1] Includes establishments distributed as follows: Maine, 1; New Hampshire, 1; Rhode Island, 4.
[2] Includes establishments distributed as follows: Maryland, 1; New Jersey, 7.

TABLE 4.—SUMMARY BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	ESTABLISHMENTS.		CAPITAL.		PRODUCTS.	
	Number.	Per cent of total.	Amount.	Per cent of total.	Value.	Per cent of total.
Central states—Cont'd.						
Illinois	60	19.2	$7,694,658	25.8	$8,960,421	28.1
Wisconsin	23	7.4	2,337,975	7.9	2,795,236	8.8
All other Central states[1]	5	1.6	49,205	0.2	76,505	0.2
All other divisions	7	2.3	60,851	0.2	155,250	0.5
California	4	1.3	19,254	0.1	47,670	0.2
All other states[2]	3	1.0	41,600	0.1	107,580	0.3

[1] Includes establishments distributed as follows: Iowa, 1; Minnesota, 4.
[2] Includes establishments distributed as follows: Colorado, 1; Kentucky, 1; Nevada, 1.

Table 4 shows that at the close of the decade the manufacture of bicycles and tricycles was, as in 1890, almost entirely confined to the New England, Middle and Central divisions, but that the relative location of the industry within those sections had undergone a considerable change. In 1890 the New England and Central divisions each had 9 establishments and the Middle division 8. In 1900 the New England states showed an increase of 46 establishments, giving them 17.6 per cent of the aggregate number for the United States; the Middle states an increase of 90 establishments, giving them 31.4 per cent of the aggregate; the Central states an increase of 143, giving them 48.7 per cent of the aggregate; and all other states an increase of 6, giving them 2.3 per cent of the aggregate. In the New England states capital increased from $1,231,601 to $7,046,197, or $5,814,506, but its proportion of the

aggregate decreased from 59.8 to 23.7 per cent; in the Middle states it increased from $76,000 to $5,701,613, or $5,625,613, and its per cent of the aggregate from 3.8 to 19.1; in the Central states it increased from $746,381 to $16,974,995, or $16,228,614, and its per cent of the aggregate from 36.2 to 57. In the New England states the value of products increased from $1,150,142 to $6,567,292, or $5,417,150, but its per cent of the aggregate decreased from 44.8 to 20.6; in the Middle states it increased from $125,916 to $6,517,665, or $6,391,749, and its per cent of the aggregate from 4.9 to 20.4; in the Central states it increased from $1,276,268 to $18,675,701, or $17,399,433, and its per cent of the aggregate from 49.7 to 58.5. In 1890 Massachusetts stood first among all the states, not only in the number of establishments, but in the capital employed, and in the value of products. In 1900 New York reported the greatest number of establishments, while Illinois ranked first in capital and products, reporting 25.8 per cent of the aggregate capital and 28.1 per cent of the aggregate value of products.

Among the New England states Connecticut in 1900 stood first in capital. Capital in Massachusetts increased from $1,202,691 to $2,646,498, or $1,443,807. The value of products in Massachusetts increased from $998,342 to $2,715,310, or $1,716,968. In 1890, however, the products reported for Massachusetts constituted 38.9 per cent of the aggregate for the United States, but in 1900 only 8.5 per cent. Among the Middle states New York retained its position as first; its capital increased from $44,700 to $3,326,943, or $3,282,243, and in 1900 constituted 11.2 per cent of the aggregate; in value of products the increase was from $85,786 to $3,842,020, or $3,756,234, placing the state in third position, with 12 per cent of the aggregate. In Pennsylvania capital increased from $30,100 to $1,550,957, or $1,520,857, and was 5.2 per cent of the aggregate in 1900, and the value of products increased from $32,630 to $1,855,043, or $1,822,413, and constituted 5.8 per cent of the aggregate. Among the Central states, Illinois retained its position as first in the division and became first among all the states in capital and in value of products, the increase in capital being $7,129,046, and in value of products $7,990,421. The capital in 1900 constituted 25.8 per cent of the aggregate, and the products 28.1 per cent. This latter percentage was, however, a decrease from 1890, when Illinois produced 37.8 per cent of the total for the United States. In 1900 Ohio stood second among the Central states, with an increase of $3,956,376 in capital and of $3,978,472 in value of products. The total value of products in Ohio was $4,099,980, placing the state in that respect second among all the states. The third place in the Central states, and the fourth place among all the states, was occupied by Wisconsin, where in 1890 the industry did not exist. In 1900, 23 establishments, with a capital of $2,337,975, reported products to the value of $2,795,236, or 8.8 per cent of the aggregate for the United States. Indiana showed a considerable change; capital increased from $58,650 to $2,061,560, or $2,002,910, and value of products from $180,000 to $2,115,901, or $1,935,901.

Table 5 is a comparative summary of capital for 1890 and 1900, with the percentage of increase for the decade and the percentage of each item to the total.

TABLE 5.—COMPARATIVE SUMMARY, CAPITAL: 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$29,783,659	100.0	$2,058,072	100.0	1,347.2
Land	1,501,003	5.0	22,650	1.1	6,526.9
Buildings	3,705,462	12.4	339,371	16.5	991.9
Machinery, tools, and implements	9,462,031	31.8	564,400	27.4	1,576.5
Cash and sundries	15,115,163	50.8	1,131,651	55.0	1,235.7

Table 5 shows the changes in the relative percentages of land, buildings, machinery, etc., and live capital since 1890. Land increased from $22,650 to $1,501,003, or $1,478,353; buildings from $339,371 to $3,705,462, or $3,366,091; machinery, tools, and implements from $564,400 to $9,462,031, or $8,897,631; and live capital from $1,131,651 to $15,115,163, or $13,983,512. The last item includes cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries. The total in this table does not include the capital stock of the corporations engaged in the manufacture of cycles.

Table 6 shows, for 1900, the kinds, quantity, and value of products for the industry, and the per cent of each item of value to the total.

TABLE 6.—NUMBER AND VALUE OF DIFFERENT KINDS OF PRODUCTS, WITH PER CENT THAT VALUE OF EACH KIND FORMED OF TOTAL VALUE: 1900.

	Number.	Value.	Per cent of total value.
Total	.....	$31,915,908	100.0
Bicycles	1,113,039	22,160,260	69.4
Individual:			
Chainless	41,899	1,893,821	5.9
Chain	1,067,624	20,031,609	62.8
Tandem	5,457	201,889	0.6
Motor	159	32,950	0.1
Tricycles	18,110	47,985	0.2
Automobiles	56	60,788	0.2
All other products	.....	9,646,875	30.2

In Table 6, as in preceding tables, are included only the 312 establishments in which the manufacture of cycles was the principal industry; but in 1900 returns were also received from 16 establishments reporting cycles as a by-product.

The number and value of the bicycles and tricycles thus added is shown in Table 7.

TABLE 7.—SUMMARY OF ESTABLISHMENTS REPORTING CYCLES AS A BY-PRODUCT, WITH THE NUMBER AND VALUE OF SUCH PRODUCTS: 1900.

STATES.	Number of establishments.	CYCLES PRODUCED AS BY-PRODUCTS.										
		Aggregate value.	Bicycles.								Tricycles.	
			Total.		Individual.				Tandem.			
			Number.	Value.	Chainless.		Chain.		Number.	Value.	Number.	Value.
					Number.	Value.	Number.	Value.				
The United States	16	$1,553,177	69,811	$1,529,177	1,030	$63,508	68,598	$1,456,989	183	$8,680	8,000	$24,000
Illinois	3	447,198	18,600	447,198	.....	.....	18,543	444,633	57	2,565	.....	.....
New York	4	141,374	7,792	141,374	1,000	62,488	6,792	78,886	.....	.....	.....	.....
Ohio	4	605,994	26,231	581,994	.....	.....	26,145	577,479	86	4,515	8,000	24,000
All other states[1]	5	358,611	17,188	358,611	30	1,020	17,118	355,991	40	1,600	.....	.....

[1] Includes establishments distributed as follows: Massachusetts, 1; Michigan, 2; Pennsylvania, 2.

Table 8 combines, for 1900, the number and value of all kinds of bicycles and tricycles manufactured, whether as principal product or as by-product, and of automobiles made in cycle factories, the per cent of each kind to the total, both in number and in value, and the average price of each kind.

TABLE 8.—TOTAL PRODUCTION OF CYCLES, INCLUDING THOSE PRODUCED AS BY-PRODUCTS, WITH PERCENTAGES: 1900.

	Number.	Value.	Per cent of total number.	Per cent of total value.	Average value.
Total	1,209,016	$23,822,210	100.0	100.0	.....
Bicycles	1,182,850	23,689,437	97.8	99.4	$20.03
Individual:					
Chainless	42,929	1,957,329	3.5	8.2	45.59
Chain	1,136,122	21,488,589	94.0	90.2	18.91
Tandem	3,640	210,569	0.3	0.9	57.85
Motor	159	32,950	(1)	0.1	207.23
Tricycles	26,110	71,985	2.2	0.3	2.76
Automobiles	56	60,788	(1)	0.3	1,085.50

[1] Less than one-tenth of 1 per cent.

The total number of vehicles manufactured was 1,209,016, of which 1,182,850, or 97.8 per cent, were bicycles. The census year 1900 was one of the first in which the chainless bicycle was produced in any considerable quantity, 42,929 being manufactured. Very few tandems were manufactured, constituting only three-tenths of 1 per cent of the total number, and only 159 motor cycles. Fifty-six automobiles were manufactured in cycle factories. The number of tricycles was 26,110, or 2.2 per cent of the total. The average price of chain bicycles at the factories was $18.91; chainless, $45.59; tandems, $57.85; and motors, $207.23. Most of the tricycles were children's toys, which accounts for their very low average price. In value, the chain bicycles constituted 90.2 per cent of the total; the chainless, 8.2 per cent; the tandems, nine-tenths of 1 per cent; and the motors, one-tenth of 1 per cent. The value of the tricycles was only three-tenths of 1 per cent of the total, and of the automobiles three-tenths of 1 per cent. There were produced in cycle factories, in addition to vehicles, other products to the value of $9,646,875, or 30.2 per cent of the total for the industry. These "other products" consisted chiefly of parts for bicycles, like chains, spokes, handle bars, saddles, rims, etc. In the beginning of the industry the larger establishments made nearly all the different parts of bicycles they required, but of late factories have more and more specialized their output, and now even some of the largest bicycle manufacturers merely buy the majority of the different parts and assemble them. The American Bicycle Company, controlling the majority of the output, is an example. Certain parts of its machines are manufactured in those of its factories best adapted for the purpose, and sent to other plants to be assembled. This procedure greatly economizes the cost of manufacture.

In addition to the bicycles given in Table 8, there was undoubtedly a considerable number manufactured by the 6,328 establishments classified as bicycle and tricycle repair shops, but as the value of their product was not reported in detail, but only the gross sum received for custom work and repairing, statistics as to the number of cycles manufactured by them are not available. The value of custom work and repairing in these establishments aggregated the large amount of $13,766,033, which should be taken into consideration in connection with the value of products of the manufacture of bicycles and tricycles. The general statistics for these latter establishments will be found in the Report on Manufactures, Parts I and II, under the classification "Bicycle and tricycle repairing."

HISTORICAL AND DESCRIPTIVE.

It is safe to say that few articles ever used by man have created so great a revolution in social conditions as the bicycle. Most of its evolution and all its perfection to the point of practical usefulness having taken place during the last fifteen years, the present generation is enabled to judge of the change it has brought in its wake. Lord Charles Beresford once said, "Whoever invented the bicycle deserves the thanks of humanity," and no expression was more fit. The bicycle has been the means of bringing out for exercise in the open air millions of persons, men and women, young and old, who otherwise would have confined themselves to homes, stores, and offices. The bicycle industry has, directly and indirectly, given employment to many thousands of persons in the manufacture and sale of its product. The very wide use of the bicycle led to the formation of the League of American Wheelmen, with a membership, at one time, of more than 100,000; and this organization started the agitation for better roads, which led, in many states, to great improvements in public highways. Like all other articles depending upon public favor for their use, the bicycle has had its successive periods of prosperity and depression. The boom of a few years ago has passed, and in its place has been established a legitimate demand for the bicycle as a mode of conveyance. It is probable that a normal stage in the manufacture has been reached, and that from now on the industry will show stability and progress. Already there is hardly a spot in the known world where the bicycle has not penetrated.

The question when the first vehicle was used by man for self-propulsion is difficult to answer. Contrivances, somewhat similar to the bicycle, were not unknown even in the most ancient times, as is shown by the hieroglyphics of the Egyptians, in which appear images bearing a faint resemblance to the "hobbyhorse" of a few generations ago; and upon the frescoes of Pompeii are to be seen winged figures astride a stick connecting two wheels. Rudimentary velocipedes were mentioned in the Fifteenth and Sixteenth centuries. The first record of a bicycle is in a stained-glass window, dated 1642, in the church of Stoke Pogis, a town near Windsor, England; but, though a bicycle is pictured, there is no explanation of its origin. John Evelyn noted in his diary that in August, 1665, he called at Durdans, near Epsom, and found Dr. Wilkins, Sir William Petty, and Mr. Hooke, contriving, among other things, "a wheele for one to run races in."[1] In 1693 Ozanam read a paper before the Royal Academy of Science, describing a vehicle driven by the pedaling of a footman. Ozanam's vehicle was followed, about 1761, by another, built on a somewhat similar plan by an Englishman named Ovenden, at which time a description of the machine appeared in the *Universal Magazine*.

In 1690 M. de Sivrac, a Frenchman, invented a vehicle consisting of two wheels joined with a wooden frame representing the body of an animal, upon the back of which was placed a saddle for the rider. This contrivance had no handle bar, but was steered by the feet of the rider. It was called the célérifère. In the London Magazine for August, 1769, there is a description of a "chaise to go without horses." Le Journal de Paris, July 27, 1779, contains a description of the wonderful invention of MM. Blanchard and Magurier, which was called the velocipede. This, however, was only a reappearance of the célérifère with the addition of an upright bar for the support of the hands. Though this vehicle was much used, it was only with the advent of the draisine that the riding of a velocipede became fashionable.

The draisine was invented by Baron Carl von Drais, of Manheim on the Rhine, in 1816. It consisted of two wheels, tandem style, connected by a bar or perch over them, the forward wheel axled in a fork swiveled to the fore end of the perch and bearing at the top a cross-bar or handle with which to guide the machine. The rider sat astride the perch, on a saddle, propelling the vehicle on the level or on an upgrade by thrusting his feet on the ground. On a descending grade he lifted his feet and coasted. In his application for a patent Baron Drais described the capacities of his invention as follows: "1, that on a well-maintained post-road it will travel uphill as fast as a man can walk; 2, on a plain, even after a heavy rain, it will go 6 to 7 miles an hour, which is as swift as a courier; 3, when roads are dry and firm it runs on a plain at the rate of 8 to 9 miles an hour, which is equal to a horse's gallop; 4, on a descent it equals a horse at full speed." The real improvement made by von Drais was that the front wheel turned on a pivot and thus the handle bar was movable, enabling the rider to steer the wheel.

The draisine excited much attention in Germany and France and was finally brought to England, where Dennis Johnson, in 1818, patented an improved draisine under the name of a "pedestrian curricle;" this had an adjustable saddle and a rest for the elbows. The enthusiasm in England was raised to a high pitch by this machine; all the fashionables adopted its use and it was soon nicknamed "dandyhorse" and "hobbyhorse." Among the names used for the draisine in England, about 1817, were "the patent accelerator," "the velocipede or swift walker," "the manivelociter," "the bivector," etc.; and in 1819 they were called bicipedes and tricipedes. The Gentlemen's Magazine for March, 1819, contains an article describing the use of the velocipedes, from which the following is an extract:

[1] Temple Bar, June, 1898.

"The new machine, entitled a velocipede, consisting of two wheels, one before the other, connected by a perch, on which the pedestrian rests the weight of his body while with his feet he urges the machine forward on the principle of skating, is already in very general use. 'The road from Ipswich to Whitton,' says the Bury paper, 'is traveled every evening by several pedestrian hobbyhorses; no less than six are seen at a time.' * * * The crowded state of London does not admit of this novel mode of exercise and it has been put down by the magistrate of police." And the Monthly Magazine for October, 1819, said: "Considerable progress continues to be made in the improvement and useful extension of the traveling vehicles named velocipedes. It being found that the propelling action of the legs led to diseases of them, it has been contrived that a propelling reaction shall be created by the energy of the arms, and Mr. Birch, who has succeeded in this new application, may soon expect to work his levers, not only by the hands, but by steam. Indeed, there can be little doubt but this triumph of mechanics will be effected within the ensuing winter."

In England the velocipede was considerably improved in 1821 by Louis Gompertz. His machine had the handle connected with a segment rack, gearing in a pinion on the front wheel, so that it could be driven either by the hands or, as before, with the feet on the ground. About this time inventive genius came to a standstill, so far as self-propelled vehicles were concerned and remained so for more than forty years, though rival claims exist that in 1836 Kirkpatrick McMillan, of Courthill, Scotland, invented a bicycle driven by the aid of cranks and levers from the rear wheel; and that Gavin Dalzell, of Lesmahgon, Scotland, about 1845, also made one on similar principles; but, as neither of these types was ever manufactured for any other person than the owner, neither claim has been recognized.

In 1865 M. Mareschal, a Frenchman, obtained a patent on a frame connecting five wheels, each having an independent axle provided with foot-cranks bearing loose pedals. Each wheel was to be mounted and driven by its own rider, the front wheel being also the guide wheel. Thus the vehicle could carry from one to five riders. The next improvement came in September, 1865, when MM. Woirin and Leconde obtained their French patent. Their machine had three wheels, two smaller rear ones on the same axle, and one larger front wheel having an axle with cranks on which were loose pedals for the feet of the rider. The frame connecting these wheels was in the shape of a wooden horse, on whose back the rider sat, well over the front wheel. From this invention sprang the tricycle, which for many years was popular.

There has been considerable controversy about who was the inventor of the first crank-driven bicycle—whether it was Ernest Michaux, the son of a French manufacturer, or Pierre Lallement, one of the workmen in the senior Michaux's shop. Most authorities seem satisfied that the honor belongs to Lallement. He conceived the idea that the foot-cranks would work as well on a two-wheeled as on a three-wheeled velocipede. He took off one of the rear wheels and set the other directly back of the front wheel, and the "bone shaker" was an accomplished fact. At that period it was generally thought impossible for anyone to balance himself on a velocipede without keeping his feet on the ground; but Lallement finally succeeded in mastering the art, and his machine was exhibited at the Paris Exposition in 1865, but he thought so little of its usefulness that he did not patent it. In 1866 Lallement came to the United States, and while looking for work he made one of these two-wheeled velocipedes and rode it on the streets of New Haven, Conn. There James Carroll, a Yankee, noticed him, and foreseeing the opportunity for establishing a new and successful industry, he and Lallement obtained a patent on the 20th of November, 1866. The velocipede described in this patent consisted of two wooden wheels, with iron tires, of nearly equal size, one before the other, surmounted by a wooden perch, from which projected downward, near its rear end, two arms on either side of the rear wheel, each pair of arms meeting at the end of the hub and forming a bearing for the end of the axle; one similar wooden bar projected from the fore end of the perch on either side the forward wheel, furnishing bearings for its axle, and arranged with a pivot in the perch so that the fore wheel could be turned in either direction. On a steel spring extending over the perch was a saddle, about midway between the wheels. The rider started the machine by pushing it along the ground with his feet, and afterwards propelled it by working the pedals, which were attached to the front wheel.

The word bicycle, thus spelled, first occurs in the English patent records in the specification of J. I. Stassen, filed April 8, 1869. For a few years previous a somewhat similar word had appeared in print, though the spelling of it varied considerably. Thus the London Daily News of that date wrote of "bysicles" and "trysicles." One of our own papers called it "bicycular velocipede," and Harper's Weekly, in 1868, called it "bicircle" and "veloce." The Franco-Prussian war of 1870 brought the flourishing velocipede industry of France to a standstill, but in England about the same time the foundation was being laid for the new industry, which, ere long, was to take such a dominating place. Improvements, however, were slow. In 1871, W. H. J. Grant proposed to use rubber pedals, so as to permit the rider to use the ball instead of the hollow of the foot; he also attached rubber tires to curved metal rims by vulcanization. By this time there was a marked increase in the size of the front wheel, while the back one grew smaller, until, in 1873, J. K. Starley, who has been called the "Father of the bicycle," produced

a machine which embodied the rudiments of the modern bicycle. It was constructed of metal and rubber and its front wheel was twice the size of the rear one. The front wheel was continually increased in size until in 1886 bicycles were built with a front wheel 60 inches in height, while the rear wheel had been reduced to 16 inches.

The first appearance of the bicycle in the United States was in 1819, when Johnson's pedestrian curricle was introduced into New York. The excitement it created rapidly spread to Boston, Philadelphia, and other places, and many riding schools were opened. On June 26, 1819, William K. Clarkson was granted a patent for improvement in a velocipede. After the first novelty had worn off, little was heard of velocipedes in the United States until Lallement's patent had been granted, nearly half a century later. Another patent was taken out in July, 1868, by the Hanlon brothers. In 1869 the new velocipede craze was at its height; rinks and riding schools were opened everywhere, but, as was the case with the hobbyhorse in 1819, the "bone-shaker" was found too cumbersome a machine to gain lasting favor, and two years later scarcely any were ridden in the United States.

In England the development of Lallement's velocipede was carried on; the first important improvement was in the construction of the wheels, which were made of steel; but progress was slow until 1874, when J. K. Starley patented the tangent wheel. In the United States nothing was done in the way of perfecting the bicycle; and until fifteen years ago the manufacture of bicycles had been more experimental and devoid of all rational theory than any other branch of the engineering industry. Up to a few years ago the designing of bicycles was thought unworthy the study of competent engineers.

The bicycle as a modern vehicle has been before the world for about thirty years. Its evolution in a diversity of patterns may be said to have taken place principally between 1868 and 1885; and its perfection, transformation, and the almost complete extinction of all but one class, in the decade 1885–1895. The first modern bicycles were imported from England in 1876 and exhibited at the Centennial Exposition in Philadelphia. There they were seen by Col. Albert A. Pope, of Boston, Mass., and he immediately recognized the opportunities that lay before this new mode of conveyance. The following year he set about carrying his idea into effect. He went to England to study the industry, which then flourished there. On his return he brought some wheels, and the same year W. S. Atwell, of Boston, built for Colonel Pope the first American bicycle. This was a very cumbersome affair, weighing 70 pounds and costing $313. After another visit to England where he found more than 100 factories busy producing bicycles, Colonel Pope decided that the field for the new vehicle in America was broad enough to warrant starting a factory. He interested the Weed Sewing Machine Company, of Hartford, Conn., in the manufacture of bicycles, and in a corner of their shop the Columbias were first manufactured.

From this small beginning evolved a chain of factories in Hartford, at times giving employment to more than 5,000 workmen, and contributing their share toward making Hartford one of the wealthiest cities in the United States. Colonel Pope bears the undisputed title "Father of the American bicycle," and a great part of the credit for the extraordinary development of the industry was due to him. The "ordinary" bicycles, however, were almost entirely built after foreign patterns. One of the American ideas to prevent "headers" was shown in the Star bicycle, patented in 1880 by G. W. Pressey, on which the small wheel was placed in front. The seat was moved so as to place the center of gravity forward of the big wheel, the feet of the rider resting upon adjustable treadles, working independent of each other.

As early as 1876 H. T. Lawson, an Englishman, invented a safety bicycle in which the rear wheel was driven by levers, but it was not until 1880 that the first rear-driving "geared" safety was built at the works of the Coventry Machinists' Company at Coventry, England, after the design of Mr. J. K. Starley. But the energies of the bicycle makers were still bent on improving the high wheel. Comparatively great as the demand was for these machines it was limited to a certain class of riders, and it was only with the advent of the "safety" that the manufacture of cycles on a large scale began. It was not until 1885 that the "safety" became a feature at the Stanley show in England, where, in the early days of the industry, all manufacturers gathered ideas.

In 1887 Mr. A. H. Overman invented a bicycle, the Victor, a machine with two wheels of the same size, set tandem style and connected by a frame on the principle of a triangular truss, with the seat at the apex of the triangle and a sprocket wheel at one end. The sprocket wheel was connected with the hub of the rear wheel by an endless chain and was turned by pedals on each side. This wheel had narrow steel tires, which were soon replaced with solid rubber, and it weighed more than 50 pounds. The history of the "safety" is a record of rapid development. Immediately after its acceptance as a popular type of a wheel, a series of changes began in design and construction, and in the ideas of manufacturers as to the necessary requirements of such a machine. Between 1885 and 1890 the evolution of the cycle industry was especially rapid; pregnant ideas and startling changes followed each other in quick succession.

A noteworthy fact is that the development of the bicycle was the result of constant experimenting, instead of being based on knowledge of the needs of the industry. While the United States took little part in the early development of the velocipede and bicycle,

it has led the world during the last decade not only in the quality and quantity of bicycles produced, but in improvements in methods of manufacture. Through the ingenuity of American engineers, tools and automatic machines have been invented by the use of which the cost of producing bicycles has been so greatly reduced as practically to place the machine within reach of all classes.

The developments which converted the velocipede into the practical bicycle of to-day may be summed up as the rubber tire, the suspension wheel, the ball bearing, weldless steel tubing, the wooden rim, the chain gearing, the coaster brake, and the chainless gear.

The rubber tire (including its later variation, the pneumatic tire) was perhaps the most important of these improvements. As early as 1845 an English civil engineer, R. W. Thompson, patented a pneumatic tire, which differed but little from the present form; but at that time there were no cyclists and little use for such a tire, so the patent was allowed to lapse without having reached any commercial importance. When the velocipede came into use in 1867, steel tires were used; later the idea was conceived of nailing rubber strips on steel rims. When the "ordinary" came into use, "U" or "V" shaped steel rims were used, into which solid rubber tires were cemented, or fastened with corrugated wires. Between 1876 and 1882 the tendency was to reduce the size of the tire. This continued until 1889, when John B. Dunlop, an Irish veterinary surgeon, fitted a piece of rubber hose to his son's bicycle.

From this inconspicuous beginning grew the pneumatic tire, the great marvel in the construction of the modern bicycle, and the basis upon which the present industry rests. At every period throughout the history of bicycle construction attempts had been made to decrease the vibration, thus at the same time contributing to the comfort of the rider and increasing velocity by lessening the rolling friction; but all efforts were in vain until the advent of the pneumatic tire. At first it was received with incredulity by the manufacturers and by the riders, who feared to meet with punctures, but it soon demonstrated its indispensability; which is abundantly proven by the fact that, though previous to 1889 a pneumatic tire was unheard of, 40 per cent of all machines manufactured were fitted with them in 1891, and two years later a bicycle fitted with any other style was a curiosity.

The general distrust of the usefulness of the pneumatic tire led to the invention of the cushion tire in 1891. This was an india-rubber tire very much larger than the solid tire, and having a small hollow air space running through it. The pneumatic and the cushion were made on the same principle; in the pneumatic the thickness of the outer wall was reduced to a minimum, the diameter was further increased, and air was forced inside and retained, at a pressure of about 40 pounds to the square inch. The pneumatic tires soon demonstrated their superiority over the cushions, and in a very short time they had surmounted all prejudices. The single-tube pneumatic tire was first suggested and described by Mr. I. W. Boothroyd, of London, England, who, however, did not patent his invention; at about the same time P. W. Tillinghast, of Providence, R. I., had invented, patented, and brought out in the United States a pneumatic tire on the same lines as Boothroyd's.

The suspension wheel is one of the oldest of all the parts which enter into the make-up of the modern bicycle. Both the English and the French claim the honor of having invented it—the former in 1826 and the latter in 1864. It, however, belongs to neither, as manuscripts left by a Spaniard, Leonardo da Vinci, a contemporary of Columbus, contain a sketch of a suspension wheel and an autographic note describing the device as one "by which wheels are strengthened and a light wheel made strong." This invention antedates 1490. A wheel in the National Museum in Washington is a reproduction from this sketch. The next record of a suspension wheel is found in the British Patent Office, where Theodore Jones, in 1826, filed his application for a patent on an "improved construction of carriage wheels, of such nature that the weight they have to carry is suspended from that part of the wheel which happens to be uppermost, instead of being supported, as is usual, by the spokes that happen to be under the axle-tree." All modern bicycle wheels are built on this principle.

The first bearing used in bicycle construction was the "plain" bearing. To this a nicely fitted and hardened sleeve was added, and this became known as the parallel bearing. The next change was to the roller bearing, which was not a success. About the same time the adjustable cone was tried. This was a male cone, threaded on the axle and fitting into a female coned space in the hub. The final and most important step in the evolution of the bearings was the innovation of interposing steel balls between these coned faces, a change which revolutionized previous theories and reduced the friction to an almost imperceptible point. The inventor of the ball bearing was Bonn, an Englishman. These bearings have now been applied to every point in a bicycle where friction may be encountered. They are, perhaps, to be more admired than any other part of the machine. Instead of allowing the axle to slide around in its bearings hard steel balls are introduced so that the parts which come in contact roll over, and do not slide upon, one another. These balls have to be made with the greatest possible accuracy, as the least flaw in them will put the wheel out of order. It is interesting to note how little the balls lose in weight by wear in traveling. Experiments have proved that 12 balls, which, when new, weighed 25:80,400 gram, after having been ridden 1,000 miles weighed 25:80,088 gram, the loss being 3:12 milligram, which is equal to 1/20.8 grain; i. e., in running 1,000 miles each ball lost

1/250 grain. This corresponds to a wear off of the surface of only 1/158,000 of an inch.[1]

The construction of the frames of bicycles has passed through many eras. In the first hobbyhorses the connections between the wheels were made of wood; on the early velocipedes the frame was made of solid steel or iron bars; then came the change from solid forgings to tubing and finally the weldless steel tube. Attempts to produce weldless tubes by a drawing process were made some thirty-five years ago. The process was, however, a costly and difficult one, and before it could reach its modern development it awaited important improvements, both in respect to the drawing appliances and to the manipulation of the ingot from which the tube was produced. W. C. Stiff, of Birmingham, England, perfected the methods of manufacture to such a degree that about 1880 weldless steel tubing began to be employed for the backbone and fork of the "ordinary" bicycle. The great demand, however, arose when the safety bicycle came into vogue. There are various modes of producing the cold-drawn steel tube, but the principle is practically the same in all. Only a very high grade of steel is suitable for the purpose, and Swedish charcoal steel containing a particular proportion of carbon has proven itself superior to all others.

Previous to 1893 a very small portion of the tubing required for bicycle manufacture was produced in the United States, and that produced was of an inferior grade, which could not be used in high-grade bicycles. In 1892 and 1893 several tube works were started in the United States, but it was not until about 1897 that the home factories could supply the demand. George F. Parker, United States consul at Birmingham, England, in his report of May 8, 1896, states that the exports of bicycle tubing from Birmingham to the United States in 1895 amounted to $507,041, and for the first quarter of 1896 the amount had risen to $231,200. The fiscal year 1897 was the first in which imports of bicycle tubing were given separately in the United States Treasury reports, the value imported that year being $185,259; in 1898, only $33,798; in 1899, $26,413; and in 1900, $16,573. The mode of making the tubing has been greatly improved, and our manufacturers are now turning out a product superior to any made in England and are exporting large quantities to all parts of the world. An idea of the amount produced can be formed when it is remembered that every bicycle requires about 20 feet of tubing, and that, during 1900, 1,182,850 bicycles were manufactured.

The frame of the modern bicycle is a marvel of construction. It is really a bridge on wheels built for the support of a man. Until a few years ago the tendency was to reduce the weight, and tubing was used which was hardly thicker than a sheet of stout paper; but, after roadsters had been produced weighing about 16 pounds, a change took place, and the average is now about 22 pounds. Originally the different parts of the frame were joined together with drop-forge connections, but now sheet-steel stampings are almost entirely used. The joints were of three kinds, flush, outside, and lapped, of which flush joints are now used almost exclusively. After the drop forgings or stampings are finished the tubes are cut down to proper lengths and closely fitted into the open joint of the stamping connection. In order to hold them securely they are pinned through, and are then taken to the brazing furnace. The process of brazing as applied in the bicycle industry is of very recent origin. Until 1880 it was generally thought impossible to braze light tubing to solid forgings, and all connections were welded together. The difficulties were solved, however, and the brazing and the flush joints make the bicycle of to-day as solid as if it were cut out of one piece of steel. A few years ago hickory wood was substituted for steel tubing by some manufacturers, but this did not prove satisfactory and was soon discontinued. The frames have also been made of papier-maché. The diamond-frame construction was not used until 1891, when Humber, in England, made a bicycle with straight tubing; previous to this the frames had been of the most fantastic shapes. One of the improvements greatly enlarging the use of the bicycle was the drop frame, which enabled women to ride. The first drop-frame bicycle was disclosed to the Patent Office on February 2, 1886, and a patent for it was granted to E. G. Latta on March 29, 1887.

The improvement in rims has also been of far-reaching proportions. The dandy-horse had wooden rims, shod with iron, but in the more modern velocipedes these were supplanted by steel or iron rims. The first rims used for rubber tires were of solid metal, grooved to receive the tire. In 1877 J. S. Smith, of London, England, patented the hollow metal rim. Until 1891 steel and iron rims were used exclusively, but the latter year a wheel with a wooden rim was put on the market by Mr. Charles Harrington. This was a purely American innovation. Makers and riders were very skeptical as to its value, but in less than two years it had completely superseded the steel rim in the American market. The steel rim is now used only on wheels exported to England, where it is claimed that climatic conditions are unfavorable to the wooden rim. In 1896 rims of papier-maché were manufactured, but as none of the prominent manufacturers accepted them, their use was very limited, and they soon disappeared.

Of all the component parts of a bicycle, the gearing has probably caused the most brain work. Lallement's velocipedes and all the early "ordinary" bicycles were fitted with a crank directly attached to the driving wheel. In 1875 Rousseau patented a bicycle using a chain gearing applied to the big wheel. The application of the chain marked an extraordinary epoch in the development of the bicycle. Before its introduction

[1] Lecture delivered by C. Vernon Boys, A. R. S. M., at the Royal Institution, March 7, 1884.

gearing had been obtained by the working of treadles or toothed gear. At first it was thought that toothed gearing could be more accurately constructed than a chain and that it was more economical of power, but as the bevel or tooth-geared machines could not be manufactured to run as fast as the chain-geared, the latter soon had the entire field.

The first patent for a bevel-gear chainless bicycle was granted in 1885, but the first practical ones were not put on the market to any extent until 1897; since then there has been a steady increase in the number manufactured. The mechanism of the "bevel gear" chainless bicycle consists of a pair of gear wheels at the crank bracket and another pair at the rear hub, with a connecting rod which rotates on ball bearings, and runs near the stationary rear fork of the bicycle. The gear wheels are furnished with roller-bearing pegs or teeth which engage each other nearly at right angles. Another type of chainless bicycle is the spur sprocket. This obtains its power by the interlocking of cogs in three spur wheels; the first wheel revolves with the cranks, communicating power by cogs to the intermediate wheel, and this in turn causes the third wheel, which is attached directly to the rear hub, to rotate.

One of the contrivances which has lately done much to restore the bicycle to public favor is the free wheel and coaster brake. The first patent for this was granted in 1880, since which time it has been greatly improved. The coaster brake is a device which allows the rider to rest his feet on the pedals, while allowing the driving wheel to revolve freely. A slight backward pressure on the pedal throws a clutch mechanism into action, which in turn operates a braking device. The foremost in use has an expanding rim inside a hub; by very slight application of power this ring generates a very high braking power and gives the rider complete control over the wheel. One of the most popular styles of coaster brakes consists of two hubs, i. e., an inner or driving hub, and an outer or coasting hub. While driving, the two hubs are locked together by means of a ball clutch; this is released by a backward pressure on the pedal, and when coasting the driving hub remains at rest, allowing the outer hub to revolve freely on an independent set of bearings resting on the inner hub.

It is easy to perceive the great advantage of the coaster brake over other brakes. The first brake on the "ordinary" bicycle was the remarkable drag brake, which was pivoted under the rear fork crown, and was operated by a cord passing over the backbone to the handle bar. It was applied by turning the handle, when the prongs of the drag were forced against the ground. An improvement over this was the "spoon" brake, which at first also was applied to the small wheel; later on it was applied to the big wheel. This has also been the most common brake used on the "safety."

The first crank hanger was made from a casting, for which later a drop forging was substituted. The latter was considered one of the best, but was also the most expensive form of brackets. As the demand for cheaper wheels arose, stamped brackets usually consisting of two pieces brazed together were used. The crank hanger is now usually of one piece construction, the steel being drawn into the shape of a tube by means of 5 separate operations. The 4 lugs to carry the rear forks, the lower main tube and diagonal stays, are then drawn and formed upon it through hydraulic pressure, making 12 more operations; the seat-pillar lug, while not seamless, is of the one piece construction with the 3 lugs drawn and formed in the same manner. The rear fork jaws are stamped out of crucible steel and are of what is known as semi-hollow construction—i. e., a half section of a circular tube. The basic patent is for a crank hanger formed with lugs to receive the tubes of the frame. A great many attempts have been made to invent brackets to evade this patent. The advantage of the sheet-metal bracket, besides its economy, is the preservation of the metallic skin, the toughest portion of the metal.

The first pedals on the velocipedes consisted of 2 elliptical side plates of sheet steel, joined in the center by a tube to slip over the pedal shaft, and having, on rods riveted into the ends of the side plates, 2 round rubbers for the tread. The bearing was either plain or the adjustable cone. The greatest improvement was the application of ball bearings to the pedals. Two forms are now used—rubber and rat-trap. The rubber pedals consist of rubber-covered disks for the feet to rest on and give them a cushion. Rat-trap pedals consist of toothed blades, and are largely used by racing men on account of their lightness and nonslipping qualities.

Originally all hubs were made of gun metal; flanges were very thick at the edge and tapered toward the center, in order to provide sufficient room for tapping and threading the hub flanges to allow for the direct spokes. From these the barrel hub in its different varieties evolved.

The spokes have also been greatly improved. At first they were one-quarter of an inch in diameter, made of iron, and headed at both ends. Then steel-wire spokes were used with a considerably smaller diameter. The nipple and nut spokes were abandoned about 1882 and the direct spoke was substituted. Manufacturers continued to reduce the size of the wire, and now use .069 wire. The first tangent spokes were made in England by the Coventry Tangent Company, and soon after their introduction the manufacturers inaugurated the method of swaging the spokes, that is, tapering them toward the center. A set of spokes for a modern wheel weighs only 15 ounces.

The saddle is the one of the component parts of a bicycle, the idea of which has undergone the least

change. On the early velocipedes the saddle was made out of a piece of wood; later on this was covered with leather and padded. On the high wheels the saddles were formed by a base of metal covered with leather. The next type was the suspension, or hammock type, where the seat rested on a piece of leather suspended between the front and rear forks. Then followed the era of the so-called hygienic saddles, of which the pneumatic saddles were the most prominent. The use of the pneumatic and other cushion saddles has been abandoned, as they were apt to produce chafing and soreness; some of them were even apt to produce forms of internal injury. The desire has been to produce saddles of such a design as to reduce vibration to its lowest degree, and at the same time to get a saddle which will retain its form under hard usage and different conditions. The perfection is exemplified in the present rigid type of saddle. Spring frames, seat posts, and forks are other devices for such reduction.

The accessories to the bicycle are too many to be enumerated; among them are air pumps, lamps, shoes, clothing, carrying baskets, cyclometers, etc.

Tricycles may be divided into three classes: children's, carriers, and vehicles for invalids. Few, except the children's, are now manufactured.

During the census year 1900 only a few motor bicycles were manufactured, and it is too early to speak of the development of this branch of the industry. The price of such machines has been considerably reduced during the last two years.

The evolution of the bicycle industry can be gauged to some extent by the number of patents issued. Since the establishment of the United States Patent Office 7,573 patents have been granted for cycles and their component parts. Of these only 16 had been granted before January 1, 1865, and the great majority were issued after 1890. The first patent issued was to J. B. Bolton, September 29, 1804, for a vehicle driven by a hand-worked toothed gear; the others issued previous to 1865 mostly covered toys. In 1892, the number of applications for patents on improvements in cycles increased at such a rate that a special division for their examination was established in the Patent Office. Patents of the velocipede class are divided into five groups, as follows: Unicycles, bicycles, dicycles, epicycles, and polycycles. All patents in this class must refer to velocipedes propelled by hand or foot, or to parts of such vehicles. Wheels and their component parts, such as hubs, spokes, rims, and tires, are not, however, included in this class, but with carriage and wagon wheels. The following tabular statement shows the number of patents that have been granted on all parts entering into the construction of cycles. The miscellaneous item includes clamps, rests, casings, mudguards, etc.

Unicycles	46
Epicycles	32
Dicycles	38
Bicycle propulsion	1,326
Polycycle propulsion	718
Frames	831
Pneumatic tires	764
Cushion and solid tires	652
Saddles	514
Brakes	451
Handlebars and handles	448
Wheels, spokes, rims, and hubs	358
Pedals and toe clips	223
Bearings	133
Miscellaneous	1,039
Total	7,573

From this tabular statement it appears that 2,044 different devices for cycle propulsion have been patented, 1,416 for rubber tires, 831 for frames, 514 for saddles, and 451 for brakes. Unicycle is a velocipede with only one wheel; dicycle is one where 2 wheels are placed side by side, and polycycle is one having 3 or more wheels placed in such a manner as to furnish a stable support. The epicycle is a vehicle very seldom seen in public. It is a portable annular track propelled by a traction wheel on the inside. The rider is seated inside the wheel in such a position that the center of gravity is a little below the axis of the annulus.

The number of patents applied for during the last two years has been considerably reduced.

The following tabular statement, taken from the reports of the United States Treasury Department, shows the exports and imports of cycles and parts thereof for the last five years of the decade. Prior to 1896 there was no separate classification for this industry, its statistics being included either with carriages and wagons, or with manufactures of iron and steel.

FISCAL YEAR.	Imports.	Exports.
1896	$56,960	$1,898,012
1897	21,122	7,005,323
1898	4,845	6,846,529
1899	4,577	5,753,880
1900	3,516	3,553,149

Almost the entire demand for bicycles in the United States and many foreign countries was, until recent years, supplied from England; but American bicycle manufacturers have had the satisfaction of reversing trade conditions, and now the United States is supplying bicycles not only to England, but also to all other parts of the world.

Table 9 shows in detail for 1900 the statistics relating to the industry.

TABLE 9.—BICYCLES AND TRICYCLES, BY STATES: 1900.

		United States.	California.	Connecticut.	Illinois.	Indiana.
1	Number of establishments	312	4	24	60	19
	Character of organization:					
2	Individual	95	3	6	17	2
3	Firm and limited partnership	54	1	3	7	2
4	Incorporated company	163	.....	15	36	15
5	Established during the decade	253	3	16	48	15
6	Established during the census year	22	1	1	5	1
	Capital:					
7	Total	$29,788,659	$19,254	$4,215,399	$7,694,658	$2,061,560
8	Land	$1,501,003	.....	$241,075	$478,407	$110,873
9	Buildings	$3,705,462	.....	$882,071	$561,680	$302,102
10	Machinery, tools, and implements	$9,462,031	$4,400	$1,487,357	$2,018,283	$782,015
11	Cash and sundries	$15,115,163	$14,854	$1,604,296	$4,636,288	$866,570
12	Proprietors and firm members	209	5	12	31	5
	Salaried officials, clerks, etc.:					
13	Total number	2,084	.....	263	642	123
14	Total salaries	$1,753,235	.....	$251,091	$522,477	$96,996
	Officers of corporations—					
15	Number	194	.....	16	37	10
16	Salaries	$430,787	.....	$47,733	$93,658	$35,140
	General superintendents, managers, clerks, and salesmen—					
17	Total number	1,840	.....	247	605	101
18	Total salaries	$1,322,448	.....	$203,358	$428,819	$61,856
	Men—					
19	Number	1,369	.....	194	466	79
20	Salaries	$1,169,087	.....	$179,335	$380,504	$53,413
	Women—					
21	Number	471	.....	53	199	25
22	Salaries	$153,361	.....	$24,023	$48,315	$8,443
	Wage-earners, including pieceworkers, and total wages:					
23	Greatest number employed at any one time during the year	27,643	30	3,476	7,052	2,320
24	Least number employed at any one time during the year	8,423	22	1,309	2,076	965
25	Average number	17,525	19	2,139	4,388	1,481
26	Wages	$8,189,817	$11,080	$1,150,736	$2,144,897	$613,840
	Men, 16 years and over—					
27	Average number	16,700	19	1,995	4,143	1,352
28	Wages	$7,952,257	$11,080	$1,107,485	$2,078,884	$570,858
	Women, 16 years and over—					
29	Average number	517	.....	104	104	126
30	Wages	$175,028	.....	$34,662	$33,276	$42,150
	Children, under 16 years—					
31	Average number	308	.....	40	141	3
32	Wages	$62,532	.....	$8,589	$28,287	$832
	Average number of wage-earners, including pieceworkers, employed during each month:					
	Men, 16 years and over—					
33	January	21,486	15	2,486	5,439	1,661
34	February	22,645	23	2,936	5,681	1,847
35	March	22,671	23	3,092	5,661	1,873
36	April	21,043	23	2,993	4,783	1,810
37	May	19,103	28	2,526	4,630	1,609
38	June	14,755	20	1,821	3,588	1,085
39	July	11,564	20	1,264	3,613	756
40	August	10,157	20	1,298	2,361	736
41	September	11,458	15	1,378	2,683	1,211
42	October	12,416	15	721	3,261	1,108
43	November	15,209	15	1,564	3,787	1,145
44	December	17,893	15	1,871	4,274	1,860
	Women, 16 years and over—					
45	January	749	.....	142	142	248
46	February	764	.....	144	128	250
47	March	720	.....	134	121	225
48	April	645	.....	133	96	200
49	May	532	.....	118	89	148
50	June	423	.....	90	78	81
51	July	327	.....	60	65	71
52	August	385	.....	78	106	86
53	September	443	.....	79	93	136
54	October	359	.....	88	98	21
55	November	413	.....	90	109	28
56	December	437	.....	92	120	21
	Children, under 16 years—					
57	January	372	.....	57	166	5
58	February	388	.....	63	179	5
59	March	394	.....	64	185	5
60	April	385	.....	64	177	5
61	May	343	.....	54	155	5
62	June	281	.....	36	116	5
63	July	249	.....	28	93	3
64	August	203	.....	25	81	1
65	September	224	.....	27	102	2
66	October	247	.....	.....	143	1
67	November	278	.....	22	141	2
68	December	337	.....	36	148	2
	Miscellaneous expenses:					
69	Total	$2,252,604	$3,144	$328,629	$630,442	$121,260
70	Rent of works	$221,381	$1,180	$26,653	$94,453	$8,200
71	Taxes, not including internal revenue	$107,709	$56	$15,656	$23,370	$11,138
72	Rent of offices, interest, insurance, etc	$1,881,997	$1,833	$277,866	$496,719	$101,922
73	Contract work	$41,517	$575	$3,454	$15,900	.....
	Materials used:					
74	Aggregate cost	$16,792,051	$25,470	$1,720,249	$4,836,585	$1,221,786
	Principal materials—					
75	Total cost	$13,957,756	$24,425	$1,514,139	$3,735,094	$1,096,178
76	Purchased in raw state	$20,405	.....	.....	.....	$8,405
77	Purchased in partially manufactured form	$13,937,351	$24,425	$1,514,139	$3,735,094	$1,087,768
78	Fuel	$341,471	$864	$32,906	$95,895	$23,127
79	Rent of power and heat	$57,957	$71	$2,509	$15,475	$7,875
80	Mill supplies	$811,775	$110	$83,251	$72,966	$16,078
81	All other materials	$1,892,107	$500	$68,208	$881,524	$84,346
82	Freight	$280,985	.....	$24,286	$37,631	$26,187

TABLE 9.—BICYCLES AND TRICYCLES, BY STATES: 1900.

Massachusetts.	Michigan.	Minnesota.	New Jersey.	New York.	Ohio.	Pennsylvania.	Rhode Island.	Wisconsin.	All other states.[1]	
25	11	1	7	66	34	24	4	23	7	1
7	4	4	1	22	9	8	3	7	2	2
6	.....	.....	1	16	5	7	1	3	2	3
12	7	.....	5	28	20	9	.....	13	3	4
18	9	4	5	55	27	20	4	22	7	5
.....	1	.....	1	7	3	2	.....	.....	.....	6
$2,646,498	$757,021	$38,205	$204,465	$3,326,943	$4,074,576	$1,550,957	$24,300	$2,337,975	$831,848	7
$51,614	$6,900	.....	$13,700	$240,167	$74,537	$78,930	$4,000	$157,200	$43,000	8
$444,803	$44,893	.....	$16,000	$365,320	$437,853	$211,840	$7,000	$304,586	$127,254	9
$908,361	$117,513	$7,433	$78,068	$948,042	$1,736,524	$422,635	$7,600	$685,218	$257,982	10
$1,241,660	$587,715	$30,772	$96,097	$1,773,414	$1,825,602	$837,552	$5,700	$1,190,971	$403,612	11
19	4	4	3	57	20	26	4	13	6	12
139	53	2	24	267	209	110	6	160	36	13
$117,242	$39,643	$2,320	$23,457	$216,120	$197,406	$91,681	$3,600	$134,007	$57,195	14
9	10	.....	5	31	35	13	.....	13	6	15
$23,400	$14,462	.....	$10,480	$62,036	$69,580	$20,688	.....	$20,610	$33,000	16
130	43	2	19	236	174	97	6	147	30	17
$93,842	$25,181	$2,320	$12,977	$154,084	$127,826	$70,993	$3,600	$113,397	$24,195	18
102	34	1	14	174	129	78	5	130	23	19
$81,947	$22,063	$1,840	$11,374	$132,018	$111,913	$65,048	$3,300	$105,157	$21,235	20
28	9	1	5	62	45	19	1	17	7	21
$11,895	$3,178	$480	$1,603	$22,066	$15,913	$5,945	$300	$8,240	$2,960	22
2,407	535	61	274	3,151	3,659	1,550	36	2,469	623	23
905	127	25	61	867	995	375	9	588	98	24
1,581	311	47	183	2,103	2,380	947	17	1,572	357	25
$815,028	$141,630	$8,440	$71,343	$988,052	$1,017,001	$431,809	$6,100	$625,149	$165,083	26
1,543	294	47	170	2,082	2,340	891	17	1,500	357	27
$798,504	$138,457	$8,440	$68,185	$970,043	$998,218	$419,958	$6,100	$611,512	$165,083	28
38	17	.....	12	46	40	29	.....	1	.....	29
$16,624	$3,182	.....	$2,972	$11,009	$18,843	$7,280	.....	$180	.....	30
.....	.....	.....	1	25	.....	27	.....	71	.....	31
.....	.....	.....	$186	$7,000	.....	$4,131	.....	$13,507	.....	32
1,887	458	60	217	2,671	2,949	1,122	9	2,082	535	33
1,913	440	60	221	2,845	3,085	1,178	14	1,850	552	34
1,922	380	56	250	2,819	3,073	1,256	22	1,715	524	35
1,967	362	56	239	2,708	2,812	1,160	22	1,602	511	36
1,798	332	51	220	2,442	2,434	1,026	31	1,507	474	37
1,448	275	36	168	1,595	2,088	897	36	1,342	366	38
1,022	142	30	167	1,163	1,650	504	26	1,088	119	39
1,064	127	32	70	1,168	1,408	534	14	1,204	131	40
1,126	135	37	64	1,286	1,607	580	8	1,172	161	41
1,304	186	51	63	1,448	1,932	658	8	1,458	208	42
1,523	300	44	162	1,925	2,333	788	7	1,378	298	43
1,597	400	49	204	2,326	2,708	990	7	1,650	422	44
43	26	.....	15	44	48	40	.....	1	.....	45
42	26	.....	15	56	57	45	.....	1	.....	46
49	16	.....	15	55	57	47	.....	1	.....	47
47	18	.....	15	51	47	42	.....	1	.....	48
39	18	.....	14	53	29	28	.....	1	.....	49
40	18	.....	14	54	31	21	.....	1	.....	50
25	11	.....	10	30	26	20	.....	.....	.....	51
27	11	.....	10	36	17	14	.....	1	.....	52
32	11	.....	10	33	36	14	.....	.....	.....	53
35	11	.....	5	37	45	18	.....	1	.....	54
37	26	.....	7	46	45	24	.....	1	.....	55
43	26	.....	10	45	46	33	.....	1	.....	56
.....	.....	.....	1	26	.....	40	.....	77	.....	57
.....	.....	.....	2	26	.....	43	.....	70	.....	58
.....	.....	.....	2	27	.....	42	.....	69	.....	59
.....	.....	.....	1	25	.....	41	.....	72	.....	60
.....	.....	.....	1	24	.....	28	.....	75	.....	61
.....	.....	.....	1	16	.....	24	.....	83	.....	62
.....	.....	.....	1	26	.....	20	.....	79	.....	63
.....	.....	.....	1	11	.....	18	.....	66	.....	64
.....	.....	.....	1	29	.....	12	.....	51	.....	65
.....	.....	.....	1	25	.....	15	.....	62	.....	66
.....	.....	.....	.....	28	.....	19	.....	61	.....	67
.....	.....	.....	.....	39	.....	28	.....	84	.....	68
$125,076	$59,485	$4,673	$19,548	$366,501	$247,332	$128,931	$1,309	$170,266	$51,008	69
$11,156	$2,693	$1,184	$3,490	$34,428	$13,756	$10,597	$496	$9,807	$3,288	70
$17,811	$1,353	$74	$718	$10,628	$10,491	$1,700	$80	$7,805	$1,329	71
$96,559	$49,501	$915	$14,540	$320,148	$217,085	$110,834	$733	$147,451	$46,391	72
$50	$5,988	$2,500	$800	$1,297	.....	$5,800	.....	$5,208	.....	73
$1,307,900	$345,725	$30,997	$147,317	$1,856,065	$2,251,358	$1,065,461	$23,195	$1,536,592	$423,351	74
$1,199,814	$280,490	$29,400	$132,265	$1,675,358	$1,881,992	$951,521	$9,550	$1,109,512	$378,028	75
.....	$12,000	.....	.....	.....	.....	.....	.....	.....	.....	76
$1,189,814	$268,490	$29,400	$132,265	$1,675,358	$1,881,992	$951,521	$9,550	$1,109,512	$378,028	77
$25,652	$4,395	$745	$3,488	$42,714	$49,537	$11,701	$180	$40,328	$10,489	78
$5,801	$2,740	$132	$1,969	$7,384	$7,450	$3,565	$315	$1,110	$3,571	79
$11,323	$2,947	$110	$1,371	$31,206	$42,054	$20,210	$110	$28,323	$2,716	80
$96,228	$52,495	$300	$4,024	$72,188	$233,822	$58,051	$13,090	$342,356	$20,080	81
$29,087	$2,658	$310	$4,210	$27,270	$36,503	$20,418	.....	$14,963	$8,517	82

[1] Includes establishments distributed as follows: Colorado, 1; Iowa, 1; Kentucky, 1; Maine, 1; Maryland, 1; Nevada, 1; New Hampshire, 1.

TABLE 9.—BICYCLES AND TRICYCLES, BY STATES: 1900—Continued.

		United States.	California.	Connecticut.	Illinois.	Indiana.
	Products:					
83	Aggregate	$31,915,908	$47,670	$3,672,225	$8,960,421	$2,115,901
	Bicycles—					
84	Total number	1,113,039	579	107,419	385,951	83,964
85	Total value	$22,160,260	$26,145	$3,029,418	$7,004,441	$1,473,600
	Individual—					
	Chainless—					
86	Number	41,899	350	15,803	5,899	525
87	Value	$1,893,821	$15,270	$888,938	$134,850	$21,250
	Chain—					
88	Number	1,067,524	217	91,309	379,026	83,064
89	Value	$20,031,600	$9,025	$2,122,369	$6,823,316	$1,441,850
	Tandem—					
90	Number	3,457	6	307	1,026	375
91	Value	$201,889	$450	$18,111	$46,275	$11,000
	Motor—					
92	Number	159	6	.....	.....	.....
93	Value	$32,950	$1,400	.....	.....	.....
	Tricycles—					
94	Number	18,110	47	5,440	.....	.....
95	Value	$47,985	$4,175	$12,000	.....	.....
	Automobiles—					
96	Number	56	3	.....	.....	40
97	Value	$60,788	$2,250	.....	.....	$47,195
98	All other products	$9,646,875	$15,100	$630,807	$1,955,980	$595,106
	Comparison of products:					
99	Number of establishments reporting for both years	236	3	20	49	11
100	Value for census year	$27,039,436	$42,170	$3,512,368	$7,154,765	$1,823,377
101	Value for preceding business year	$27,045,264	$36,000	$3,157,505	$7,080,519	$1,487,770
	Power:					
102	Number of establishments reporting	260	3	20	48	18
103	Total horsepower	21,588	11	2,372	6,417	2,164
	Owned—					
	Engines—					
	Steam—					
104	Number	177	.....	19	29	18
105	Horsepower	16,853	.....	2,078	4,589	1,700
	Gas or gasoline—					
106	Number	45	1	2	14	3
107	Horsepower	661	3	37	304	89
	Water wheels—					
108	Number	19	.....	5	3	.....
109	Horsepower	568	.....	88	100	.....
	Electric motors—					
110	Number	70	.....	4	33	1
111	Horsepower	1,741	.....	90	1,012	8
	Rented—					
112	Electric, horsepower	756	8	32	71	207
113	Other kind, horsepower	1,009	.....	47	341	160
114	Furnished to other establishments, horsepower	215	.....	.....	56	35
	Establishments classified by number of persons employed, not including proprietors and firm members:					
115	Total number of establishments	312	4	24	60	19
116	No employees	9	.....	1	1	.....
117	Under 5	43	1	2	5	.....
118	5 to 20	72	3	7	12	3
119	21 to 50	65	.....	6	16	2
120	51 to 100	50	.....	1	10	8
121	101 to 250	40	.....	3	8	3
122	251 to 500	21	.....	2	4	2
123	501 to 1,000	8	.....	1	1	1
124	1,001 to 5,000	4	.....	1	3	.....

TABLE 9.—BICYCLES AND TRICYCLES, BY STATES: 1900—Continued.

Massachusetts.	Michigan.	Minnesota.	New Jersey.	New York.	Ohio.	Pennsylvania.	Rhode Island.	Wisconsin.	All other states.	
$2,715,310	$627,658	$66,505	$295,226	$3,842,020	$4,099,980	$1,855,043	$43,382	$2,795,236	$779,331	83
62,915	18,196	2,250	42	95,093	112,397	67,632	599	143,515	32,487	84
$1,792,460	$498,042	$37,375	$1,470	$2,239,962	$1,878,978	$1,490,509	$20,000	$1,951,164	$716,696	85
2,841	6,506	.....	.....	3,662	2,566	602	.....	1,044	2,101	86
$205,006	$202,920	.....	.....	$157,901	$81,650	$27,330	.....	$54,626	$103,080	87
59,708	11,676	2,250	42	90,828	109,756	66,706	595	142,042	30,305	88
$1,522,507	$292,122	$37,375	$1,470	$2,051,855	$1,793,778	$1,442,784	$19,695	$1,863,138	$610,816	89
339	.....	.....	.....	600	75	322	4	322	81	90
$58,247	.....	.....	.....	$29,006	$3,550	$20,095	$305	$17,050	$2,800	91
27	14	.....	.....	3	.....	2	.....	107	.....	92
$10,700	$3,000	.....	.....	$1,200	.....	$300	.....	$16,350	.....	93
1	42	.....	.....	1	238	12,341	.....	.....	.....	94
$724	$3,900	.....	.....	$150	$9,036	$18,000	.....	.....	.....	95
3	.....	.....	.....	2	3	4	.....	.....	1	96
$4,148	.....	.....	.....	$1,700	$2,000	$2,500	.....	.....	$1,000	97
$917,983	$125,716	$29,130	$293,756	$1,000,208	$2,209,966	$344,084	$23,382	$844,072	$61,635	98
20	7	4	4	46	26	18	3	20	5	99
$2,637,298	$546,808	$66,505	$163,329	$2,805,774	$3,911,025	$1,657,325	$35,600	$2,524,911	$658,181	100
$2,651,816	$414,161	$51,500	$146,723	$2,486,605	$3,418,181	$1,990,949	$36,000	$2,364,552	$1,082,983	101
23	10	3	7	53	25	18	3	23	6	102
1,557	323	16	216	2,119	3,282	978	26	1,711	416	103
12	5	.....	4	27	23	16	1	18	5	104
983	197	.....	153	1,742	2,606	892	8	1,575	330	105
.....	4	2	.....	6	2	1	.....	9	1	106
.....	27	13	.....	74	53	2	.....	46	13	107
4	1	.....	1	4	.....	.....	.....	.....	1	108
285	10	.....	10	74	.....	.....	.....	.....	1	109
7	.....	.....	.....	2	18	1	.....	4	.....	110
109	.....	.....	.....	4	487	3	.....	28	.....	111
88	84	3	40	37	91	5	18	.....	72	112
72	5	.....	13	188	45	76	.....	62	.....	113
60	.....	.....	.....	9	45	.....	.....	10	.....	114
25	11	4	7	66	34	24	4	23	7	115
.....	.....	.....	1	3	3	.....	.....	.....	.....	116
3	2	2	.....	12	5	5	2	2	2	117
4	4	1	1	18	4	7	1	6	1	118
8	2	1	3	15	2	4	1	4	1	119
5	.....	.....	1	8	9	2	.....	5	1	120
2	2	.....	1	7	7	4	.....	2	1	121
1	1	.....	.....	2	3	2	.....	3	1	122
2	.....	.....	.....	1	1	.....	.....	1	.....	123
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	124

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 177. WASHINGTON, D. C. June 2, 1902.

AGRICULTURE.

COLORADO.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture in the state of Colorado, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

> The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Colorado, June 1, 1900, numbered 24,700, and were valued at $106,344,035. Of this amount $16,002,512, or 15.0 per cent, represents the value of buildings, and $90,341,523, or 85.0 per cent, the value of land and improvements other than buildings. On the same date the value of farm implements and machinery was $4,746,765, and of live stock, $49,954,311. These values, added to that of farms, give $161,045,111, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold or slaughtered on farms, are referred to in this bulletin as "animal products." The total value of all such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $33,048,576, of which amount $16,077,988, or 48.6 per cent, represents the value of animal products, and $16,970,588, or 51.4 per cent, the value of crops, including forest products, cut or produced on farms and ranges. The "total value of farm products" for 1899 exceeds that for 1889 by $19,011,766, or 151.6 per cent.

The value of "net farm products," or the "gross farm income," is obtained by deducting from the "total value of farm products" the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $6,182,830, leaving $26,865,746 as the gross farm income for that year. The percentage which this amount is of the "total value of farm property" is referred to as the "percentage of income upon investment." For Colorado in 1899 it was 16.7 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

Special reports as to the dimensions and cost of the leading irrigation ditches and canals, the area of land under them, methods for the artificial application of water to the growing crops, and other facts relating to irrigation, were obtained by correspondence with farmers, engineers, and others. This correspondence was under the joint direction of Mr. F. H. Newell, chief hydrographer of the Geological Survey, acting as expert special agent for the division of agriculture, and Mr. Clarence J. Blanchard. The office is indebted to the State Engineer of Colorado and his able force of water superintendents and commissioners for important data concerning canals, ditches, etc.

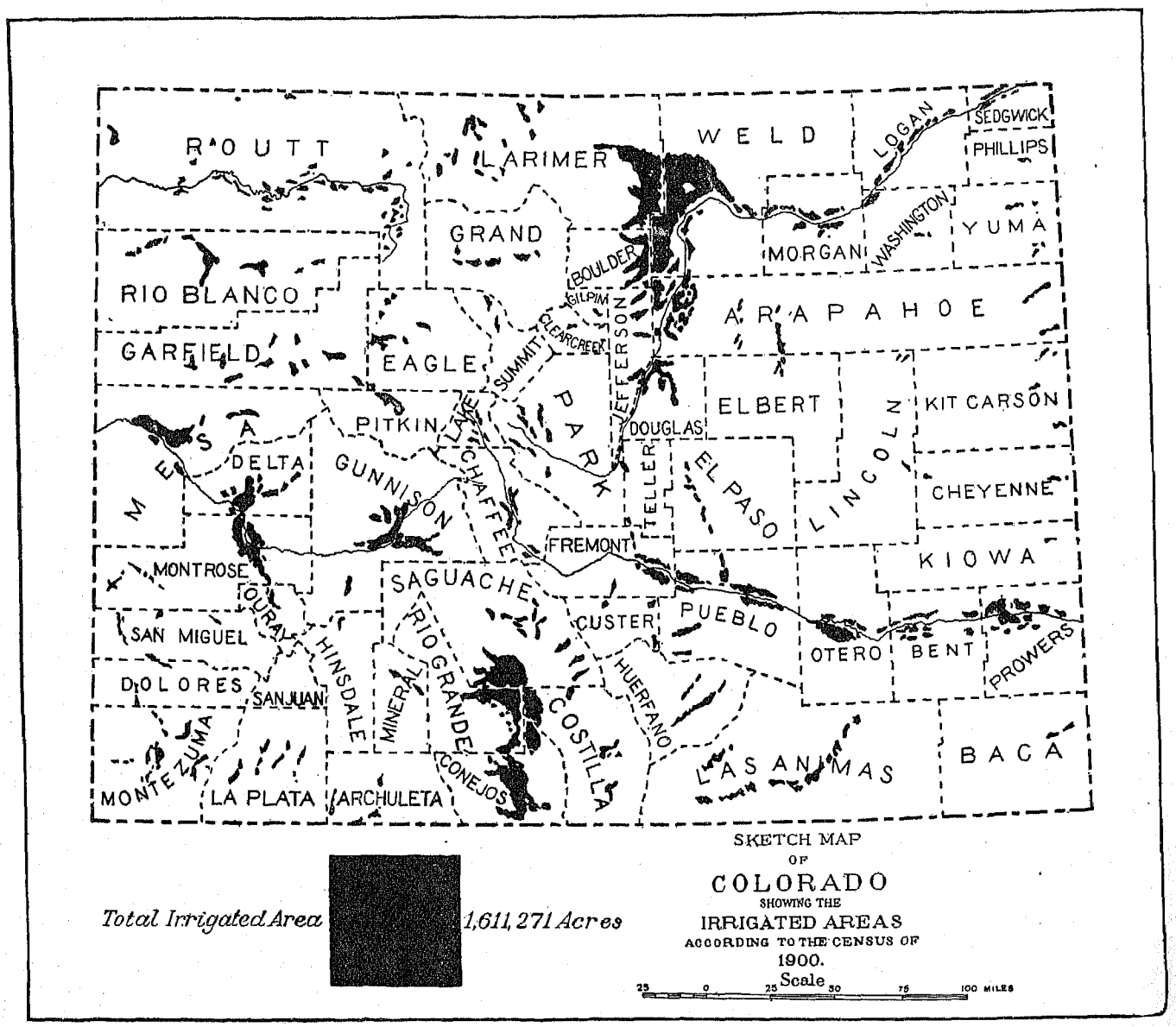
The statistics presented in this bulletin will be treated in greater detail in the final report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Colorado.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

OP 15M



Total Irrigated Area 1,611,271 *Acres*

SKETCH MAP
OF
COLORADO
SHOWING THE
IRRIGATED AREAS
ACCORDING TO THE CENSUS OF
1900.

Scale 25 0 25 50 75 100 MILES

AGRICULTURE IN COLORADO.

GENERAL STATISTICS.

Colorado has a total land area of 103,645 square miles, or 66,332,800 acres, of which 9,474,588 acres, or 14.3 per cent, are included in farms.

The central and western divisions of the state, comprising about two-thirds of its area, are traversed by the principal ranges of the Rocky Mountains. The eastern third is occupied by the great plains, which are not continuous levels, but a series of valleys separated by ridges and watered by numerous rivers. About one-third of the state is well adapted to agriculture, the remainder being better suited for grazing purposes. The soil of the foothills is fertile and among the mountains are rich valleys and fine grazing lands. The arid sands of the plains are generally surface deposits, covering a soil which can be rendered productive by irrigation.

NUMBER AND SIZE OF FARMS.

Table 1 gives, by decades since 1870, the number of farms, the total and average acreage, and the per cent of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1870 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	24,700	9,474,588	2,273,968	7,200,620	383.6	24.0
1890	16,389	4,598,941	1,823,520	2,775,421	280.6	39.6
1880	4,506	1,165,373	616,169	549,204	258.6	52.9
1870	1,738	320,346	95,594	224,752	184.3	29.8

The development of the agricultural resources of the state dates from the early part of the decade 1860 to 1870, at about the time when the territory was organized. Previous to this time the inhabitants consisted, for the most part, of miners, who had settled in the region in 1859, and who had devoted little attention to farming. Since the first agricultural census in 1870, the number of farms has increased rapidly, the greatest gains taking place between 1880 and 1890. In the last decade there was an increase of 50.7 per cent. The total area in farms, also, has increased at a rapid rate, principally through entry of the public domain and purchase of railroad grant lands.

The percentage of farm land improved has decreased since 1880. This is due largely to a more strict construction of the term "improved," by the present census. The increased acreage and production of nearly all crops indicate that there has been little, if any, abandonment of improved land.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1870.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1870 TO 1900.

Year.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$161,045,101	$106,344,035	$4,746,755	$49,954,311	$33,048,576
1890	110,358,040	85,035,180	2,728,850	[2]22,594,010	13,136,810
1880	34,722,650	25,109,223	910,085	[2]8,703,342	5,035,228
1870[3]	6,529,454	3,385,748	272,604	2,871,102	[4]2,335,106

[1] For year preceding that designated.
[2] Exclusive of the value of animals on ranges.
[3] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[4] Includes betterments and additions to live stock.

The value of all classes of farm property has advanced rapidly in the last twenty years, the total value in 1900 being nearly five times as great as in 1880, and 45.9 per cent greater than in 1890. During the last decade there has been an increase of 25.1 per cent in the reported value of land, improvements, and buildings; of 73.9 per cent in that of implements and machinery; and of 121.1 per cent in that of live stock. Of the increase of $50,687,071 in the total value of farm property, $21,308,855, or 42.0 per cent, represents the gain in the value of land, improvements, and buildings; $27,360,301, or 54.0 per cent, in that of live stock; and $2,017,915, or 4.0 per cent, in that of implements and machinery. The value of farm products as returned in 1899 was 151.6 per cent greater than in 1889. But a portion of this increase, and of that noted in the case of implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than in previous census years. The large increase in the reported value of live stock is also due in part to a more complete enumeration.

In 1880 and in 1890 domestic animals on ranges were not enumerated, and the values of live stock shown in the above table are therefore deficient for both these years. The value of domestic animals on ranges in 1890 is estimated to have been $6,659,016, which would make the total value of live stock in that year $29,253,026. Computed on this basis the increase in the value of live stock between 1890 and 1900 was approximately 41.4 per cent.

COUNTY STATISTICS.

In Table 3 general agricultural statistics are given by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH GROSS INCOME OF 1899, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Gross income (products of 1899 not fed to live stock).	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	24,700	23,532	9,474,588	2,273,968	$90,841,528	$16,002,512	$4,746,755	$49,954,311	$26,865,746	$4,100,905	$23,225
Arapahoe	2,105	2,029	604,708	202,047	11,904,190	1,858,050	408,490	3,126,165	2,677,537	444,460	9,970
Archuleta	215	190	41,298	10,372	277,460	71,930	23,210	913,011	319,380	32,370	----
Baca	137	135	77,751	7,832	127,050	40,860	20,860	549,992	80,807	13,100	----
Bent	274	256	118,485	38,858	1,137,100	131,920	61,160	1,295,766	670,541	94,500	----
Boulder	937	953	191,373	91,708	4,338,615	892,875	216,340	789,626	920,886	126,710	1,470
Chaffee	242	236	47,065	14,726	458,300	151,790	42,480	256,018	217,098	30,430	----
Cheyenne	57	49	116,191	2,740	141,630	30,370	7,520	461,403	141,717	14,040	----
Clear Creek	31	29	10,838	1,196	73,500	15,780	3,350	18,714	11,487	2,470	----
Conejos	617	529	208,245	98,960	1,804,710	284,870	94,510	1,164,600	588,772	85,390	----
Costilla	331	311	634,205	79,678	1,673,870	137,810	54,970	586,969	311,669	30,890	----
Custer	351	327	98,607	23,111	837,490	172,390	53,210	500,386	180,971	31,670	----
Delta	874	832	93,689	38,016	2,607,550	392,480	151,980	1,068,780	788,219	99,500	----
Dolores	36	22	3,382	942	22,110	5,320	3,410	114,759	19,577	2,800	----
Douglas	457	448	296,302	39,165	1,946,390	366,150	77,230	558,953	359,661	42,390	80
Eagle	208	199	52,352	19,709	811,775	146,700	52,400	625,196	325,574	72,810	----
Elbert	579	574	502,365	40,460	1,678,010	366,500	107,450	1,144,875	432,945	58,160	----
El Paso	729	720	566,790	62,408	2,361,554	675,945	118,250	1,297,117	651,624	106,570	----
Fremont	606	590	109,488	20,512	3,089,270	520,900	97,420	673,519	472,293	92,000	600
Garfield	507	482	81,357	29,002	1,503,770	270,810	120,080	1,086,965	557,979	92,400	----
Gilpin	49	49	12,035	2,110	50,770	30,680	5,510	22,999	26,129	3,930	----
Grand	179	168	66,538	18,504	502,100	63,930	33,940	330,615	138,812	31,970	----
Gunnison	289	284	52,795	28,163	577,000	154,475	61,340	686,472	280,738	71,120	200
Hinsdale	35	32	5,238	1,707	41,580	11,490	3,570	96,320	36,893	2,700	----
Huerfano	486	457	138,421	25,468	695,470	132,150	45,300	657,029	257,067	53,710	----
Jefferson	1,050	1,028	225,230	61,224	6,003,617	1,045,643	194,110	769,728	1,013,097	198,510	2,880
Kiowa	138	116	71,957	4,138	114,070	62,810	14,080	758,815	353,417	17,860	----
Kit Carson	305	289	38,844	19,581	154,860	97,715	37,760	676,581	115,352	18,290	----
Lake	71	68	19,724	7,636	420,320	76,670	19,950	186,696	152,902	25,510	200
La Plata	297	257	60,089	14,491	628,020	211,695	81,405	452,267	225,418	43,130	300
Larimer	1,412	1,382	543,468	180,358	5,837,718	1,189,015	323,720	2,569,700	1,970,665	280,630	200
Las Animas	1,037	991	419,503	38,441	1,565,820	302,200	115,490	1,850,724	648,944	118,450	100
Lincoln	188	124	163,144	8,195	269,885	83,025	17,860	819,783	202,134	47,510	----
Logan	413	386	182,513	57,639	1,421,440	218,820	66,820	1,737,762	293,356	66,670	----
Mesa	747	713	68,018	34,205	2,143,985	408,360	120,960	1,320,817	556,501	96,190	----
Mineral	48	42	11,784	2,929	49,524	19,575	5,880	49,429	23,176	7,400	----
Montezuma	261	240	46,072	15,201	435,640	135,340	38,390	353,917	201,454	21,520	125
Montrose	524	457	88,349	36,884	1,585,330	253,850	96,220	1,012,104	552,277	100,050	----
Morgan	376	361	125,074	43,282	1,376,000	232,140	68,740	1,156,362	601,010	93,290	----
Otero	814	780	244,594	68,036	3,562,360	433,270	157,450	2,335,018	1,089,341	166,920	600
Ouray	128	128	25,673	11,184	879,445	86,270	32,200	256,801	169,278	30,660	----
Park	220	218	212,801	40,258	1,269,203	265,030	66,670	661,653	368,615	88,420	80
Phillips	244	239	69,626	20,028	218,490	110,100	39,840	504,057	142,337	6,780	----
Pitkin	170	167	35,363	12,583	586,000	93,250	45,420	242,291	262,378	44,010	100
Prowers	478	445	217,332	58,172	2,569,998	349,260	106,974	1,780,010	465,688	65,750	600
Pueblo	668	634	478,821	40,821	3,511,040	408,680	115,480	1,321,522	691,693	90,070	1,850
Rio Blanco	264	255	68,124	21,846	883,980	148,250	59,150	1,336,979	207,296	68,260	----
Rio Grande	361	347	173,448	78,141	1,786,790	212,165	89,480	442,625	404,683	48,930	120
Routt	703	662	190,503	58,977	1,676,530	292,340	118,600	2,547,286	716,952	121,360	----
Saguache	406	385	329,337	119,587	2,139,023	238,610	98,590	1,102,353	606,803	78,480	----
San Juan	6	4	55	18	1,025	1,500	155	16,049	2,904	750	----
San Miguel	229	218	45,566	10,088	442,360	106,715	53,660	512,581	248,659	28,730	70
Sedgwick	156	140	51,014	9,209	302,640	56,835	12,340	355,560	81,668	4,630	----
Summit	77	73	13,676	4,031	153,750	31,410	6,730	108,138	37,054	5,480	70
Teller	148	141	31,588	4,685	218,250	79,735	15,433	168,010	167,229	13,135	----
Washington	201	197	107,440	17,961	272,540	82,090	27,950	768,425	147,600	24,420	----
Weld	2,002	1,959	556,044	251,307	9,484,426	1,610,214	601,920	2,949,360	3,528,928	505,260	8,550
Yuma	291	281	93,581	30,145	327,050	182,650	32,388	838,045	194,042	28,360	----
Southern Ute[1]	14	14	2,240	237	4,000	1,110	1,480	1,169	4,476	----	----

[1] Indian reservation.

During the last decade the number of farms increased in most of the counties. In each of twelve counties, the number of farms reported in 1900 is more than double that of ten years before, the largest gain being in Montezuma county, where there were more than seven times as many farms in 1900 as there were in 1890. Eight counties show decreases, the largest of which is 55.8 per cent in Baca county.

The portion of the total land surface included in farms in 1900 varied from 0.02 per cent in San Juan county to 52.1 per cent in Douglas county, and the average size of farms, from 9 acres in San Juan county to 1,916 in Costilla county.

The total acreage in farms increased during the last decade in all counties, except Phillips, Montrose, Yuma, and Sedgwick, which reported decreases of 26.2 per cent, 19.3 per cent, 14.9 per cent, and 3.2 per cent, respectively. The greatest relative increase was in Cheyenne county, where the acreage in 1900 was thirteen times that reported in 1890; in Costilla the increase was nearly tenfold. In 19 counties the area of improved farm land has decreased in the last decade, but in 12 others it has nearly doubled.

In the value of farms all counties, with the exception of 13, show increases since 1890. The counties showing the greatest losses are Gilpin, with a decrease of 68.4 per cent; Phillips, 46.2 per cent; Washington, 33.0 per cent; and Sedgwick, 22.6 per cent. Arapahoe and Douglas also show decreases, but as the value of the farm products of these counties in 1899 exceeds that reported for 1889, it is probable that the valuation of farm land reported to the Eleventh Census was, to some extent, speculative, and that there has been little, if any, actual loss. The average values per farm in 1900 vary from $421 in San Juan county to $6,999 in Lake county.

In all but 9 counties, the value of implements and machinery has increased greatly during the last decade, 21 counties showing a value more than twice as great, and one, Prowers, a sixteenfold increase. Sedgwick, Phillips, Washington, Custer, and Montrose counties are among those showing losses.

Since 1890 there has been a large increase throughout the state in the value of live stock, decreases appearing in 4 counties only. In Prowers county the value in 1900 was eighteen times as great as in 1890, in Otero county, eight times, and in Morgan and Delta counties, four times as great.

The average value per farm of the products of 1899 not fed to live stock varies from $371 in Clear Creek county to $2,561 in Kiowa county.

The average expenditure per farm for labor, including the value of board furnished, varies from $28 in Phillips county to $402 in Park county. The average expenditure for fertilizers is less than $1 per farm, and the total expenditure for the state is 7.4 per cent less than it was in 1890. Three-fourths of the total amount was expended in Arapahoe, Jefferson, and Weld counties.

CHANGES IN FARMING POPULATION.

The first agricultural census of Colorado, taken in 1870, showed 1,738 farms, and 6,462 males engaged in agriculture, 2,659 of whom were classed as farm laborers. The census of 1880 reported 4,506 farms, and 13,462 males engaged thereon, 2,525 of whom were reported as farm laborers.

The fact that in both years the number of males reported as engaged in agriculture, other than farm laborers, largely exceeded the number of farms, indicates either that many persons who were thus reported were really engaged in other occupations, or that many farms were omitted from the enumeration in both years.

In 1890 there were reported in Colorado 16,389 farms, 36,134 males engaged in agriculture, and 9,926 farm laborers, showing increases for the decade of 263.7 per cent in the number of farms, of 168.4 per cent in the number of males engaged in agriculture, and of 293.1 per cent in the number of farm laborers. The fact that there was a greater relative increase during this decade in the number of farms than in the number of persons engaged in agriculture, when considered in connection with the changes shown in the reports for 1870 and 1880, makes it appear very probable that a large number of farms were omitted from the enumeration, both in 1870 and in 1880, and that a considerable part of the increase shown for the decade from 1880 to 1890 was due to a more perfect census of agriculture in the latter year.

The occupation tables for 1900 are not yet available, but in the decade from 1890 to 1900, the number of farms increased 50.7 per cent, while the rural population, which includes not only those engaged in agriculture but also those employed in small mining centers throughout the state, increased only 14.2 per cent. Without the occupation tables, it is impossible to draw any definite conclusions, but the flourishing condition of agricultural and mining interests in Colorado in recent years makes it probable, after allowing for a more perfect census in 1900 than ever before, that there has been a greater relative increase in the last decade in the number of persons operating farms as owners and tenants than in the number of persons working on farms for wages, and consequently, that the average status of those employed on farms has been steadily improving.

FARM TENURE.

Table 4 gives a comparative exhibit of the number of farms operated by owners and tenants in 1880, 1890, and 1900. Tenants are subdivided into two groups: (1) "Cash tenants" who pay a cash rental or a stated amount of labor or farm produce, and (2) "share tenants" who pay as rental a share of the products. In Table 5 the tenure of farms for 1900 is given by race of farmer, and the farms operated by owners are subdivided into groups, designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other, or others, owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	24,700	19,119	2,230	3,351	77.4	9.0	13.6
1890	16,389	14,546	585	1,258	88.7	3.6	7.7
1880	4,506	3,922	165	419	87.0	3.7	9.3

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	24,700	15,785	2,368	136	880	2,230	3,351
White	24,627	15,662	2,363	136	880	2,227	3,339
Colored[1]	73	53	5			3	12

[1] Comprising 58 negroes and 15 Indians.

The number of farms operated by owners is nearly five times as great in 1900 as in 1880; the number operated by cash tenants, over thirteen times; and the number operated by share tenants, nearly eight times as great. Between 1890 and 1900, the number operated by owners increased 31.4 per cent; by cash tenants, 281.2 per cent; and by share tenants, 166.4 per cent. In 1880, 71.7 per cent of all tenants were share tenants; in 1890, 68.3 per cent; and in 1900, 60.0 per cent. This change indicates a growing sentiment on the part of both landlord and tenant in favor of the cash payment system, as well as greater independence and financial responsibility on the part of the tenant. The farms operated by share tenants are principally hay and grain farms, while those conducted by cash tenants, as a rule, are live-stock and dairy farms.

Of the farms of the state, 99.7 per cent are operated by white farmers, and 0.3 per cent, by colored farmers. Of the white farmers, 73.8 per cent own all or a part of the land they operate, and 26.2 per cent operate farms owned by others. Of the colored farmers, 58 are negroes and 15 are Indians, all of the Indians and nearly three-fourths of the negroes, being owners or part owners.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	24,700	383.6	9,474,588	100.0	$161,045,111	100.0
White farmers	24,627	384.2	9,461,241	99.7	160,887,318	99.9
Colored farmers[1]	73	182.8	13,347	0.3	157,793	0.1
Owners	15,785	206.9	3,265,081	34.4	75,334,633	46.8
Part owners	2,368	1,204.2	2,851,462	30.1	27,985,385	17.4
Owners and tenants	136	369.8	50,298	0.5	1,090,788	0.7
Managers	880	2,031.3	1,787,515	18.9	25,296,587	15.7
Cash tenants	2,230	361.0	804,968	8.5	13,155,121	8.1
Share tenants	3,351	216.4	725,264	7.6	18,182,597	11.3

[1] Comprising 58 negroes and 15 Indians.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$3,658	$648	$192	$2,022	$1,088	16.7
White farmers	3,664	649	193	2,027	1,090	16.7
Colored farmers[1]	1,463	280	90	329	395	18.3
Owners	2,588	603	169	1,478	778	16.3
Part owners	6,667	913	276	3,962	1,852	15.7
Owners and tenants	4,395	1,061	219	2,345	1,107	13.8
Managers	18,955	1,003	428	13,351	5,289	18.4
Cash tenants	3,917	672	162	1,148	872	14.8
Share tenants	3,881	544	199	802	1,040	19.2

[1] Comprising 58 negroes and 15 Indians.

The average values of farm property and products per farm are much lower for the farms of colored farmers than for those of white farmers. The higher percentage of gross income for farms of colored farmers is not due to superior farm management, but to the fact that the labor of the negro, whose farm and investment of capital are generally small, counts for more relatively than the labor of a white farmer with a larger and more valuable farm.

Except in the item of buildings, the highest average values are reported by managers. The high average value of live stock on farms operated by managers indicates that most of them are stock ranches, and their large average acreage sustains this view.

The total value of the farm property of the 15 Indian farmers was $7,634, and that of their products, $2,097. They operated an area of 2,190 acres.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	24,700	383.6	9,474,588	100.0	$161,045,111	100.0
Under 3 acres	794	1.8	1,432	(1)	3,716,924	2.3
3 to 9 acres	1,047	7.0	7,347	0.1	2,778,023	1.7
10 to 19 acres	1,332	13.3	13,744	0.1	3,588,979	2.2
20 to 49 acres	2,122	34.1	72,403	0.8	6,073,085	3.8
50 to 99 acres	2,526	78.8	199,057	2.1	9,582,952	5.9
100 to 174 acres	9,104	154.8	1,409,466	14.9	35,839,978	22.3
175 to 259 acres	1,578	216.7	341,241	3.6	10,224,236	6.3
260 to 499 acres	3,799	358.1	1,360,382	14.4	27,346,497	17.0
500 to 999 acres	1,466	712.0	1,043,856	11.0	18,847,930	11.7
1,000 acres and over	1,237	4,062.8	5,025,660	53.0	42,096,507	26.8

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$3,658	$648	$192	$2,022	$1,088	16.7
Under 3 acres	400	422	64	3,795	1,406	30.0
3 to 9 acres	1,605	702	83	263	547	20.6
10 to 19 acres	2,357	704	129	288	615	17.7
20 to 49 acres	1,848	476	112	431	491	17.2
50 to 99 acres	2,514	392	162	706	697	18.5
100 to 174 acres	2,203	458	154	1,122	689	17.5
175 to 259 acres	4,138	721	244	1,402	1,170	18.0
260 to 499 acres	4,179	715	246	2,058	1,196	16.6
500 to 999 acres	6,960	1,046	323	4,528	2,022	15.7
1,000 acres and over	18,608	2,143	516	13,573	4,946	14.2

The group of farms of 1,000 acres, or over, comprises more than one-half of the total farm acreage, but only a little more than one-fourth of the value of farm property. The percentage of gross income on total investment in farm property is smaller for this group than for any other, while that for farms of less than 3 acres each is higher. The high average value of live stock for farms of this latter group is due to the fact that many of them are operated by stock raisers who pasture their cattle on ranges or the public domain. The high average and percentage of gross income for this group are doubtless due to the fact that it includes, besides the ranges just mentioned, 33 florists' establishments, and a number of city dairies. It should be borne in mind that the income from these industries is determined, not so much by the acreage of land used, as by the capital invested in buildings, implements, and live stock, and by the amounts expended for labor and fertilizers.

The group of farms between 100 and 174 acres comprises by far the largest number of farms of any single group and the largest aggregate acreage of any except the one comprising farms of 1,000 acres and over. The predominance of this group is due to the practice of taking up land in 160 acre, or quarter-section tracts. The next largest group is that of farms having 260 to 499 acres, which includes the 320 acre, or half-section holdings.

The average gross incomes per acre for the various groups classified by area are as follows: Farms under 3 acres, $779.81; 3 to 9 acres, $78.00; 10 to 19 acres, $46.18; 20 to 49 acres, $14.39; 50 to 99 acres, $8.85; 100 to 174 acres, $4.45; 175 to 259 acres, $5.39; 260 to 499 acres, $3.34; 500 to 999 acres, $2.84; 1,000 acres and over, $1.22.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading statistics for farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop and constitutes 40 per cent of the products not fed to live stock, the farm is classified as a hay and grain farm. If vegetables are the leading crop, constituting 40 per cent of the value of products, it is a vegetable farm. The farms of the other groups are classified according to the same general principle. "Miscellaneous" farms are those whose operators do not derive their principal income from any one class of products. Farms for which no income was reported are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	24,700	383.6	9,474,588	100.0	$161,045,111	100.0
Hay and grain	7,070	265.9	1,880,052	19.8	44,523,564	27.6
Vegetables	2,363	114.9	271,409	2.9	9,943,867	6.2
Fruit	651	57.1	37,195	0.4	3,408,191	2.1
Live stock	8,761	696.5	6,102,102	64.4	79,385,132	49.3
Dairy produce	3,867	223.8	865,351	9.1	16,518,947	10.3
Sugar	50	96.4	4,821	0.1	166,079	0.1
Flowers and plants	53	2.9	153	(1)	686,270	0.4
Nursery products	21	36.4	765	(1)	127,673	0.1
Miscellaneous	1,864	167.8	312,740	3.3	6,285,388	3.9

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$3,658	$648	$192	$2,022	$1,088	16.7
Hay and grain	4,564	652	223	859	897	14.2
Vegetables	2,957	606	187	458	972	23.1
Fruit	3,954	757	162	362	978	18.7
Live stock	3,953	673	202	4,283	1,583	17.5
Dairy produce	2,375	648	145	1,109	604	14.1
Sugar	2,613	382	116	211	410	12.4
Flowers and plants	8,705	3,933	278	32	3,744	28.9
Nursery products	4,851	955	169	105	2,442	40.2
Miscellaneous	2,147	448	143	634	598	17.7

It is seen by Table 10 that live-stock, hay and grain, and dairy farms are the leading classes of farms in the state, the three together making up 93.3 per cent of the acreage, and 87.2 per cent of the value of farm property for all farms. Of the three classes, live-stock farms are the most important, with 64.4 per cent of the total acreage and 49.3 per cent of the value of farm property.

The average values per acre of products not fed to live stock are as follows: For farms deriving their principal in-

come from flowers and plants, $1,296.75; nursery products, $67.02; fruits, $17.12; vegetables, $8.47; sugar, $4.26; miscellaneous, $3.56; hay and grain, $3.37; dairy produce, $2.70; and live stock, $2.27. In computing these averages the total area of the farms is used and not the acreage devoted to the crop from which the principal income is derived.

The wide variations shown in the averages and percentages of gross income are largely due to the fact that in computing gross income, no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than in the case of "hay and grain," "live stock," or "miscellaneous" farms. Were it possible to present the average net income, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	24,700	383.6	9,474,588	100.0	$161,045,111	100.0
$0	1,020	331.3	337,889	3.6	4,209,560	2.6
$1 to $49	979	156.5	153,212	1.6	1,848,340	1.1
$50 to $99	1,181	157.2	185,678	1.9	2,423,450	1.5
$100 to $249	3,691	169.3	624,721	6.6	9,187,382	5.7
$250 to $499	4,581	191.8	878,779	9.3	14,919,688	9.3
$500 to $999	5,579	249.5	1,391,955	14.7	27,367,420	17.0
$1,000 to $2,499	5,270	391.9	2,065,401	21.8	43,345,320	26.9
$2,500 and over	2,399	1,599.4	3,836,953	40.5	57,743,951	35.9

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$3,658	$648	$192	$2,022	$1,088	16.7
$0	1,361	281	68	2,467		
$1 to $49	1,045	222	65	556	34	1.8
$50 to $99	1,134	264	75	559	66	3.2
$100 to $249	1,399	351	100	629	161	6.5
$250 to $499	1,806	467	126	858	356	10.9
$500 to $999	2,955	550	177	1,193	696	14.2
$1,000 to $2,499	5,100	907	263	1,956	1,502	18.8
$2,500 and over	12,418	1,554	501	9,597	5,807	22.0

The absence of reported income for farms of the first group is due in part to the inability of the enumerators to secure complete reports for farms which had changed hands shortly prior to the date of enumeration. Frequently the person in charge June 1, 1900, could not give definite information concerning the products of the preceding year. This is also true of some of the farms with reported incomes of less than $100. To this extent the reports fall short of giving a complete statement of farm income in 1899.

Some of the farms reporting no income were doubtless country places held for pleasure and not profit, and others were homesteads taken up in the spring of 1900. The high average value of live stock indicates that some were cattle ranches which reported no sales in 1899. Many of the farms of this group report products fed to live stock.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the census of 1900. The age grouping for neat cattle was determined by their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle by age and sex. The new classification permits a very close comparison with previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES, ON FARMS AND RANGES, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS AND RANGES.			NOT ON FARMS OR RANGES.
		Number.	Value.	Average value.	Number.
Calves	Under 1	269,154	$3,130,465	$11.63	2,625
Steers	1 and under 2	204,101	4,130,902	20.24	849
Steers	2 and under 3	138,775	3,927,154	28.71	1,229
Steers	3 and over	62,069	2,120,710	34.17	2,587
Bulls	1 and over	26,487	1,460,909	55.26	172
Heifers	1 and under 2	151,627	3,156,858	20.82	1,503
Cows kept for milk	2 and over	100,116	3,797,997	37.94	3,581
Cows and heifers not kept for milk.	2 and over	483,039	13,807,743	28.59	3,047
Colts	Under 1	23,645	291,280	12.32	503
Horses	1 and under 2	27,360	530,164	19.38	503
Horses	2 and over	185,541	6,487,282	34.96	35,757
Mule colts	Under 1	898	22,803	24.58	19
Mules	1 and under 2	874	33,800	38.10	22
Mules	2 and over	5,017	269,944	53.81	2,371
Asses and burros	All ages	5,513	52,010	9.43	2,029
Lambs	Under 1	691,991	1,144,294	1.65	281
Sheep (ewes)	1 and over	1,089,680	3,417,781	3.14	921
Sheep (rams and wethers).	1 and over	263,148	1,022,872	3.89	161
Swine	All ages	101,198	482,722	4.77	3,047
Goats	All ages	37,433	73,141	1.95	3,946
Fowls:[1]					
Chickens[2]		968,761	393,219		
Turkeys		30,781			
Geese		2,576			
Ducks		15,002			
Bees (swarms of)		59,756	195,096	3.26	
Unclassified			6,215		
Value of all livestock			49,954,311		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The total value of all live stock on farms and ranges, June 1, 1900, was $49,954,311. Of this amount, 14.6 per cent represents the value of horses; 7.6 per cent, that of dairy cows; 63.5 per cent, that of other neat cattle; 11.2

per cent, that of sheep; and 3.1 per cent, that of all other live stock.

The low average value of asses and burros is due to the fact that the majority of these animals are the small burros of the mountainous districts. No reports were secured of the value of live stock not on farms and ranges, but it is probable that such animals have higher average values than farm or range animals. Allowing the same averages, however, the total value of all live stock in the state, exclusive of poultry and bees not on farms, would be approximately $52,018,800.

CHANGES IN LIVE STOCK ON FARMS AND RANGES.

The following table shows the changes since 1870 in the numbers of the most important domestic animals.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS AND RANGES: 1870 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	100,116	1,333,202	236,546	12,297	1,352,823	101,198
1890[2]	76,948	640,913	155,170	7,139	717,990	64,358
1880[2]	28,770	318,069	42,257	2,581	746,448	7,656
1870	25,017	45,719	6,446	1,173	120,928	5,509

[1] Lambs not included.
[2] Exclusive of animals on ranges.

Since the live-stock enumeration in 1880 and in 1890 did not include domestic animals on ranges, the figures presented in the table for these years are not comparable with the figures of 1900. The number of animals on ranges in 1890 was estimated by special agents to be as follows: All neat cattle, 448,681; horses, 31,209; mules and asses, 65; sheep, 178,820; swine, 33. The census shows a marked increase in dairy cows, the number reported in 1900 being four times as great as the number reported thirty years before, and 23,168, or 30.1 per cent greater than in 1890. The number of "other neat cattle" given for 1900 includes 269,154 calves. Whether any calves were reported in 1890 under this designation is uncertain. If not, the number of calves in 1900 should be deducted when making comparisons with reports for previous years, in which case the increase during the last decade in the number of "other neat cattle" over 1 year of age would be only 66.0 per cent, instead of 108.0 per cent, as indicated by the above table.

The number of horses has increased rapidly since 1870; taking into account the estimated number on ranges in 1890, the per cent of increase in the last decade was 26.9. Since 1890, mules and asses have increased in number 72.3 per cent, and swine, 57.2 per cent. Nearly one-third of the swine in the state are reported in Weld, Arapahoe, and Morgan counties.

In the number of sheep there was a slight decrease from 1880 to 1890, but since 1890 there has been a gain of 634,833, or 88.4 per cent. Sheep raising is confined in general to the southern counties, although Weld and Morgan counties report comparatively large numbers.

In comparing the poultry report for 1900 (see Table 14) with that of 1890, it should be borne in mind that in 1900 the enumerators were instructed not to report fowls less than 3 months old, while in 1890 there was no such limitation. During the past decade geese have increased in number 135.0 per cent; turkeys, 47.5 per cent; chickens, 36.3 per cent; and ducks, 23.9 per cent.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the products of the animal industry.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED, ON FARMS, IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	8,543,937	$1,115,331
Mohair and goat hair	Pounds	1,843	550
Milk	Gallons	[1] 38,440,111	[2] 23,778,901
Butter	Pounds	4,932,482	
Cheese	Pounds	103,184	
Eggs	Dozens	5,704,290	852,978
Poultry			687,536
Honey	Pounds	1,732,630	171,740
Wax	Pounds	24,930	
Animals sold			8,477,587
Animals slaughtered			1,093,365
Total			16,077,988

[1] Comprises all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Comprises the value of milk sold and consumed, and of butter and cheese made.

The value of animal products in 1899 was $16,077,988, or 48.6 per cent of the total value of all farm products, and 59.8 per cent of the gross farm income. Of the above amount, 59.5 per cent represents the value of animals sold and animals slaughtered on farms; 23.5 per cent, that of dairy produce; 9.0 per cent, that of poultry and eggs; 6.9 per cent, that of wool and mohair; and 1.1 per cent, that of honey and wax.

ANIMALS SOLD AND SLAUGHTERED.

The aggregate value of animals sold and slaughtered on farms and ranges in 1899 was $9,570,952, or 35.6 per cent of the gross farm income. Of all farmers reporting live stock, 10,949, or 46.1 per cent, reported sales of live animals, and 10,529, or 44.3 per cent, reported animals slaughtered. The average receipts per farm from the sale of live animals in 1899 were $774.28, and the average value per farm of animals slaughtered was $103.84.

DAIRY PRODUCTS.

Dairying stands third in importance among the several branches of agriculture in Colorado. Of the 24,700 farmers in the state, 3,867, or 15.7 per cent, reported dairy products as their principal source of income. While the population has increased but 30.7 per cent since 1890, and the number of dairy cows but 30.1 per cent, the quantity of milk produced shows a gain of 18,759,320 gallons, or 95.3 per cent. The discrepancy between the increase of milk production and dairy cows, however, is probably apparent rather than real, since the definition of "dairy cows," adopted in the census of 1900, was more strict than in preceding censuses. As a result, many animals that would have been included in the class of "dairy cows," if the classification of 1890 had been followed,

were doubtless excluded, causing reduction in the percentage of increase for the decade.

Arapahoe county reported 6,435,955 gallons of milk, or more than twice the quantity produced in any other county. The average production per capita increased from 47.7 gallons in 1889, to 71.2 gallons in 1899. Since 1879 the quantity of milk sold has increased 12,665,104 gallons, or approximately 250 per cent.

Comparison with the figures for 1889 shows a gain of 1,650,396 pounds, or 50.3 per cent, in the amount of butter, and of 16,001 pounds, or 18.4 per cent, in the quantity of cheese made on farms.

Of the $8,778,901 given in Table 16 as the value of dairy produce in 1899, $1,355,858, or 35.9 per cent, represents the value of such produce consumed on farms, and $2,423,043, or 64.1 per cent, the amount realized from sales. Of the latter sum, $1,747,424 was derived from the sale of 18,170,810 gallons of milk; $589,394, from 2,756,798 pounds of butter; $76,531, from 132,297 gallons of cream; and $9,694, from 80,833 pounds of cheese.

POULTRY AND EGGS.

The total value of the products of the poultry industry in 1899 was $1,440,514, of which 59.2 per cent represents the value of eggs produced, and 40.8 per cent, that of fowls raised. Over three million dozens more eggs were produced in 1899 than in 1889, an increase of 112.4 per cent.

WOOL.

In the last decade the production of wool has increased 5,209,703 pounds, or 156.2 per cent. As the wool product given for 1890, however, did not include wool produced on ranges, the real increase was probably considerably less than that shown by simple comparison of the figures. The average weight of fleeces has remained practically the same, being 5.9 pounds in 1890 and 6.1 pounds in 1900. Las Animas county reported the largest quantity of wool, 820,644 pounds. Mohair and goat hair were reported by but few counties, Las Animas, Mesa, La Plata, and Saguache counties reporting over 80 per cent of the total clip.

HONEY AND WAX.

In 1900, 4,518 farmers reported, in the aggregate, 59,756 swarms of bees. They obtained, in 1899, 1,732,630 pounds of honey and 24,930 pounds of wax, the gains in the last decade being 87.4 per cent in the former item, and more than twofold in the latter. The leading counties in 1900, as in 1890, were Jefferson, Arapahoe, Montrose, Delta, Larimer, and Weld.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In the computation of these averages, only those farms are included which report the kind of stock under consideration.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	23,020	236,546	10.3	18,669	100,116	5.4
White farmers	22,954	236,283	10.3	18,637	99,924	5.4
Colored farmers	66	263	4.0	32	192	6.0
Owners[1]	17,166	166,087	9.7	13,942	74,826	5.4
Managers	763	32,548	42.7	564	3,876	6.9
Cash tenants	2,090	14,066	7.0	1,667	11,064	6.6
Share tenants	3,091	23,895	7.7	2,496	10,350	4.1
Under 20 acres	2,360	11,496	4.9	1,723	7,331	4.3
20 to 99 acres	4,243	20,188	4.8	3,331	13,068	3.9
100 to 174 acres	8,596	67,867	7.9	6,809	32,185	4.7
175 to 259 acres	1,502	14,194	9.5	1,326	7,238	5.5
260 acres and over	6,319	122,801	19.4	5,480	40,344	7.4
Hay and grain	6,482	54,650	8.4	5,121	20,597	4.0
Vegetable	2,156	10,407	4.8	1,528	4,205	2.8
Fruit	553	2,148	3.7	415	792	1.9
Live stock	8,455	136,132	16.1	6,489	34,632	5.3
Dairy	3,661	22,920	6.3	3,867	34,851	9.0
Miscellaneous[2]	1,683	10,289	6.1	1,249	5,039	4.0

[1] Including "part owners" and "owners and tenants."
[2] Including florists' establishments and nurseries.

CROPS.

The following table gives the statistics of the principal crops grown in 1899.

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	85,256	Bushels	1,275,680	$508,488
Wheat	294,949	Bushels	5,587,770	2,809,370
Oats	120,952	Bushels	3,080,180	1,121,745
Barley	21,949	Bushels	531,240	246,510
Rye	2,148	Bushels	26,180	13,576
Buckwheat	27	Bushels	226	151
Flaxseed	434	Bushels	1,820	1,551
Clover seed	----------	Bushels	12,623	52,520
Grass seed	----------	Bushels	1,012	775
Hay and forage	952,214	Tons	1,647,477	8,159,279
Kafir corn	18	Bushels	302	131
Peanuts	5	Bushels	188	173
Dry beans	2,634	Bushels	28,570	49,169
Dry peas	3,621	Bushels	47,461	29,906
Broom corn	1,241	Pounds	226,550	10,577
Potatoes	44,075	Bushels	4,465,748	1,717,111
Sweet potatoes	20	Bushels	2,291	2,064
Onions	754	Bushels	205,841	125,713
Sugar beets	1,094	Bushels	6,656	26,771
Miscellaneous vegetables	14,742	----------	----------	1,006,285
Sorghum cane	51	Tons	20	71
Sorghum sirup	----------	Gallons	2,661	1,036
Small fruits	2,347	----------	----------	294,365
Grapes	[1] 436	Centals	5,863	[2] 17,174
Orchard fruits	[1] 43,523	Bushels	354,049	[3] 378,119
Nuts	----------	----------	----------	433
Forest products	----------	----------	----------	113,055
Flowers and plants	137	----------	----------	198,479
Seeds	495	----------	----------	11,113
Nursery stock	497	----------	----------	65,936
Miscellaneous	338	----------	----------	8,450
Total	1,593,962	----------	----------	16,970,583

[1] Estimated from number of vines or trees.
[2] Including value of raisins, wine, etc.
[3] Including value of cider and vinegar.

Of the total value of crops, hay and forage contributed 48.1 per cent; cereals, 27.7 per cent; vegetables, including potatoes, sweet potatoes, and onions, 16.9 per cent; fruits, 4.1 per cent; and all other crops, 3.2 per cent. Of the total acreage devoted to crops, that of hay and forage constituted 59.7 per cent; cereals, 33.0 per cent; vegetables, 3.8 per cent; fruits, 2.9 per cent; and other crops, 0.6 per cent.

The average values per acre of the principal crops were as follows: Flowers and plants, $1,448.75; onions, $166.73; nursery stock, $132.67; small fruits, $125.43; miscellaneous vegetables, $68.26; grapes, $39.39; potatoes, including sweet potatoes, $38.96; cereals, $8.95; orchard fruits, $8.69; and hay and forage, $8.57.

The crops yielding the highest returns per acre were grown upon highly improved land. Their production required a relatively great amount of labor and large expenditures for fertilizers.

CEREALS.

Table 19 shows the changes in cereal production since 1869.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1869 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	21,949	27	85,256	120,952	2,148	294,949
1889	12,086	117	119,310	87,959	4,615	126,999
1879	4,112	8	22,991	28,023	1,294	64,698

[1] No statistics of acreage were secured prior to 1879.

PART 2.—BUSHELS PRODUCED.

1899	531,240	226	1,275,680	3,080,130	26,180	5,587,770
1889	331,556	2,081	1,511,907	2,514,480	54,153	2,845,439
1879	107,116	110	455,968	640,900	19,465	1,425,014
1869	35,141	178	231,903	332,940	5,235	258,474

The total area devoted to cereals in 1899 was 525,281 acres; in 1889, 351,086 acres; and in 1879, 116,121 acres. The acreage of each of the specified grains in 1899 shows a considerable increase over that reported twenty years before. In the last decade the total acreage in cereals has increased 49.6 per cent, the gains for wheat, barley, and oats being 132.2 per cent, 81.6 per cent, and 37.5 per cent, respectively, while the acreage devoted to corn shows a decrease of 28.5 per cent.

The acreages given in the above table are exclusive of 1,341 acres of corn, nonsaccharine sorghum, and similar crops grown for forage or ensilage, and of 46,530 acres of grain cut green for hay.

HAY AND FORAGE.

In 1900, 17,008 farmers, or 68.9 per cent of the total number, reported hay and forage crops. The average yield, exclusive of cornstalks, was 1.7 tons per acre. The total area in hay and forage in 1899 was 952,214 acres, an increase of 97.7 per cent over the acreage reported in 1889. In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 335,748 acres and 309,599 tons; millet and Hungarian grasses, 8,323 acres and 9,370 tons; alfalfa or lucern, 455,287 acres and 1,107,511 tons; clover, 2,582 acres and 5,410 tons; other tame and cultivated grasses, 80,566 acres and 113,392 tons; grains cut green for hay, 46,530 acres and 55,277 tons; crops grown for forage, 23,228 acres and 42,928 tons; and cornstalks, 5,741 acres and 3,990 tons.

In Table 18 the production of cornstalks is included, but not the acreage, as the forage secured was only an incidental product of the land on which it was raised.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 are shown in the following table.

TABLE 20.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900.	1890.	1899.	1889.
Apples	2,004,895	77,798	257,563	70,728
Apricots	14,854	1,512	2,363	284
Cherries	127,001	4,085	5,387	345
Peaches	319,998	8,204	47,381	3,135
Pears	168,837	3,752	19,272	2,441
Plums and prunes	259,332	10,645	15,224	1,675

Only 2,162, or 8.8 per cent, of the farmers in the state reported orchard fruits in 1899. In the census of 1890, the value of orchard products was not separately reported but in 1879 it was $3,246. For 1899 the value was $378,119, a hundredfold gain in twenty years. The three counties of Mesa, Fremont, and Delta produced over one-half the fruit crop of the state. The total number of trees shown in the above table is 2,894,917, of which 69.3 per cent are apple trees; 11.0 per cent, peach trees; 9.0 per cent, plum and prune trees; 5.8 per cent, pear trees; 4.4 per cent, cherry trees; and 0.5 per cent, apricot trees. Since 1890, there have been very marked gains in the number of all trees, the fruit-raising industry practically dating its origin from that year.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 was 2,347 acres, distributed among 1,778 farms. The value of the fruits grown was $294,385, an average of $125 per acre. Of the total area, 1,067 acres, or 45.5 per cent, were devoted to strawberries, the total production of which was 2,224,240 quarts. The acreage and production of other berries were as follows: Raspberries and Logan berries, 689 acres and 817,450 quarts; currants, 226 acres and 204,480 quarts; blackberries and dewberries, 195 acres and 216,020 quarts; gooseberries, 122 acres and 133,750 quarts; and other berries, 48 acres and 53,290 quarts.

VEGETABLES.

The value of all vegetables grown in the state in 1899, including potatoes, sweet potatoes, onions, and sugar beets, was $2,877,836. Of this amount, 59.7 per cent represents the value of potatoes, which were reported by more than one-fourth of the farmers of the state. Weld county led in the production of potatoes, reporting 2,821,285 bushels, valued at $1,013,325, or 59.0 per cent of the value of the entire crop.

In the growing of miscellaneous vegetables, 14,742 acres were used. The products of 4,957 acres were not reported in detail, but of the remaining 9,785 acres, 2,329 were devoted to muskmelons; 1,761, to cabbages; 1,316,

to green peas; 1,253, to tomatoes; 1,095, to sweet corn; 670, to watermelons; and 1,361, to other vegetables.

SUGAR BEETS.

The production of sugar beets bids fair to become an important branch of agriculture in this state. In 1899, 169 farmers devoted to this crop an area of 1,094 acres, or an average of 6.5 acres per farm, and obtained therefrom 6,656 tons of beets, an average of 6.1 tons per acre. The amount realized from the crop was $26,711, an average of $158 per farm, $24 per acre, and $4 per ton. Of the total acreage devoted to the crop, 85.3 per cent was reported by Mesa county.

FLORICULTURE.

The proprietors of 53 of the 72 establishments where flowers were grown for market in 1899 made commercial floriculture their principal business. They had a capital of $686,270, of which $461,375 represents the value of buildings; $208,475, that of land; $14,745, that of implements; and $1,675, that of live stock. In 1899 they raised flowers and plants valued at $183,303 and obtained other products valued at $15,100, making a total gross income of $198,403, or $1,296.75 for each of the 153 acres used. During the same year they expended $1,270 for fertilizers and $56,132 for labor. The 27 florists of Arapahoe county reported 71.5 per cent of the total product.

An aggregate of 859,700 square feet of land under glass was reported by the operators of 225 farms and florists' establishments. The greenhouses of the 53 florists had 698,682 square feet of glass surface, covering 524,012 square feet of land.

NURSERIES.

Nursery products were grown in 1899 by the operators of 41 farms, but of this number only 21 derived their principal income from this class of products. From 705 acres of land these 21 nurserymen secured products valued at $51,273, an average income per acre of $67.02. Of the total receipts, $45,288 was derived from the sale of trees, shrubs, and vines, and the balance from other farm products.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $4,100,905, an average of $166 per farm. The average was highest on the most intensively cultivated farms, being $1,059 for florists' establishments, $415 for nurseries, $227 for fruit farms, $226 for live-stock farms, $157 for vegetable farms, $153 for hay and grain farms, $87 for dairy farms, and $62 for sugar farms. "Managers" expended on an average, $939; "share tenants," $137; "cash tenants," $118; and "owners," $113. White farmers expended $166 per farm, and colored farmers, $22.

Fertilizers purchased in 1899 cost $23,225, an average of less than $1 per farm, and a decrease since 1890 of 7.4 per cent. For florists' establishments the average expenditure was $24; for vegetable and fruit farms, $3; and for hay and grain farms, dairy farms, and nurseries, $1.

SOUTHERN UTE INDIAN RESERVATION.

The Southern Ute reservation, containing 870 square miles, is situated in the southwestern corner of Colorado, a small portion extending into New Mexico. On this reservation are located the Moache, Capote, and Wiminuche Ute, of Shoshonean stock. These bands are commonly known as the Southern Ute Indians.

The arable land, constituting about one-fifth of the total area, is confined to the river valleys. No part of the reservation is cultivable without irrigation, but the soil is everywhere fertile, and wherever water can be supplied, cereals, grasses, fruits, and vegetables may be successfully grown.

The eastern part of the reservation, on which the Moache and Capote bands reside, is well supplied with irrigation facilities. There are now in operation 4 large canals, aggregating 24.8 miles in length, and also many smaller ditches. The work is gradually being extended and new land is constantly being reclaimed. The unallotted western portion is without irrigation, although the land is as fertile as any in the eastern section. Congress has appropriated $150,000 for an irrigation system in this part of the reservation, but as yet the work of construction has not been begun.

Naturally adverse to manual labor, the Colorado Indians have been slow to adopt agriculture as a means of subsistence. The allotted Ute (Moache and Capote) are making steady advancement, and when their irrigation systems are fully developed they will doubtless become self-supporting. They are rapidly improving their allotments, constructing new roads and irrigation ditches, in addition to building fences, barns, and log houses. In some instances these improvements have been accomplished without the assistance of white men. Although most of the Indian farmers have from ten to twenty acres under cultivation, government rations still constitute 25 per cent of their subsistence.

The principal crops of the Southern Ute are wheat and alfalfa. In 1899, 14 farmers sowed 120 acres to wheat, and obtained a yield of 2,400 bushels, valued at $1,440. Their alfalfa yields two and three cuttings each season. From 102 acres sown to alfalfa in the census year they cut 409 tons, valued at $1,227. They find a ready market at good prices for everything they raise.

Their live stock, June 1, 1900, consisted of 48 horses, 22 neat cattle, and 30 goats. Their horses and sheep range all winter without shelter and without being fed, and it is estimated that 400 sheep and 100 horses perished during the severe winter of 1898–1899. Their horses are mostly pony stock of little value. The small number of animals reported in 1900 is due to the fact that the Wiminuche, who own most of the live stock, had left the reservation with their flocks and herds and no report of their animals could be obtained.

IRRIGATION STATISTICS.

During the decade 1889 to 1899, Colorado advanced to the front rank of irrigated states, surpassing California in the extent of land under irrigation, but remaining second in the number of irrigators and in the value of irrigated crops. The colder climate and greater altitude of Colorado make it impossible to raise the high-priced citrus or semitropical fruits, or to practice the degree of intensive farming for which Arizona and California are noted.

The surface of the state is divided about equally into mountain area and plains, the latter lying to the east, and being a continuation of the Kansas uplands. Among the mountains of the western half of the state are open valleys, surrounded by lofty ranges. In the southwest, the mountains are particularly abrupt, presenting jagged and rocky peaks, Alpine in their characteristics. At an elevation of 7,000 or 8,000 feet, surrounded by mountains rising 8,000 feet higher, are found a number of green parks which are widely different in aspect from the lower plains of the east, or the vast plateaus or table-lands of the middle west. Most of these parks, once the basins of lakes, have floors which are apparently level but which have sufficient fall to be easily irrigable.

The plains, which comprise an area of 30,000 square miles, are barren of timber, and have a gradual slope toward the Mississippi Valley. About two-thirds of the people of Colorado live in this area. The soil is rich and the vegetation is particularly luxuriant along the water courses. The rainfall is insufficient, however, and crops can not be produced without irrigation.

The land surface of Colorado comprises 66,332,800 acres, of which only 9,474,588, or 14.3 per cent, were included in farms in 1900, and 2,273,968 acres, or 3.4 per cent were improved. Of this area, 2,240 acres are included in the Indian reservations. Of the total area in farms, 24.0 per cent is improved.

The importance of irrigation as a feature of the agricultural development of the state is shown by the fact that the irrigated land outside of the Indian reservations amounts to 1,611,271 acres, or 70.9 per cent of the improved farm land. In 1890 the acres irrigated outside of the Indian reservations numbered 890,735, or 48.8 per cent of the improved land. Since then, by the opening of new ditches and canals, by the enlargement of those previously constructed, and by the application of more intelligent methods of water distribution, 720,536 acres of land have been added to the irrigated area of the territory, an increase of 80.9 per cent. In 1890 most of this land was public domain and comparatively valueless. At the present time its value, at a low estimate, is $28,968,552, an average of $40.77 per acre. Irrigation has added this large amount to the farm wealth of the state. The relation of irrigation to the various agricultural operations is shown in the following table.

TABLE A.—ACREAGE AND PRODUCTION OF ALL CROPS, AND OF IRRIGATED CROPS IN 1899.

CROPS.	ACREAGE.			Unit of measure.	PRODUCTION.		
	Total.	Irrigated.	Per cent irrigated.		Total.	Irrigated.	Per cent irrigated.
Corn	85,256	40,905	48.0	Bushels	1,275,680	871,560	68.3
Wheat	294,949	247,644	84.0	Bushels	5,587,770	5,309,350	95.0
Oats	120,952	100,515	83.1	Bushels	3,080,180	2,763,340	89.7
Barley	21,949	20,304	92.5	Bushels	581,240	509,960	96.0
Rye	2,148	888	41.3	Bushels	26,180	15,060	57.5
Alfalfa	455,237	452,433	99.4	Tons	1,107,471	1,100,706	99.4
Grain cut green for hay	46,630	19,277	41.4	Tons	55,277	29,940	54.2
Other hay	460,447	320,509	71.1	Tons	485,119	370,361	76.4
Broom corn	1,241	45	3.6	Pounds	226,550	17,000	7.5
Dry beans	2,634	2,359	84.6	Bushels	28,570	26,747	93.6
Dry pease	3,621	3,523	97.3	Bushels	47,461	46,704	98.4
Potatoes	44,075	36,344	82.5	Bushels	4,465,748	4,118,737	92.2
Sweet potatoes	20	19	95.0	Bushels	2,291	2,258	98.6
Onions	754	677	89.8	Bushels	205,841	188,169	91.4
Miscellaneous vegetables	14,742	11,667	79.1				
Small fruits	2,347	1,749	74.5				
Grapes	436	408	93.6	Centals	5,713	4,921	86.1
Orchard fruits	43,528	38,957	89.4				
Other crops	3,096	2,617	84.5				
Total	1,593,962	1,300,840	81.6				

The total number of acres of irrigated crops, as given above, is 1,300,840, while the total number of acres of land irrigated is 1,611,271. The difference of 310,431 acres represents in part the area of pasture lands irrigated, but includes also a considerable acreage, which, by reason of shortage of water, was only partially irrigated and did not produce crops. On the other hand, it is probable that a portion of the area upon which crops were reported as grown without irrigation, was really irrigated at some time during the year.

Table B is a comparative exhibit, by counties, of the number of irrigators, and the acreage irrigated in 1889 and in 1899. Table C presents the corresponding figures for the six drainage divisions of the state.

TABLE B.—NUMBER OF IRRIGATORS, AND ACRES IRRIGATED, WITH PERCENTAGES OF INCREASE, BY COUNTIES: 1889 AND 1899.

COUNTIES.	NUMBER OF IRRIGATORS.			ACRES IRRIGATED.		
	1899.	1889.	Per cent of increase.	1899.	1889.	Per cent of increase.
The State	17,613	9,659	82.3	1,611,271	890,735	80.9
Arapahoe	1,153	520	121.7	81,807	35,619	129.7
Archuleta	151	45	235.6	6,529	3,084	111.7
Baca	10	2	400.0	156	60	160.0
Bent	223	83	168.7	33,039	4,221	682.7
Boulder	887	449	97.6	83,766	70,962	18.0
Chaffee	191	148	29.1	13,071	11,994	9.0
Cheyenne	14			291		
Clear Creek	9	12	[1]25.0	368	352	4.5
Conejos	608	387	55.8	98,486	46,273	112.8
Costilla	315	196	60.7	50,290	25,918	94.0
Custer	155	221	[1]29.9	11,183	20,997	[1]47.0
Delta	798	812	155.8	35,219	17,846	97.4
Dolores	23	12	91.7	855	216	295.8
Douglas	134	96	39.6	7,962	5,699	39.7
Eagle	188	176	6.8	18,486	14,250	29.7
Elbert	17	32	[1]46.9	905	2,616	[1]66.0
El Paso	180	139	29.5	13,131	10,959	19.8
Fremont	588	312	88.5	15,542	13,508	15.1
Garfield	487	314	55.1	24,937	14,687	70.4
Gilpin	16			354		
Grand	153	98	56.1	17,648	10,281	71.6
Gunnison	226	165	37.0	26,971	20,115	34.1
Hinsdale	30	19	57.9	1,339	1,389	[1]4.0
Huerfano	345	400	[1]13.8	15,329	22,294	[1]31.0
Jefferson	751	470	59.8	43,850	40,829	7.4
Kiowa	3			158		
Kit Carson	23			859		
Lake	56	36	55.6	7,380	6,591	12.0
La Plata	220	230	[1]4.3	10,771	11,735	[1]9.0
Larimer	1,256	769	63.3	169,028	103,483	63.3
Las Animas	549	353	55.5	24,661	22,891	7.7
Lincoln	17	5	240.0	1,678	334	402.4
Logan	226	73	209.6	8,913	8,970	[1]1.0
Mesa	742	310	139.4	33,223	13,798	140.8
Mineral	32			2,640		
Montezuma	240	29	727.6	12,246	2,122	477.1
Montrose	468	462	1.3	34,132	27,361	24.7
Morgan	305	97	214.4	37,012	16,443	125.1
Otero	762	189	448.2	62,268	16,431	279.0
Ouray	128	94	36.2	10,440	7,894	32.3
Park	172	136	26.5	39,861	24,015	66.0
Phillips	4			19		
Pitkin	153	115	33.0	12,088	7,041	71.7
Prowers	377	18	1,994.4	46,092	1,808	2,449.3
Pueblo	561	206	172.3	85,943	10,930	228.8
Rio Blanco	239	135	77.0	21,381	7,532	183.9
Rio Grande	351	195	80.0	71,325	21,797	227.2
Routt	552	280	97.1	44,542	16,328	172.9
Saguache	364	240	51.7	75,909	52,453	44.7
San Juan	3			9		
San Miguel	108	57	89.5	5,425	2,125	155.3
Sedgwick	81			4,779		
Summit	72	20	260.0	3,531	1,316	168.3
Teller	41			881		
Washington	25	1	2,400.0	5,099	720	608.2
Weld	1,814	1,046	73.4	226,613	112,080	102.2
Yuma	22	5	340.0	856	373	129.5

[1] Decrease.

TABLE C.—NUMBER OF IRRIGATORS, AND ACRES IRRIGATED, WITH PERCENTAGES OF INCREASE, BY WATER DIVISIONS: 1889 AND 1899.

WATER DIVISIONS.	NUMBER OF IRRIGATORS.			ACRES IRRIGATED.		
	1899.	1889.	Per cent of increase.	1899.	1889.	Per cent of increase.
The State	17,613	9,659	82.3	1,611,271	890,735	80.9
I	6,872	3,706	85.4	711,192	422,161	68.5
II	4,095	2,062	98.6	281,662	143,018	96.9
III	1,695	1,037	63.5	299,989	147,830	102.9
IV	614	304	102.0	29,555	16,991	73.9
V	3,546	2,135	66.1	222,950	136,880	62.9
VI	791	415	90.6	65,923	23,855	176.3

While the number of farms outside of the Indian reservations increased, in ten years, 50.7 per cent, the number of irrigators, as shown in the above tables, increased 82.3 per cent, and the irrigated area 80.9 per cent.

Table D is an exhibit, by counties, exclusive of Indian reservations, of the number of irrigated farms compared with the total number of farms, and of the irrigated acreage compared with the total improved acreage.

TABLE D.—COMPARISON OF IRRIGATED FARMS WITH TOTAL NUMBER OF FARMS, AND OF IRRIGATED ACREAGE WITH IMPROVED ACREAGE, JUNE 1, 1900.

COUNTIES.	NUMBER OF FARMS.			NUMBER OF IMPROVED ACRES IN FARMS.		
	Total.	Irrigated.	Per cent irrigated.	Total.	Irrigated.	Per cent irrigated.
The State	24,686	17,613	71.3	2,273,731	1,611,271	70.9
Arapahoe	2,105	1,153	54.8	202,047	81,807	40.5
Archuleta	227	151	66.5	10,372	6,529	62.9
Baca	137	10	7.3	7,832	156	2.0
Bent	274	223	81.4	38,858	33,039	85.0
Boulder	967	887	91.7	91,708	83,766	91.3
Chaffee	242	191	78.9	14,726	13,071	88.8
Cheyenne	57	14	24.6	2,740	291	10.6
Clear Creek	31	9	29.0	1,196	368	30.8
Conejos	617	608	97.7	98,960	98,486	99.5
Costilla	331	315	95.2	79,678	50,290	63.1
Custer	351	155	44.2	23,111	11,183	48.4
Delta	874	798	91.3	38,016	35,219	92.6
Dolores	36	23	63.9	942	855	90.8
Douglas	457	134	29.3	39,165	7,962	20.3
Eagle	208	188	90.4	19,709	18,486	93.8
Elbert	579	17	2.9	40,460	905	2.2
El Paso	729	180	24.7	62,408	13,131	21.0
Fremont	606	588	97.0	20,512	15,542	75.8
Garfield	507	487	96.1	29,002	24,937	86.0
Gilpin	49	16	32.7	2,110	354	16.8
Grand	179	153	85.5	18,504	17,648	95.3
Gunnison	239	226	94.6	28,163	26,971	95.8
Hinsdale	35	30	85.7	1,767	1,339	75.8
Huerfano	486	345	70.9	25,466	15,329	60.2
Jefferson	1,050	751	71.5	61,224	43,850	71.6
Kiowa	138	3	2.2	4,138	158	3.8
Kit Carson	305	23	7.5	19,581	859	4.4
Lake	71	56	78.9	7,686	7,380	96.6
La Plata	285	220	77.2	14,491	10,771	74.3
Larimer	1,412	1,256	89.0	180,353	169,028	93.7
Las Animas	1,037	549	52.9	38,441	24,661	64.2
Lincoln	138	17	12.3	8,195	1,678	20.5
Logan	413	226	54.7	57,639	8,913	15.5
Mesa	747	742	99.3	34,205	33,223	97.1
Mineral	48	32	66.7	2,929	2,640	90.1
Montezuma	261	240	92.0	15,204	12,246	80.5
Montrose	524	468	89.3	36,884	34,132	92.5
Morgan	378	305	80.7	43,282	37,012	85.5
Otero	814	762	93.6	68,036	62,268	91.5
Ouray	128	128	100.0	11,184	10,440	93.3
Park	220	172	78.2	40,258	39,861	99.0
Phillips	244	4	1.6	20,028	19	0.1
Pitkin	170	153	90.0	12,588	12,088	96.1
Prowers	478	377	78.9	58,172	46,092	79.2
Pueblo	668	561	84.6	40,821	35,943	88.1
Rio Blanco	264	239	90.5	21,846	21,381	97.9
Rio Grande	361	351	97.2	78,141	71,325	91.3
Routt	708	552	78.5	53,977	44,542	82.5
Saguache	406	364	89.6	119,587	75,909	63.5
San Juan	6	3	50.0	18	9	50.0
San Miguel	229	108	47.2	10,088	5,425	53.8
Sedgwick	156	81	51.9	9,209	4,779	51.9
Summit	77	72	93.4	4,031	3,531	87.6
Teller	143	41	28.7	4,685	881	18.8
Washington	201	25	12.4	17,961	5,099	28.4
Weld	2,002	1,814	90.6	251,307	226,613	90.2
Yuma	291	22	7.6	30,145	856	2.8

Of the 24,686 farms of the state, 17,613, or 71.3 per cent, are irrigated; and of the total number of acres in farms, 6,241,850, or 65.9 per cent, are in irrigated farms.

Of the improved land in farms, 70.9 per cent is irrigated. The average size of all farms, exclusive of those held by the Indians, is 384 acres, and the average size of irrigated farms is 354 acres. The average number of acres of improved land in all farms is 92, and in irrigated farms it is 107, of which 91 acres are actually irrigated.

Most of the water used for irrigation is surface water obtained from rivers, but in addition to this, considerable quantities of ground water, or so-called underflow, found at depths varying from 20 to 1,500 feet, have been utilized. There were 227 farms which were irrigated wholly, or in part, by pumping this underflow from wells.

Table E shows the number of ditches operated in 1899, with length and cost of construction and of maintenance, by water divisions.

TABLE E.—NUMBER OF MAIN CANALS AND DITCHES OPERATED IN 1899, WITH LENGTH IN MILES AND COST OF CONSTRUCTION, AND OF MAINTENANCE, BY DRAINAGE DIVISIONS.

WATER DIVISIONS.	MAIN CANALS AND DITCHES.					
	Number.	Length in miles.	Average number of acres irrigated per mile.	Cost of construction.		Cost of maintenance per acre irrigated in 1899.
				Total.	Per acre irrigated in 1899.	
The State	1,890	7,374	218	$11,568,137	$7.21	$0.34
I	380	2,292	310	4,131,874	5.82	0.43
II	438	1,574	179	3,316,414	11.80	0.37
III	142	758	396	1,743,369	5.89	0.13
IV	99	240	123	93,095	3.15	0.30
V	544	1,828	122	2,076,718	9.34	0.32
VI	287	687	96	206,667	3.16	0.17

The statistics presented in Table E relate only to the canals and ditches outside of the Indian reservations. The number of acres of irrigated land for each mile of ditch operated averages 218, or slightly less than double that for Arizona. The number of acres under ditch for each mile is 390, or nearly twice the area irrigated. In other words, the area rendered cultivable by irrigation would be nearly doubled if the ditches already constructed were furnished with a sufficient and properly administered water supply.

In 1899, however, the water supply in many parts of Colorado was exceptionally deficient, and in years of average precipitation the area irrigated is undoubtedly much larger.

The average cost of constructing the ditches was about $1,575 per mile, a little more than half the cost of construction in Arizona. The average construction cost, per acre of land under ditch, was $3.60, and per acre of land actually irrigated in 1899, $7.21. The average cost of maintenance per acre irrigated in 1899 was $0.34, but estimating the cost of water right upon the basis of the area irrigated in a year of short water supply, necessarily made the average cost higher than it would be in an ordinary year.

No estimates having been secured in 1889 of the cost per mile of ditches, no comparisons can be presented. In 1899 the average value of arable land under ditch, but not yet prepared for irrigation, varied from $2 to $20 per acre, while that of irrigated land is from $24 to $1,000. The difference represents the increment to the value of the land by irrigation and the improvements thereby made possible. This shows a large profit on the cost of ditch construction.

There were, in 1889, 7,055 acres irrigated from wells. The total cost of construction of the irrigation systems obtaining water from wells, was $190,566. The value of all land in irrigated farms, not including buildings, is $79,696,998, and in unirrigated farms, $10,640,465. The value of all buildings on irrigated farms is $13,178,702, and on unirrigated, $2,822,700. The land in irrigated farms, then, represents 88.2 per cent of the total value of all farm lands, although constituting but 65.8 per cent of the total acreage. The value of buildings on these farms is 82.4 per cent of the total for all farms, and the value of implements and machinery, 83.1 per cent. The irrigation systems in the state, as reported in 1899, represent a cost of $11,613,732. The value of the irrigated products grown in 1899 was $15,633,938. The irrigated area in crops, as shown in Table A, is 1,300,840 acres; the income from this land in 1899 was, therefore, slightly more than $12 per acre.

Exclusive of the Indian reservations, the average value of land, exclusive of buildings, is, for all farms, $9.54 per acre; for unirrigated farms, $3.29; and for irrigated farms, $12.77. The average value per acre of irrigated land is $40.77, while that for the best irrigated land, suitable for growing alfalfa, ranges from $50 to $150, and irrigated fruit land has, in some instances, a reported value as high as $1,000 per acre.

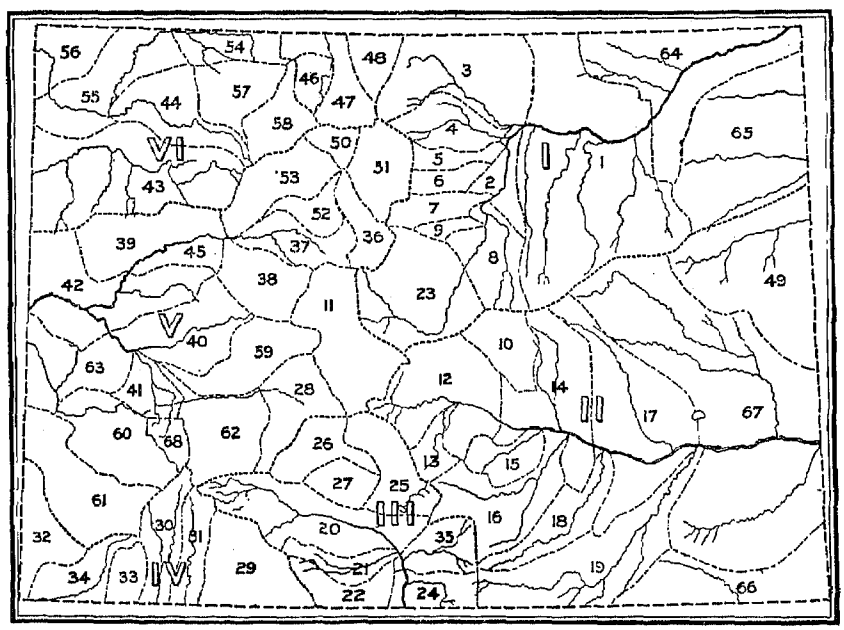
Table F presents, by counties, the average values per acre of irrigated and unirrigated farms, and of irrigated and unirrigated land under ditch.

TABLE F.—AVERAGE VALUE PER ACRE OF IRRIGATED AND UNIRRIGATED FARMS AND FARM LAND IN 1900.

COUNTIES.	AVERAGE VALUE PER ACRE.				
	Farms, exclusive of buildings.			Land under ditch.	
	All.	Irrigated.	Unirrigated.	Irrigated.	Unirrigated.
Arapahoe	$13.16	$24.03	$3.88	$65.63	$4.16
Archuleta	6.72	7.39	4.10	28.53	3.19
Baca	1.53	1.69	1.68	15.20	1.57
Bent	9.60	11.20	3.98	20.56	4.26
Boulder	22.67	24.41	5.02	62.46	5.88
Chaffee	9.76	10.39	2.97	29.24	1.90
Cheyenne	1.22	6.20	0.94	19.03	1.63
Clear Creek	6.76	8.68	4.32	17.67	2.13
Conejos	3.67	8.81	2.51	15.36	2.25
Costilla	2.64	2.66	1.11	12.87	1.94
Custer	8.83	11.59	5.50	34.81	4.88
Delta	28.47	29.45	9.96	47.27	10.67
Dolores	6.54	6.54		11.67	1.39
Douglas	6.57	7.81	5.52	96.11	3.55
Eagle	15.51	15.96	5.49	38.26	2.93
Elbert	3.34	3.45	3.31	32.58	5.79
El Paso	4.17	4.58	3.80	68.16	2.74
Fremont	27.76	29.91	3.04	343.96	20.28
Garfield	18.48	18.98	5.69	60.67	2.68
Gilpin	4.22	5.28	3.54	17.88	4.67
Grand	7.55	8.07	2.60	13.64	1.57
Gunnison	10.98	12.09	3.15	19.07	3.55
Hinsdale	7.86	7.98	4.16	15.07	1.45
Huerfano	5.02	5.70	2.83	27.69	1.89
Jefferson	26.66	38.02	10.03	91.22	4.92
Kiowa	1.59	4.67	1.56	15.76	1.54
Kit Carson	1.75	3.21	1.53	21.01	1.55
Lake	21.31	22.81	6.70	31.20	7.70
La Plata	10.45	11.99	2.02	39.94	2.50
Larimer	$10.74	$11.29	$4.57	$46.94	$2.03
Las Animas	3.71	6.42	2.15	17.24	1.59
Lincoln	1.65	1.74	1.59	12.73	1.47
Logan	7.24	9.88	1.00	24.09	1.91
Mesa	34.02	34.10	4.00	69.22	1.47
Mineral	4.20	4.62	1.80	9.77	1.74
Montezuma	9.46	9.55	3.74	11.08	1.93
Montrose	18.18	19.58	3.37	27.94	5.64
Morgan	10.95	13.10	2.85	28.01	2.89
Otero	14.56	17.46	1.45	43.55	2.92
Ouray	14.43	14.43		42.77	2.79
Park	5.92	6.14	3.05	14.42	1.79
Phillips	3.14	5.30	3.06	16.34	1.64
Pitkin	16.57	17.29	4.58	42.15	1.57
Prowers	11.83	17.81	2.87	39.18	1.68
Pueblo	7.33	7.85	2.65	61.72	3.21
Rio Blanco	12.98	13.38	3.34	39.51	1.37
Rio Grande	10.01	15.54	1.13	19.27	2.46
Routt	8.70	9.53	3.99	28.40	3.23
Saguache	6.49	6.69	1.24	15.52	2.09
San Juan	18.64	23.57	10.00	27.09	3.47
San Miguel	9.71	12.64	6.58	34.83	5.06
Sedgwick	5.74	7.90	2.95	16.32	1.38
Summit	11.24	11.74	2.41	21.03	1.41
Teller	6.86	8.34	6.42	29.05	3.23
Washington	2.54	9.52	1.23	24.64	1.76
Weld	16.76	23.64	2.52	39.14	8.44
Yuma	3.51	6.53	3.03	18.06	1.67

IRRIGATION BY DRAINAGE DIVISIONS.

The principal rivers of the state are the South Platte, Arkansas, Rio Grande, San Juan, Grand, and Green. The three last mentioned are tributaries of the Colorado of the West. The state has been divided by law into six large drainage divisions, corresponding with the natural hydrographic basins of the above named six principal rivers. For administrative purposes, these divisions are subdivided into water districts, the relative locations of which are shown on the accompanying map.



MAP OF WATER DIVISIONS.

THE SOUTH PLATTE RIVER.

The most important drainage basin in Colorado is that of the South Platte River, which includes the following counties: Arapahoe, Boulder, Douglas, Elbert, Jefferson, Larimer, Logan, Morgan, Park, Phillips, Sedgwick, Washington, Weld, and Yuma. The headwaters of the South Platte are in South Park in Park county. In the mountains the stream has a considerable fall, which gradually

diminishes as it enters the plains. Like most streams in this region, it is subject to great fluctuations in volume. During the spring floods its channel is nearly a mile wide, and the discharge is very great, while at other seasons, it sinks into its sandy bed and becomes almost dry. The area comprised in the drainage basin of this stream and its branches is 90,011 square miles.

On no river in the United States has irrigation been more largely developed or extended to a larger area than on the South Platte and its tributaries. Embraced in its drainage system are many populous cities and towns, and the richest farming communities in the state. The area under ditches and canals diverting water from the main Platte and its tributaries in Colorado, Wyoming, and Nebraska, is approximately 2,000,000 acres. In Colorado the area irrigated in 1899 was 711,192 acres, an increase since 1889 of 68.4 per cent. In this section are 38.9 per cent of the total number of irrigated farms, 44.1 per cent of the total irrigated area, and 43.4 per cent of the total population of the state. The total value of the farm land and buildings is 51.5 per cent of that of the whole state.

The first large irrigation enterprise of the state was founded at Greeley on this stream. The summer flow has been increased by the diversion of some of the headwaters of the western side of the range, and also by the building of reservoirs, both in the mountains and out on the plains. The great problem before the irrigators in this division is that of water storage and conservation of the floods which run to waste. There is already under ditch more land than can be supplied during times of drouth, but if the present supply of water were used with greater skill and economy, much larger areas could be cultivated. The acreage of fertile land to which water could be carried by canals and ditches already constructed can not be definitely ascertained, but unquestionably it far exceeds the area actually watered. The system of water storage is, however, being eagerly adopted by irrigators and others interested in such matters, as a relief from the trials and uncertainties of the chance supply. Reservoirs are being built by individuals and corporations. Some of these are among the high mountains, but the greater number are near the foothills in the vicinity of the land to be irrigated. The largest and best reservoir sites, however, have not been taken, their very magnitude and importance necessitating some form of public action in which other states may be concerned. The most completely developed of the reservoir systems is probably that on the Cache la Poudre River, a tributary of the South Platte. Among the important canals are Cache la Poudre; Larimer county; Larimer County Canal No. 2; Larimer and Weld Canal; Pleasant Valley and Lake Canal; and the Mercer Ditch. The combined length of these canals is more than 220 miles, and the area irrigated by them in 1899 was approximately 100,000 acres.

Water is held in the layers of sand and gravel which have been deposited at various depths beneath the surface of the plains. Investigations indicate that this supply is large, and that considerable areas of valuable land, located at too great an elevation to be irrigated by gravity diversion of water, will ultimately be reclaimed by utilizing the underflow.

THE ARKANSAS RIVER.

The Arkansas River rises in the vicinity of Leadville, in central Colorado, at an altitude of 10,000 feet, and receives some of its waters from the region of perpetual snow. It first flows south, through mountains covered with valuable forests, then east to Canyon, where it leaves the mountains. Within the mountains the slope is extremely steep, averaging 40 feet to the mile, but the fall gradually diminishes after the river enters the plains, where, for a distance of 500 miles, it averages 7 feet per mile. The drainage basin of the Arkansas contains 185,671 square miles, and its total length is 1,497 miles.

At the point where the Arkansas River enters the Great Plains of eastern Colorado its waters are largely drawn upon for irrigation, even the floods being stored and used; as a result, very little water flows into Kansas except when the stream is highest. In many respects the river has the same characteristic features as the South Platte. The tributaries are of two classes—those from the mountains, having a perennial flow, and those which drain the Great Plains and receive water only in time of rain or in the early spring. The largest of these mountain tributaries are Lake, Badger, and Grape creeks. Fountain Creek and St. Charles, Huerfano, Purgatoire, and Apishapa rivers receive their supply from the plains, as well as from the mountains. The Huerfano, Apishapa, and Purgatoire rivers come from the south, where they rise in the Sangre de Cristo Range. In their upper courses they carry considerable water, especially in the spring, but as the major portion of the supply is taken for irrigation, they contribute little or no water to the Arkansas during the irrigation season. These streams are subject to sudden rises during storms or local cloud-bursts, and at such times discharge great volumes of water into the main stream, much damage often resulting. Among the tributaries of the second class, which drain the plains, are such streams as Horse, Adobe, Big Sandy, and Timpas creeks, and many others of lesser note. The volume of water received by these streams is at times enormous, but for the greater portion of the year their channels are dry. During the flood season their flow has been estimated to be 10,000 cubic feet per second.

The average size of the farms in the upper Arkansas Valley is very small, the majority of them ranging from five to twenty acres. As a natural consequence, the average value per acre is the highest in the state. Where the valley broadens, the canals become more extensive and important, and the farms increase in size. Vast fields of alfalfa stretch for miles along the big ditches, producing winter forage and affording late fall pasturage for herds of cattle and sheep that graze on the free range in the spring and summer. The acreage in wheat, oats, and corn is large and the yields are uniformly good. This valley is especially adapted to the raising of sugar beets, and the industry is a growing one.

During a great part of the irrigation season the entire flow of the Arkansas River is exhausted by the canals and ditches in Colorado and the supply is insufficient for the land under ditch. The deficiency occurs when the water is most needed, and in many districts a shortage of crops is reported each year. The further development of irrigation is impracticable without recourse to artificial storage. Opportunities for this are afforded in the mountainous region of this basin and a number of excellent reservoir sites have been found and reported. The system of reservoirs constructed by the Great Plains Water Company, near Lamar, has proved very beneficial in preventing loss of crops.

THE RIO GRANDE DRAINAGE BASIN.

The Rio Grande, rising in the San Juan Range, drains the mountain area to the south and east of the Continental Divide in the southwestern part of the state. Its total drainage area in Colorado is 7,527 square miles. For 80 miles of its course it flows easterly as a mountain stream, until it enters the San Luis Valley, a fertile, level plain, having an area about equal to that of Connecticut, and lying between ranges of the Rocky Mountains. This valley has a general elevation of 7,500 feet, the mountains surrounding it rising from 4,000 to 6,000 feet higher. The Rio Grande cuts through it diagonally from northwest to southeast, and receives from the adjacent mountains the waters of nearly thirty streams. The principal tributary is the Conejos River, coming in from the west near the lower end of the valley. The Rio Grande receives from the west also the waters of the Alamosa, La Jara, and San Antonio rivers; and from the east, those of the Trinchera, Culebra, and Rio Costilla. About four miles north of the New Mexico state line, the river enters the long Rio Grande Canyon, through which it continues into that state. The Rio Grande receives but little water from any of its tributaries, as the supply of these streams is practically all utilized during the summer time, and most of the supply of the Rio Grande itself is used in the upper part of the valley, so that near the state line there is little water left in the channel. The drainage of the mountains surrounding the northern part of the San Luis Valley is received by the San Luis River, which terminates in the center of the valley in a number of saline lakes having no visible outlets.

The structure of the soil of the greater part of the Rio Grande Valley is such that it readily transmits water, or subirrigates, and its adaptability for holding moisture has enabled the farmers to extend cultivation over a much larger area than could be done without this aid. The soil is generally rich, and farming by irrigation is profitable throughout the valley. Extensive experiments have been made with artesian wells, especially in Rio Grande and Saguache counties, but have not been altogether successful.

THE GRAND RIVER.

The Grand River, draining a considerable portion of western Colorado, rises in the eastern part of Middle Park, among some of the highest mountains of the Continental Divide, and is the most important tributary of the Colorado River. The river runs for the greater part of its course through a region of plateaus, flowing mostly in steep-walled canyons. The courses of the Eagle, Roaring Fork, Gunnison, and Dolores rivers, tributaries of the Grand, are marked by similar characteristics. The valley lands are limited in area and the water supply for irrigation generally far exceeds the requirements. Shortages sometimes occur, however, on some of the branches and small creeks, where irrigation works are extensive and considerable areas are under ditch. This is the case on Uncompahgre River and its tributaries, and a large diversion canal from Gunnison River is planned.

The water is furnished to bench lands along the Grand River by a number of pumping plants. These benches, terrace like, rise above the valley of the stream and lie between the valley and the plateau. Several pumping plants now in successful operation at Grand Junction are operated by waterpower. Numerous steam-power plants have been abandoned, as the cost of operating them was found to be greater than the returns from the products. There are a number of large irrigating ditches in this part of Colorado, and nearly all farm crops are grown that can be raised in this latitude. Orchard fruits, including apples, peaches, apricots, etc., and small fruits, are produced in considerable quantities. Alfalfa is a staple product, and in 1899 in the basin of the Grand, the area devoted to this forage crop was approximately 75,000 acres, with a production of about 210,000 tons.

The establishment of a large beet-sugar factory at Grand Junction has given an impetus to the cultivation of beets, and the acreage devoted to this crop is growing larger each year.

Dolores River is the least important tributary of the Grand River in Colorado, and has its sources in La Plata and San Miguel Mountains. The ditches are generally small, the most notable being that which irrigates about 8,000 acres in the vicinity of Cortez.

THE SAN JUAN RIVER.

Flowing south from the San Juan Mountains are a number of streams, uniting at the base of the range into the San Juan, which flows westward through a plateau region to the junction with the Colorado. In the mountains these streams have a rapid fall which becomes greatly lessened in the channel across the plateau, the grade of the river towards its mouth being very much less than that of the Colorado.

The San Juan, while an important tributary of the Colorado, is but little utilized for irrigation in Colorado. Three of its affluents, the Rio de los Pinos, La Plata, and Las Animas rivers, and their small branches, supply almost all of the water which is diverted into ditches in this drainage basin. The valleys through which they flow are comparatively narrow, and the area irrigated is not large.

THE GREEN RIVER.

Very little land is irrigated in Colorado in the valley of the main stream of this river, irrigation being confined to

the basin of the Yampa or Bear River, in Routt county, and to the White River in Rio Blanco county.

The Yampa or Bear River, which drains Routt county, in the extreme northwestern part of the state, has its sources in Egeria Park, with branches rising in the Elk Head range on the north, and the White River divide on the south. Its valley varies in width from one-fourth of a mile to five miles, and is inclosed in canyons at only a few points in its course of 150 miles. The entire valley was formerly covered with a luxuriant growth of native grasses, which extended to the summits of the low ranges, but of late, the ranges have been overstocked, and the former rank growth of forage has been partially destroyed. The open prairie country extends back from the river for a considerable distance, until it reaches an altitude of 7,000 or 8,000 feet, where there is a belt of quaking-aspen timber, and above this, a heavy growth of red and white spruce. Croppings of coal, mostly bituminous, are found throughout the valley.

In this valley the chief industry is cattle raising, and the principal crops are hay and forage. The development of agriculture on any large scale has been greatly retarded by the isolation of the valley and the lack of transportation facilities.

The irrigation ditches are, for the most part, owned by the farmers or ranchmen, either individually or coöperatively, and are simply constructed and comparatively inexpensive.

The total area of all farms in the valley of the Bear River is 190,503 acres, of which 53,977 acres were improved, and 44,542 acres were irrigated in 1899.

THE WHITE RIVER.

The White River rises in the timber reserve in the mountains on the eastern side of the White River plateau. North and South Forks are fed by the snows on the same high peaks, though they flow in widely separated channels for a long distance before joining at Buford. The White River carries a large amount of water, its capacity at Meeker averaging 300 second feet at normal stage. This stream and its tributaries drain all of Rio Blanco county. The drainage basin is rough, and of little value except for stock raising. The valley is broad, and the cultivated areas are devoted to hay and forage crops, which are fed to the range stock.

The area irrigated in 1899 was 21,381 acres. This district is subject to early frosts which sometimes ruin almost the entire grain crop. Coal is found in great abundance in this region.