WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

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NEW DATA ON UNITED STATES FLOUR PRODUCTION SINCE 1899

BY STATES AND BY SIZES OF MILLS

CONSUMPTION of flour in the United States was about nine-tenths of a barrel per capita during each year 1921–1929, but it dropped sharply during the depression, and declined further when the processing tax was imposed. By 1934 the average consumption per capita had declined about 14 per cent, to slightly over three-quarters of a barrel. Consumption per capita during 1935 was about the same as in 1934 or perhaps slightly higher, at about .774 barrel per capita.

Biennial census statistics of flour production have been somewhat defective in recent years, but the only important omissions of production data, except in 1933, have been for mills producing under 5,000 barrels annually. The defects, apart from omissions, have been largely remedied through a retabulation of data by the Bureau of the Census, which is here presented. The production of mills omitted from the several censuses we have estimated on a newly developed basis which appears trustworthy.

In 1899, one-eighth of the total flour production was provided by 9,835 mills producing less than 5,000 barrels each. Steady extinction of these very small mills reduced their production to one-sixteenth of the total in 1919, and to one-thirtieth in 1929; but, subsequent revival of custom milling checked this decline. Large mills, producing 100,000 barrels or more annually, provided 40.2 per cent of the total flour output in 1899 and 80.0 per cent in 1929. Their proportion declined slightly during the depression and was still only 79.9 per cent in 1935.

In the face of competition of the large mills, those of small and intermediate size have declined in numbers and production even more rapidly than have the very small mills. In some sections of the country, however, the smaller mills have been maintaining their position well.

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NEW DATA ON UNITED STATES FLOUR PRODUCTION SINCE 1899

BY STATES AND BY SIZES OF MILLS

The present study offers the results of a critical analysis of census statistics and other data bearing on production of wheat flour in the United States by mills of different size groups. It presents revised figures for total flour production, and gives series of estimates of quantities of flour produced by mills in each of five principal output groups, by census years since 1899. For the census years 1899, 1919, and 1931 the division of production by output groups is shown by states. There results a striking picture of the effects of competition in the American milling industry.

A main objective of the analysis has been improvement in the figures for total flour production in the United States. Detailed study of the statistics by states and by output groups revealed significant defects in the data. With the co-operation of the Bureau of the Census we have been able to remedy most of the defects and to contribute significant information for the interpretation of future statistics of production.

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Active interest in changes in flour consumption in the United States which has developed in recent years has focused attention on production changes that might otherwise pass with slight notice. For example, the difference between flour production in 1929 and in 1931, as reported in the biennial census of manufactures, may be calculated to indicate a decline in United States flour consumption of only 2 million barrels between those two years. Our current interpretation of the Census monthly statistics of flour production, however, indicated that the decline in consumption between 1929 and 1931 amounted to about 5 million barrels. This interpretation is now substantiated by a retabulation of data by the Bureau of the Census. Regarded as a fraction of a total flour output of 115 to 122 million barrels, the difference of 3 million barrels between these two figures is small; but the difference is great from the standpoint of interpreting the effect of the economic depression on flour consumption.

Accurate appraisal of the decline in flour consumption that followed imposition of the processing tax on wheat milling in 1933 involves measuring a change of 3 million barrels a year, or perhaps only 2 million. The increase in consumption of flour that may be induced by the current advertising campaign designed to increase bread consumption will presumably be such as to require similar precision of measurement.

In short, if statistics of flour production are to be of much value for use in measuring changes in consumption over periods as short as two or three years, they must meet requirements of accuracy and consistency beyond those ordinarily demanded from production statistics.

In the present investigation much attention has been devoted to determining the amounts of flour production omitted from census statistics for certain years. The purpose is to obtain a consistent series of statistics even though absolute completeness may be unattainable. If it were necessary to choose between a series of statistics of flour production that always omitted a small but constant fraction of the total production, and another series that was generally more complete, but varied in the proportion omitted, preference should generally be given to the less inclusive but more consistent series. In practice, however, consistency is very difficult to obtain in a series that is not substantially complete.

Perfect completeness and accuracy in flour production statistics is more difficult to obtain than might be supposed. The absolute accuracy of such statistics hangs in part on the measurement of a barrel of flour. The barrel is no longer a customary container of flour, but only a unit of measurement. It is uniformly defined as 196 pounds of flour—of unstated moisture content. In practice, however, barrelage of flour production is commonly determined in mill records (and therefore, for census purposes) not from a weight of flour but as a count of individually weighed bags. If the flour is being packed in 98-pound bags, two bags are counted as a barrel, which is then 196 pounds of flour. But if the flour is being packed in 24-pound bags, eight bags will be counted as a barrel, though they contain only 192 pounds of flour. And if 5-pound bags are being packed, forty of them are commonly counted as one barrel, which is then 200 pounds of flour. Probably the average "barrel" actually represents close to 196 pounds of flour. Whether it represents precisely 196 pounds or not matters little so long as the average number of pounds per barrel remains substantially the same over a period of years.

I. REVISED STATISTICS OF TOTAL PRODUCTION AND CONSUMPTION

Flour production statistics collected biennially in the census of manufactures have in recent years fallen considerably short of the degree of accuracy and consistency required for satisfactory use as a basis for calculating flour consumption. The *monthly* statistics of flour production collected by the Bureau of the Census are in most respects extremely accurate and consistent; but they suffer from variations in completeness of coverage, as is inevitable in any compilation of data that is incomplete and on a voluntary basis. These monthly data, therefore, require to be supplemented by estimates of production of non-reporting mills; and for such estimates resort must be had to the statistics of the census of manufactures.

The main defects in the statistics of flour milling of the census of manufactures have arisen from several measures taken to reduce the expense of collecting and compiling the statistics. These have been: (1) elimination of custom mills from the scope of the census of manufactures in 1904 and 1914, and in all censuses, 1921–1935, inclusive; (2) restriction of the canvass in all censuses, 1921–1935, to establishments with a value of products of $5,000 or more, with consequent omission of many with a value of products considerably over $5,000; and (3) restriction of the detailed statistics of production in the census of 1933 to concerns with a value of products of $100,000 or more in either 1931 or 1933.[1]

Within the prescribed range of establishments to be canvassed, the completeness of census statistics of flour production has been improved in recent years through collection of statistics of flour production in establishments classified elsewhere than in the "Flour and other grain-mill products" industry.

Another important defect in the statistics of flour production reported in the censuses of manufactures arises from lack of uniformity in the periods to which the production statistics apply. Most concerns report production for the calendar year, but some report for their individual fiscal years. The available evidence indicates that production was much more uniformly reported on a calendar-year basis in earlier censuses than in those of 1929–1933 inclusive. For these later years this defect has been largely remedied by the Bureau of the Census through a new compilation of the statistics, which we present in Appendix Table V.[2]

Revised Statistics of United States Flour Production

Our analysis of the statistics of flour production leads to changes in totals for the

[1] Exception was made in Massachusetts; and detailed reports of production were made by central administrative offices covering a number of mills which individually had values of products under $100,000.

[2] This covers all the years for which the original census schedules are still on record.

United States which are summarized in Table 1. For 1904 and 1914 the additions constitute better estimates than have been available hitherto for production by custom mills. For census years from 1921 the additions represent estimates of production by custom mills and by merchant mills omitted in the census statistics. The additions represent only production of mills with annual output under 5,000 barrels except that for 1933 they include estimated production of a large proportion of all mills producing 5–20 thousand barrels each; and the estimates of omitted flour production by establishments classified outside the "Flour and other grain-mill products" industry for 1919, 1921, and 1923 represent chiefly the production of fairly large mills.[1]

TABLE 1.—SUMMARY OF REVISIONS IN STATISTICS OF UNITED STATES FLOUR PRODUCTION, 1899–1933

(*Thousand barrels*)

Census year	Estimate of production omitted in Census of Manufactures, for mills			Total addition to census figures
	Producing under 1,000 barrels	Producing 1,000–4,999 barrels	Classified outside "Grain-mill" industry	
1899.....	0	0	0	0
1904.....	1,241	648	0	1,889
1909.....	0	0	0	0
1914.....	936	121	0	1,057
1919.....	0	0	650	650
1921.....	997	0	650	1,647
1923.....	926	252	650	1,828
1925.....	857	388	0	1,245
1927.....	802	245	0	1,047
1929.....	843	65	0	2,055[a]
1931.....	935	555	0	—494[a]
1933.....	...[b]	...[b]	...[b]	6,927[a,c]

[a] Including changes resulting from retabulation by the Bureau of the Census (Appendix Table V), which results for 1931 in an indicated total smaller than that of the *Census of Manufactures* even after addition of omitted production, as estimated.

[b] Not available separately.

[c] Including also production of about 4 million barrels by omitted mills producing 5–20 thousand barrels each.

Presumably some flour was produced prior to 1919 by establishments classified elsewhere than in the "Flour and other grain-mill products" industry, for which it would be desirable to have estimates to be added to the census totals of reported production. Estimates of such production have been omitted for lack of any sound basis for judging even the approximate quantities, except that they may be supposed to have been smaller than in 1919.

For 1929, 1931, and 1933 the "total addition" shown in Table 1 includes the effect of compiling the production statistics, so far as possible, from data reported monthly to the Bureau of the Census rather than from production as reported in the census of manufactures. Tabulation on this basis resulted for 1929 in a total slightly over 1 million barrels larger than the comparable total for the census of manufactures; and for 1931 in a total nearly 2 million barrels smaller than the comparable figure of the census of manufactures. (A precise comparison between the corresponding totals for 1933 is not available.) These differences reflect in part the effect of superior accuracy in the data reported monthly, but arise chiefly from the fact that the monthly data used were all for calendar years, whereas the production statistics reported in the census of manufactures apply in part to fiscal years of milling companies.

RECENT CHANGES IN FLOUR CONSUMPTION

The new evidence on total United States flour production provides a considerably improved basis for appraising recent changes in per capita consumption of flour in the United States. Table 2 (p. 276) shows a calculation from the new estimates of flour production in census years, official trade statistics, and estimates of changes in flour stocks developed in our previous studies of flour consumption. In this table we have included a preliminary estimate of 1935 flour production. This is obtained by adding to the published statistics of flour production reported monthly during 1935 estimates of flour produced by non-reporting mills. Although this estimated total rests on a rather different footing from those for earlier years, it is probably nearly as trustworthy as the total for 1933.

[1] We defer to Section IV the discussion of the methods of estimation employed.

This calculation indicates for 1921–1927 almost exactly the same level of per capita flour consumption as our earlier estimates, but differs slightly in that it suggests that there was a slight decline rather than an increase in per capita consumption over the period. For 1929–1933 per capita consumption as here calculated runs 1–2 per cent below our earlier estimates, but the general indications of changes during the depression and following imposition of the processing tax remain the same.[1] Per capita consumption of flour in 1934 — the first full calendar year during which the processing tax was in effect— doubtless declined below the 1933 level, probably to about .77 barrel per capita. The figure for 1935 in the above tabulation suggests some increase in per capita consumption from its probable level in 1934, but uncertainties in the estimates of flour stocks prevent any confident statement that per capita consumption had in fact turned upward by the end of 1935. In any event, the 1935 consumption appears some 14 per cent below the level characteristic of the decade of the 1920's.

TABLE 2.—REVISED ESTIMATES OF UNITED STATES FLOUR PRODUCTION AND TOTAL AND PER CAPITA CONSUMPTION, CENSUS YEARS 1921–1935

(Thousand barrels)

Year	Estimated total production	Net exports and shipments	Domestic disappearance	Increase (+) or decrease (—) in flour stocks[a]	Domestic consumption	
					Total	Per capita (bbl.)
1921..	112,493	16,397	96,096	—1,490	97,586	.900
1923..	116,267	16,666	99,601	—1,580	101,181	.901
1925..	115,935	11,703	104,232	+ 230	104,002	.896
1927..	119,179	13,423	105,756	—1,440	107,196	.899
1929..	122,095	14,281	107,814	—1,240	109,054	.895
1931..	114,870	10,248	104,622	+ 640	103,982	.838
1933..	102,593	4,562	98,031	— 865	98,896	.786
1935..	101,300	3,927	97,400	—1,200	98,600	.774

[a] Estimates, mostly unpublished, based on earlier studies of the Food Research Institute. The figure for 1921 was published in WHEAT STUDIES, December 1927, IV, 90 (Table 5). In WHEAT STUDIES, January 1934, X, 159–60, we gave estimates of changes in flour stocks suggesting a decline during 1933 of 0–1.73 million barrels. The figure here used is the middle of this range.

The present study was initiated largely because a number of able students of the flour production statistics have believed that our standing series of estimates of monthly flour production were too low, and we concurred to the extent of believing it probable that our monthly estimates made too little allowance for production by very small mills since 1929. It now appears, however, that in our monthly estimates we have been making ample allowance for the production of very small mills, and that during 1929–34 we allowed 1–2 per cent too much for production of larger mills not reporting monthly. During 1935 our monthly estimates developed a progressively larger error, which reached about 2.5 per cent, owing to failure to make due allowance for increasing completeness of the monthly reports. Defects in the biennial census statistics of flour production have hitherto prevented us from getting a proper check on our monthly estimates since 1927.

It must be admitted that these observations on the errors in our monthly estimates rest upon comparisons with figures which for 1933 and 1935 involve a substantial element of estimation, although on a greatly strengthened basis. There exist in official records, readily available for compilation, statistics of wheat milled and flour produced as reported for processing tax purposes which should permit an accurate appraisal of 1935 flour production. Steps have been taken toward obtaining a compilation of these data, but they have not yet been made available. Before many months 1935 production statistics from the biennial census of manufactures will be published. These will not cover the production of mills with a value of product under $5,000, but in other respects will probably be reasonably complete and accurate. The Bureau of the Census will endeavor to avoid the defects which have so seriously restricted the usefulness of the statistics of 1929–1933.

[1] See especially WHEAT STUDIES, January 1934, X, 159–60. The data here presented call for little change in our earlier estimates of flour production since 1928 because those estimates were never adjusted to bring them into line with the statistics of the 1929 and 1931 censuses of manufactures; and it now appears that we were warranted in placing more confidence in the monthly production statistics, raised to 100 per cent by our method, than in the totals of the census of manufactures.

II. PRODUCTION BY MILLS IN DIFFERENT SIZE GROUPS

There are two common measures of size of a mill: *capacity* in barrels of flour per 24 hours, and *production* in barrels per year. The basis of classification by size employed in all census statistics except those based on monthly and quarterly reports is production. For general purposes this is the more useful measure of size. From most economic standpoints, a mill of 200 barrels daily capacity operated the equivalent of 150 24-hour days per year is a larger mill than one of 300 barrels daily capacity but operated the equivalent of only 75 days per year. Of two such mills, the one with 300-barrel capacity will usually represent the larger investment, but it will produce 25 per cent less flour, use 25 per cent less wheat, and give employment to fewer men.

In general there is a close relation between capacity of mills and production, but on the average, production changes more than proportionally with changes in capacity, except for mills with capacity over about 750–1,000 barrels per day. Differences in size are paralleled by important differences in operating characteristics.

Characteristics of Mills by Size Groups

Large mills customarily operate 24 hours a day whenever flour sales warrant. Mills of intermediate size usually run only one or two shifts per day even in their seasons of most active operation. Small mills resort seldom to night operation and normally average only a few hours of operation per day except in the busiest season. Most very small mills (producing under 5,000 barrels a year) operate very irregularly. Of these the smallest, producing under 1,000 barrels a year, do chiefly custom grinding, although in the census of 1919 nearly half of them were classed as merchant mills on the ground that they did some merchant milling.

Any division of mills into size groups is necessarily quite arbitrary, for there are mills of virtually all possible sizes below the very largest, and there is no marked tendency for mills to concentrate within any particular size ranges. The particular division of mills into production groups which has been employed in the censuses of manufactures is about as serviceable as any system of classification into an equal number of groups which might be chosen. The lines of division are set at 1, 5, 20, and 100 thousand barrels.[1] This is the basis of classification which we here employ.

The following tabular statement defines the size groups which we employ in terms of annual production of flour and gives the ranges of capacity and rate of operation characteristic of most of the mills in each group. It serves to put in quantitative terms the observations made above regarding the relations between production, capacity, and rate of operation of mills. We express rate of operation in terms of number of 24-hour days of capacity operation represented by annual production, in preference to the more common expression of rate of operation in terms of percentage of full capacity. Statement of rate of operation in terms of percentage of capacity is likely to carry the implication that 24-hour operation is normal. For large mills 24-hour operation is normal for part of each year, but for most smaller mills it is not normal at any time.

Size group	Annual output (*barrels*)	Capacity per 24 hours (*barrels*)	No. of days full operation represented in annual output
Very small	Under 1,000	10–50	10–40
	1,000–4,999	25–100	20–80
Small	5,000–19,999	75–300	50–100
Intermediate	20,000–99,999	200–750	80–150
Large	100,000 or more	600–20,000[a]	150–220

[a] Only one mill (in Buffalo) now has this rated capacity; the next largest are two in Minneapolis, which formerly had a capacity of over 20,000 barrels each but now maintain a capacity of only about 15,000 barrels each.

The ranges of capacity and activity of mills in the several output groups as stated in the tabulation above are representative rather than fully inclusive. Among mills to be designated as small and intermediate, producing

[1] On the basis of average operating characteristics under modern conditions the line of division between small and intermediate size mills might perhaps better have been put at about 30 thousand barrels rather than 20 thousand.

5–20 and 20–100 thousand barrels respectively, there are to be found a number with lower capacity than the lowest indicated above for the group. By operating more hours per day and more days per year than most similar mills they obtain unusually large production for mills of such capacity. There are also mills to be classed as small or very small, on the basis of annual output, which have a capacity that would normally place them in a higher output group. Regional shortages of wheat and fluctuations in flour demand, as well as conditions peculiar to individual mills, affect their activity. Most of the mills falling in each size group, however, normally have a daily capacity and a rate of operation within the ranges given by the tabulation above.

The range in typical number of days of 24-hour operation represented in the annual output of mills in each size group is wide partly owing to diversity of other characteristics of the mills within each group. The "large" mills which attain the equivalent of only 150 to 175 days of full operation in a year are chiefly mills producing under 200 thousand barrels. Under favorable conditions large mills not infrequently obtain considerably better than the equivalent of 220 days of capacity operation. Most of the mills of intermediate size obtain the equivalent of 100 to 140 days of full operation in a year. This represents active regular operation on one shift, with more or less overtime operation. It is only mills near the lower limit of the class that often fall to the equivalent of 80 days of full operation annually. Among the small and very small mills there is a general tendency within each output group for the mills of smaller capacity to operate less regularly than those of larger capacity. The larger of the "small" mills operate fairly regularly through the year on a single-shift basis to obtain the equivalent of 100 24-hour days of operation; but most smaller mills are distinctly irregular in operation.

For some purposes it is desirable to know the average rate of operation of mills in different *capacity* groups, without regard to the *output* class in which they fall. Such data we have computed from statistics of mills reporting monthly and quarterly to the Bureau of the Census, 1932–1935, and present in Appendix Table VII. For the mills with capacity of 200 barrels and less, the averages for 1934 and 1935 are much more nearly representative than those for the earlier years. In 1932 and 1933 the reports were sought in general only from the most active of these low-capacity mills. Even the data for 1934 and 1935 doubtless reflect the effect of some tendency for selection of the more active mills in these capacity groups.

Numbers of Mills by Output and by Capacity Groups

Considerable interest attaches to the question of distribution of mills by output within the rather broad output classes for which census statistics of numbers are available. The related subject of distribution of mills by capacity is worthy also of brief notice. The basis for estimating distribution of numbers by output within the broader output classes is best for 1899. This distribution is also of special interest because of the part it plays in estimation of average output per mill within the broader output groups. For a statement of distribution of mills by capacity we present data for recent years, relying on the fairly comprehensive lists of the *Northwestern Miller*.

The census statistics for 1899 show numbers of mills by output classes as follows:

Class (*barrels*)	Number
Under 100	1,655
100–499	2,554
500–999	1,316
1,000–4,999	4,310
5,000–19,999	2,584
20,000–99,999	634
100,000 or more	135

The ranges covered by the several classes as thus arranged vary so widely that the character of the distribution by output is obscured. For mills producing under 100 thousand barrels, however, the frequency distribution indicated is of a fairly simple type. By fitting an appropriate frequency-curve to the published data it becomes possible to determine approximately the number of mills within any stated output range under 100 thousand barrels.

To represent the distribution of mills by output classes of equal width for all mills producing under 100 thousand barrels, a class interval of 10 thousand barrels may be used to advantage. Thus classified, the numbers show an extreme concentration in the lowest output class and a rapid decline in numbers in the higher output classes, as follows:

Class (*barrels*)	Number
Under 10,000	11,582
10,000–19,999	837
20,000–29,999	273
30,000–39,999	132
40,000–49,999	78
50,000–59,999	51
60,000–69,999	36
70,000–79,999	27
80,000–89,999	21
90,000–99,999	16
Total under 100,000	13,053

A similar concentration in the lowest output class and rapid decline in numbers in the higher classes is shown if the mills producing under 20 thousand barrels are grouped into 1,000-barrel classes, as in the left half of the following tabulation. To economize space only the lower limit of each class is stated:

Class (*barrels*)	Number	Class (*barrels*)	Number
Under 1,000	5,525	Under 100	1,655
1,000–	1,616	100–	966
2,000–	1,143	200–	674
3,000–	868	300–	509
4,000–	683	400–	406
5,000–	540	500–	336
6,000–	421	600–	288
7,000–	325	700–	254
8,000–	250	800–	228
9,000–	195	900–	209
10,000–	157	1,000–	195
11,000–	130	1,100–	185
12,000–	110	1,200–	177
13,000–	94	1,300–	170
14,000–	81	1,400–	164
15,000–	71	1,500–	157
16,000–	62	1,600–	151
17,000–	55	1,700–	145
18,000–	49	1,800–	139
19,000–	44	1,900–	133
Total under 20,000	12,419	Total under 2,000	7,141

Finally, if the mills producing under 2,000 barrels be grouped into 100-barrel classes, the concentration in the lowest class persists, though in somewhat moderated degree. The data appear in the right half of the tabulation above.

For an analysis of numbers of mills by capacity we use the lists of mills published by the *Northwestern Miller* for 1931 and 1935. The *Northwestern Miller* makes no claim for completeness of these lists, but they are in fact remarkably comprehensive, especially, we judge, for mills with capacity above about 200 or 300 barrels. In compiling these data from the published lists we have omitted mills designated as idle. We necessarily take no account of mills for which the capacity is not given, of which there were 357 in the 1935 list. These mills of unrecorded capacity may be assumed to be chiefly very small mills.

The distribution of numbers of mills by capacity groups for recent years, as shown in Table 3 (p. 280), has characteristics similar to those of the distribution of numbers by output groups in 1899. In both the tabulation of all mills grouped into 1,000-barrel classes, and in the tabulation of mills with capacity under 1,000 barrels grouped into 100-barrel classes, the greatest number appears in the group of smallest capacity. In the grouping by 50-barrel classes, shown for mills of under 400 barrels capacity, however, the greatest number appears in the second group. The result would have been otherwise if 50 barrels had been made the upper limit of the lowest class instead of the lower limit of the second class, for there is a great concentration of mills at exactly 50 barrels of rated capacity.

The tendency of rated capacity of mills to concentrate on certain figures is worthy of passing notice in connection with Table 3. The more important points of concentration and the corresponding numbers of mills were as follows in 1935:

Capacity	No.	Capacity	No.
25	462	200	93
50	729	500	59
100	256	600	33
125	86	1,000	22
150	87	1,200	20

TABLE 3.—NUMBERS OF ACTIVE FLOUR MILLS BY CAPACITY GROUPS, 1931 AND 1935*

Capacity group[a]	1931	1935	Capacity group[a]	1931	1935
Under 1,000	3,926	3,192	Under 100	2,804	2,274
1,000–	124	104	100–	600	485
2,000–	36	37	200–	182	161
3,000–	18	19	300–	102	75
4,000–	7	4	400–	58	40
5,000–	4	5	500–	66	63
6,000–	4	3	600–	58	46
7,000–	1	1	700–	33	20
8,000–	–	1	800–	17	22
9,000–	–	–	900–	6	6
10,000–	2	1			
11,000–	–	–	Total under		
12,000–	–	–	1,000	3,926	3,192
13,000–	–	–			
14,000–	1	–			
15,000–	–	2	Under 50	1,263	982
16,000–	–	–	50–	1,541	1,292
17,000–	–	–	100–	463	380
18,000–	–	–	150–	137	105
19,000–	–	–	200–	108	100
20,000–	1	1	250–	74	61
21,000–	–	–	300–	72	50
22,000–	1	–	350–	30	25
23,000–	1	–			
			Total under		
Total	4,126	3,370	400	3,688	2,995

* Compiled from lists of mills published by the *Northwestern Miller*, which, though not fully complete, indicate well the relative numbers in different capacity groups. A mill is counted active for the purpose of this table unless it is on record as having been idle for a considerable period and is so indicated in the list.

[a] Capacity in barrels of flour per 24 hours operation. For each group only the lower limit is stated.

TRENDS IN PRODUCTION BY MILLS OF DIFFERENT SIZES

The relative importance of mills of different sizes is reflected better by their aggregate production than by their numbers. In some respects, however, trends in the milling industry, as affected by flour demand, wheat production, and advantages in business competition, are most clearly reflected in the statistics of numbers of mills. Census statistics, for the most part, show only numbers of mills in the several size groups, but we have found it possible to supplement the census statistics by trustworthy estimates of production by output groups.

Total flour production in the United States rose, with only minor interruptions that do not show in statistics for census years, to a record peak in 1919.[1] The production in 1919 was abnormally large, owing partly to building up of flour stocks during the year by dealers, bakers, and consumers. During this period of expansion the production of large mills, producing 100,000 barrels or more annually, increased rapidly, while the production of smaller mills steadily declined. The available census statistics and our estimates by size groups are given in Table 4 (p. 281) and shown graphically in Chart 1 (p. 282).

Between 1919 and 1921 there was a sharp decline in flour production by mills in all size groups, but during 1921–1929 trends of production in the several size groups were similar to pre-war trends.

Since 1929 total flour production has again declined sharply, and in this decline the large mills have suffered more severely than others. Even in 1935 the proportion of total production accounted for by the large mills was still only about 80 per cent, as it was in 1929. In the previous six-year period the proportion had risen nearly 7 points from 73.1 per cent to 80.0 per cent in continuation of an increase that received its first interruption after 1929.

Between 1929 and 1931 the large mills lost in proportion of business to mills of intermediate size. The gain in proportion of total production by the intermediate mills in 1931 reflected chiefly recovery from an abnormal situation in 1929. Supplies of wheat for milling in 1929 were scarce in much of the soft red winter-wheat region, where a large proportion of the mills normally producing 20–100 thousand barrels are located. In consequence the output of mills of this size was curtailed in that year, to the advantage especially of large mills in other regions.

This fortuitous advantage accruing to the large mills in 1929 was lacking in the later years, but its loss does not explain why their production failed to rise above 80 per cent of the total by 1933 at least. Since 1929 the large mills have lacked the general compet-

[1] Estimates of annual total flour production by crop years, 1879–80 to 1926–27 were given in WHEAT STUDIES, December 1927, IV, 101. Revised estimates by crop years prepared on the basis of the new information here presented would differ from earlier estimates by as much as half a million barrels in only a few years.

itive advantage which during earlier years won them a steady and rapid gain in proportion of the total business. Since 1929 the relative advantage has lain with the small and very small mills. Their total production declined, as did that of all other size groups; but in proportion of the total production they about held their own or gained slightly, in contrast with their steady loss of ground during earlier years. Whether mills of intermediate size have been affected peculiarly by developments since 1929, apart from the special factor of local supplies of wheat, is not clear.

Since 1929 there has been an extraordinary revival of custom milling, as a measure of economy stimulated by the depression and, during the latter half of 1933 and subsequently, as a means of obtaining flour without payment of the processing tax. This increased custom business has come to large country mills as well as to the small ones. To the larger country mills it has represented little beyond a minor shift in channels of disposition of flour. But to the mills with output averaging less than 20 thousand barrels annually, and largely dependent for business on local flour sales and custom grinding, this revival in custom business has been a factor of the first importance.

According to our estimates, the combined flour production of all small and very small mills (those producing less than 20 thousand barrels each) declined from 14.4 per cent of the national total in 1919 to 7.9 per cent in 1929, or at an average rate of 1.3 points in each biennium. In the next two years their proportion of the total declined only slightly, in 1933 it rose above the 1929 proportion, and in 1935 was still nearly equal to that of 1929.

In much recent discussion, privately and in the trade press, it has been held that the revival of custom milling has resulted in an absolute increase in the flour production of small and very small mills. The reasoning on which this conclusion is based appears to us to give inadequate weight to three important facts: (1) the tendency toward the decline in numbers and production of small and very small mills has been so strong that a very important change was required even to check the decline in percentage of total output accounted for by these mills; (2) much of the increased volume of custom milling has been done by

TABLE 4.—PRODUCTION OF WHEAT FLOUR BY ALL MILLS, AND DIVISION AMONG SIZE GROUPS, CENSUS YEARS, 1899–1935*

(Thousand barrels and percentages)

Census year	Production[a]						Percentage				
	All mills	Large (100 or more)	Intermediate (20–100)	Small (5–20)	Very small		Large (100 or more)	Intermediate (20–100)	Small (5–20)	Very small	
					(1–5)	(Under 1)				(1–5)	(Under 1)
1899.....	103,524	*41,592*	*25,086*	*23,886*	*11,275*	*1,685*	40.2	24.2	23.1	10.9	1.6
1904.....	*105,902*	*49,047*	*25,688*	*19,744*	*9,723*	*1,700*	46.3	24.3	18.6	9.2	1.6
1909.....	107,108	*57,457*	*23,650*	*16,204*	*8,084*	*1,713*	53.6	22.1	15.1	7.6	1.6
1914.....	*117,461*	71,809	*24,164*	*12,944*	*6,891*	*1,653*	61.1	20.6	11.0	5.9	1.4
1919.....	*134,321*[b]	90,830	*23,451*	*11,139*	*6,467*	*1,784*	67.6	17.5	8.3	4.8	1.3
1921.....	*112,493*[b]	76,919	*19,589*	*8,742*	*5,076*	*1,517*	68.4	17.4	7.7	4.5	1.3
1923.....	*116,267*[b]	84,976	*17,776*	*7,229*	*4,324*	*1,312*	73.1	15.3	6.2	3.7	1.1
1925.....	*115,935*[b]	86,806	*17,333*	*6,270*	*3,680*	*1,183*	74.9	14.9	5.4	3.2	1.0
1927.....	*119,179*[b]	91,471	*16,765*	*6,035*	*3,335*	*1,113*	76.8	14.1	5.0	2.8	0.9
1929.....	*122,095*	97,706[c]	14,783[c]	5,577[c]	*2,967*	*1,062*	80.0	12.1	4.6	2.4	0.9
1931.....	*114,870*	90,708[c]	15,319[c]	5,062[c]	*2,761*	*1,020*	79.0	13.3	4.4	2.4	0.9
1933.....	*102,593*	81,096[c]	13,243[c]	*4,700*	*2,576*	*978*	79.0	12.9	4.6	2.5	1.0
1935.....	*101,300*	*80,900*	*12,700*	*4,360*	*2,400*	*940*	79.9	12.5	4.3	2.4	0.9

* Production from Appendix Table I except for 1935 estimates, which are from tabulation on p. 301.

[a] Production figures in Roman type are census statistics; those in *italics* are partly or wholly estimated.

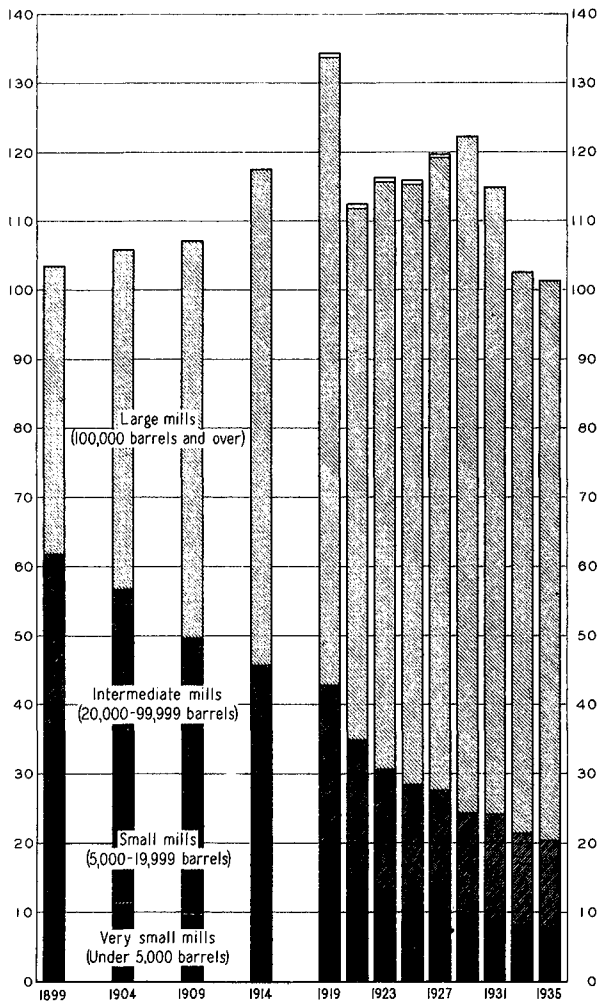
[b] Includes production by establishments classified elsewhere than in the "Flour and other grain-mill products" industry (which cannot be segregated by size groups), as follows, in thousand barrels: 1919, 1921, and 1923—650; 1925—663; 1927—460.

[c] From special tabulation prepared by the Bureau of the Census (Appendix Table V).

mills producing over 20 thousand barrels annually; and (3) in the regions where small and very small mills are most numerous, wheat

CHART 1.—FLOUR PRODUCTION IN THE UNITED STATES, BY CLASSES OF MILLS, CENSUS YEARS 1899–1935*

(Million barrels)



* Data from Table 1. The total length of each bar represents total production, while the shading shows portions of the total accounted for by mills in the four main output classes. The small unshaded portions at the top of five bars represent production which cannot be classified by size groups.

growers have always obtained their flour in exchange for wheat to such a large extent that imposition of the processing tax did not greatly increase the amount of custom milling in those regions.

The foregoing assertions regarding the percentage of total flour production provided by the small and very small mills since 1929 are no more reliably founded than the estimates of flour production on which they are based. We present these estimates with confidence in their substantial accuracy, but it should be noted that the direct statistical information on changes from 1931 to 1935 in total flour production by all of the groups of mills producing less than 20 thousand barrels a year is precisely nil. The census statistics of production since 1931 cover only a fraction of the mills producing less than 20 thousand barrels each, and provide only such a rough basis for judging what fraction of the total production may have been omitted that we have resorted to other bases of estimation.

The Bureau of the Census is undertaking for 1935 to obtain full coverage of production of all mills with a value of products of $5,000 or more, and may therefore be expected to include all mills producing as much as 1,000 barrels of flour, unless some are omitted on the ground of doing wholly a custom business. When the statistics of the 1935 census become available they should provide a basis for fairly close appraisal of the precision with which we have estimated the 1933 and 1935 production of small mills.

TRENDS IN NUMBERS OF MILLS BY SIZE GROUPS

Although the total production of mills in the several size groups is greatest for the large mills and least for the very small mills, the numbers of mills represented in the groups stand in the opposite relation. Since 1899 the number of mills in each size group, except that of the large mills, has been decreasing progressively, and decreasing at a relatively more rapid rate since 1919 than during earlier years. The number of mills producing 100 thousand barrels and over, on the other hand, showed a marked increase in each successive census year until it suffered a sharp set-back in 1921. From that level a steady but slower rise was resumed until 1929, since when the number has declined. There is a similarity between changes in total flour production and changes in number of mills producing 100 thousand

barrels and more such as does not exist between total production and number of mills in any other size group.

The numbers of mills in each size group are given in Table 5 and shown graphically in Chart 2, p. 284. The data for the three groups of mills producing 5 thousand barrels and over are all census statistics with the exception of that for number of mills producing 1909, 1919, or 1931. For 1935 no complete statistics are as yet available for the number of mills in any size group and we attempt no estimates.

The character of the changes in numbers of mills in the several size groups is most clearly revealed in a chart on a logarithmic vertical scale, as used for Chart 2. On such a chart the slope of a line reflects relative rate of change

TABLE 5.—NUMBERS OF MILLS BY SIZE GROUPS, AND RATIOS BETWEEN NUMBERS IN ADJACENT GROUPS, CENSUS YEARS 1899–1931*

Year	Numbers of mills						Numbers of mills per 100 in next higher output class			
	Under 1,000	1,000–4,999	5,000–19,999	20,000–99,999	100,000 and over	Total	Under 1,000	1,000–4,999	5,000–19,999	20,000–99,999
1899.....	5,525[a]	4,310	2,584	634	135	13,188	128	167	408	470
1904.....	5,150	3,843	2,123	622	166	11,904	134	181	341	375
1909.....	4,720	3,313	1,733	550	193	10,509	142	191	315	285
1914.....	4,420	2,996	1,377	540	218	9,551	148	218	255	248
1919.....	4,330	2,900	1,185	494	274	9,183	149	245	240	180
1921.....	3,700	2,256	930	420	239	7,545	164	243	221	176
1923.....	3,200	1,880	769	386	247	6,482	170	244	199	156
1925.....	2,850	1,600	667	351	247	5,715	178	240	190	142
1927.....	2,650	1,450	642	352	255	5,349	183	226	182	138
1929.....	2,500	1,290	592	288	267	4,937	194	218	206	108
1931.....	2,400	1,200	544	299	251	4,694	200	221	182	119
1933.....	2,300	1,120	500	261	228	4,409	205	224	192	114

* Numbers from Appendix Table I.

[a] This number, from the census of 1899, was divided as follows: mills producing under 100 barrels, 1,655; 100–499 barrels, 2,554; 500–999 barrels, 1,316.

5–20 thousand barrels in 1933, which it has been necessary to estimate. The figures for numbers of mills producing 1–5 thousand barrels include estimates for mills omitted from the census tabulations in all but two census years. The estimates for the mills thus added are in the main sums of estimates made separately by states for each census year and may be regarded as highly reliable. The figures for numbers of mills producing under 1,000 barrels are wholly estimates except for 1899. Independent estimates of the numbers of such mills were made by states for 1909, 1919, and 1931, on information permitting estimates not likely to be in error by more than 5 or 10 per cent as regards the national totals. For intervening census years the estimates of total numbers of mills producing under 1,000 barrels are made on the basis of estimated changes from the census figures for 1899 or from the estimated figures for

rather than absolute rate of change. Thus the curve for the number of mills producing 5–20 thousand barrels per year declines more steeply from 1899 to 1919 than the curve for the number of mills producing 1–5 thousand barrels, reflecting the fact that the decline amounted to 53 per cent as compared with a decline of 34 per cent for mills producing 1–5 thousand barrels. Similarly, the fact that the general slope of the curve of number of mills producing 5–20 thousand was about the same for 1923–1933 as for 1899–1909 indicates that the percentage rate of decline in number of mills in this size group was about the same in the last ten years covered by the chart as in the first ten, although the number of mills that dropped out of the group in the last ten years was only about 269 as compared with a decrease of 851 in the first ten years.

The rough correspondence between changes

in number of mills producing 100 thousand barrels and over and changes in total flour production has already been remarked. This arises in part from the fact that a considerable number of mills (about 50 in recent years) normally produce within 5–10 per cent of an even 100 thousand barrels annually. Conditions of flour demand determine whether a large proportion of these mills will fall within the group producing 100 thousand barrels and over or below it; and with the total number of mills usually in the group only about 250 or less, such shifts conspicuously affect the total number of mills in the group.

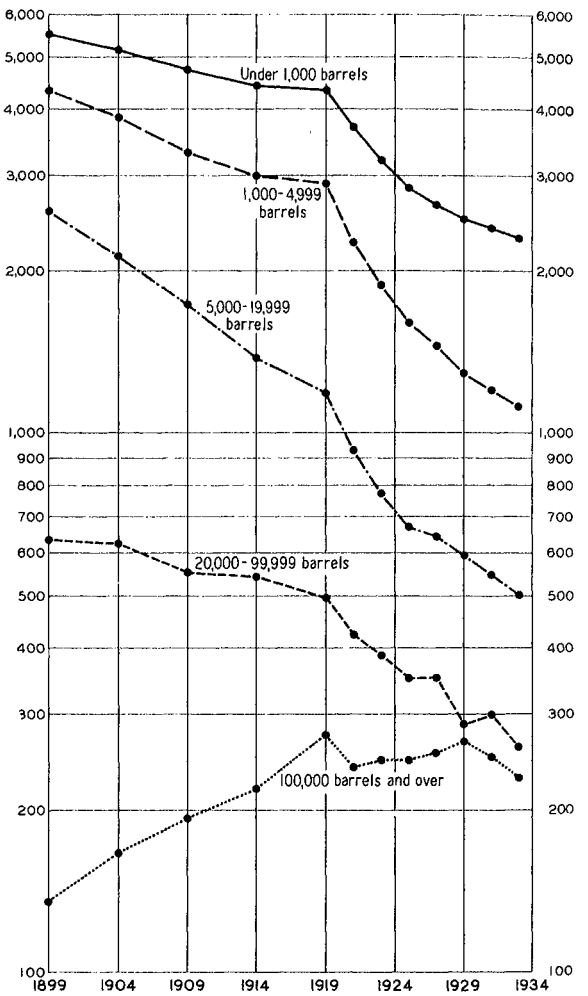
Fluctuations in flour demand do not markedly affect the numbers of mills in other output classes, for a variety of reasons. The market supplied by the smaller mills is somewhat more stable; in general the numbers of mills near the borders of each of the other classes is not so large relative to the total number in the class; and for the lower classes changes in demand that cause mills to shift into the class across one border cause other mills to shift out across the other border.

Relative Numbers of Mills by Size Groups

The proportions of the total number of mills falling in different size classes are of very little interest. The changes in relative numbers which are most significant are those which involve only comparison of the numbers of mills in one size group with numbers in the adjacent size group. These relations are shown in the figures of the last four columns of Table 5 (p. 283) and are represented graphically in Chart 3 (p. 285). The character of the changes is again most clearly revealed by use of a logarithmic vertical scale for the chart.

One of the most striking features of Chart 3 is the uniformity in the rate of decline in the number of mills of intermediate size (producing 20–100 thousand barrels) per 100 large mills (producing 100 thousand barrels or more), as shown in Section D. In 1899 there were 47 mills of intermediate size for each 10 large mills—a ratio of 470 intermediate mills per 100 large mills. By 1919 this ratio had declined to 180 per 100 large mills. The change in the ratio, however, resulted more from an increase in the number of large mills than from decrease in the number of mills of intermediate size. Since 1921 the rise in the number of large mills has been slower, and the number of intermediate mills has fallen at a more rapid rate than in earlier years, with the result that the number of intermediate mills per 100 large mills has declined at the same

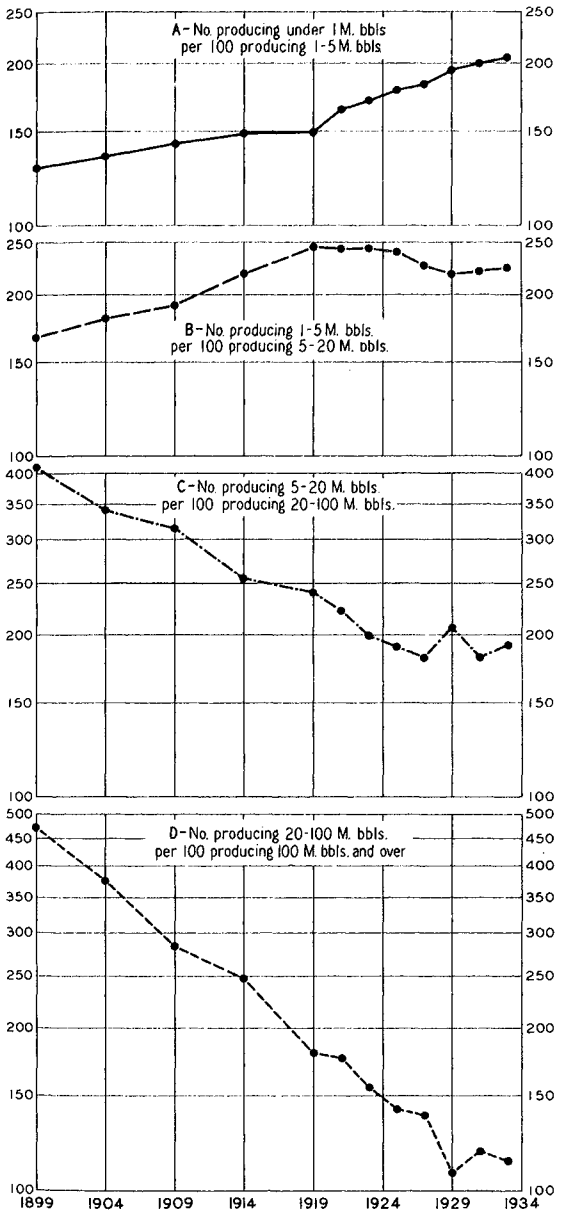
Chart 2.—Numbers of Flour Mills in Five Principal Output Classes, Census Years 1899–1933*



* Data from Appendix Table I. A logarithmic vertical scale is here employed in order to show *percentage changes* in numbers in correct proportion despite the wide range in magnitude of the numbers. Flour production by each size group has changed in roughly the same proportion as the number of mills, because changes in average output per mill within any one size group have been small relative to the changes in numbers.

relative rate as in earlier years. It appears, therefore, that the competitive disadvantage of mills of intermediate size has remained about the same, as regards its effect on relative numbers of mills, since 1919 as in earlier years.

CHART 3.—RELATIVE NUMBERS OF MILLS IN ADJACENT SIZE GROUPS, CENSUS YEARS 1899–1933*



* Data from Table 4. These relative numbers reflect the effects of comparative advantage and disadvantage in competition more clearly than the absolute numbers.

The sharp dip at 1929 in the curve of number of mills producing 20–100 thousand barrels per 100 large mills reflects the effect of shortage of wheat supplies in much of the soft red winter-wheat region which was noted in the comment on proportions of flour production obtained by the different size groups.

The number of small mills (5–20 thousand barrels) per 100 mills of intermediate size declined steadily and rapidly from 1899 to 1927 (Chart 3, Section C). The sharp rise in relative number in 1929 reflects not an interruption of the decline in the number of small mills, but the abnormal drop in the denominator of the ratio—the number of mills producing 20–100 thousand barrels in that year. In 1931 and 1933 the number of small mills per 100 mills of intermediate size remained conspicuously above the number that might have been expected from the previous trend. This reflects the effect of a definite advantage gained by the small mills from the revival of custom milling.

The number of mills producing 1–5 thousand barrels per 100 mills in the next larger size group rose from 1899 to 1919 (Chart 3, Section B). These "very small" mills, though declining rapidly in total number, did not suffer so severely as "small" mills from the competition of mills producing 100 thousand barrels or more. Since 1919, however, the number of mills producing 1–5 thousand barrels appears to have remained constant or declined relative to the number in the next larger size group, except during 1929–1933. The evidence that the changes since 1919 in the number of mills producing 1–5 thousand barrels have been as here shown is not wholly satisfactory. This question is discussed in some detail below (pp. 296–97). The critical question involved is whether the census of 1929 obtained substantially complete coverage of merchant mills of this size. All other censuses since that of 1921 appear to have omitted considerable numbers of mills in this size group.

Mills producing under 1,000 barrels each in 1899 numbered 128 per 100 mills producing 1–5 thousand barrels (Chart 3, Section A). This ratio increased slowly until in 1919 there were 149 mills producing less than 1,000 bar-

rels for each 100 mills in the next higher output class. Since 1919 the ratio has changed more rapidly, reflecting the fact that the rate of decline in absolute number of mills producing under 1,000 barrels annually was not accelerated as much as the rate of decline in number of mills producing 1–5 thousand barrels of flour.

Average Output per Mill, by Size Groups

Average production per mill within each output class varies little from year to year. This is partly a consequence of the fact that a change in flour demand, tending, for example, to decrease the production of all mills, results in shifting some mills out of the class at its lower border and bringing other mills in from the next higher class, if any. In other words, stability of average output in the class is maintained partly because the identity of the included mills is not maintained.

During the course of over 30 years, however, marked increases have gradually taken place in the average output per mill in three of the size groups. In a fourth group—that of mills with a product of 1–5 thousand barrels—the average output per mill decreased more than 10 per cent between 1899 and 1919 and has since increased by a trifling amount. And in another group—mills producing 5–20 thousand barrels—there has been no significant change in average output per mill since 1899.[1]

The largest percentage increase in average output per mill has developed in the group producing under 1,000 barrels annually. Among those mills the average output rose 35 per cent in 20 years, from 305 barrels per mill in 1899 to 412 barrels in 1919. The increase may have resulted in part merely from exclusion from the statistics of many mills producing under 100 barrels each, for no census after that of 1899 canvassed establishments with a value of products under $500. In 1899 the census recorded 1,655 mills reporting some wheat flour, but less than 100 barrels each. It is probable, however, that after 1899 there was a rapid decline in the number of mills producing less than 100 barrels annually. As the millstones of an earlier era wore out they were not replaced by more modern equipment unless a fair volume of business could be obtained.

The more important changes in average production per mill have been in the two groups of mills designated as intermediate and large. For mills producing 20–100 thousand barrels, there was a fairly steady increase in average production per mill amounting to 28 per cent between 1899 and 1929. The averages, in thousand barrels, are tabulated below, together with those for mills producing 100 thousand barrels or more.

Census Year	Mills producing 20–100	Mills producing 100 or more	Census Year	Mills producing 20–100	Mills producing 100 or more
1899	40	308	1923	46	344
1904	41	295	1925	49	351
1909	43	298	1927	48	359
1914	45	329	1929	51	366
1919	47	331	1931	51	361
1921	47	322	1933	51	356

The general upward tendency of production per mill in the group producing 20–100 thousand barrels has been a consequence of rapid decline in numbers of mills producing at the lower levels within the range, coupled with comparative stability in numbers of mills producing at the higher output levels. Between 1899 and 1919, indeed, there was probably an increase in the number of mills producing 80–100 thousand barrels. Mills of this size share many of the competitive advantages enjoyed by large mills. Mills producing only 20–40 thousand barrels, on the other hand, have suffered much the same competitive disadvantage as the small mills producing under 20 thousand barrels annually and, like them, have declined rapidly in number.

Among mills producing 100 thousand barrels or more, the tendency of average production per mill was downward for some years after 1899. This period was one of rapid introduction of the large mill at points close to the source of wheat supplies. The small cities of the wheat-growing regions did not afford wheat supplies sufficient for extremely large milling units, yet offered favorable opportunities for mills large enough to obtain high operating efficiency and low cost. With the expansion of wheat-growing in Kansas and

[1] Our estimates for all output classes in each census year appear in Appendix Table I.

Oklahoma, in particular, mills of this size occupied the field to such an extent that conspicuous development of very large milling units in the Southwest was postponed until after about 1915.

Although the rapid increase from 1899 to 1909 in the number of mills producing only 100–200 thousand barrels held down the average output per mill for the group of large mills as a whole, there continued in most milling centers a tendency for the larger units to increase in size. Since 1909 the number of mills producing 100–200 thousand barrels has increased much less rapidly and the expansion in size of the larger units in the industry has been more clearly reflected in the averages for all mills producing 100 thousand barrels or more. Between 1909 and 1929 the average output per mill for all mills producing 100 thousand barrels or more increased 23 per cent.

An important factor in the recent increase in average output per mill in the group producing 100 thousand barrels or more has been the establishment of very large mills in Buffalo and in Kansas City. Dominated by the output of two huge milling units in Buffalo, the average for all New York mills producing 100 thousand barrels or more rose in 1929 to 1 million barrels per mill. The following tabulation shows for selected states, in which the large mills are chiefly concentrated, the trend of the average output per mill, for the group producing 100 thousand barrels or more. The figures, in thousand barrels, are census statistics except those for 1899, which are our estimates.

State	1899	1914	1919	1929
New York	232	548	644	1,000
Minnesota	774	728	673	578
Missouri	118	184	213	636
Illinois	207	316	308	375
Kansas	156	199	241	309
Texas	177	200	224	255
Washington	214	303	343	461

Geographical Features of Flour Production

Emphasis on the spectacular and obvious, with easy reliance on broad national totals in the statistics, tends to obscure the fact that the large mill is by no means dominant in the industry in all sections of the country, nor everywhere crowding out the smaller mills. There are even sections of the country in which hundreds of very small mills, producing less than 5,000 barrels a year each, continue to thrive, and account for a large volume of flour production.

In the Appalachian region and eastward, from Pennsylvania to South Carolina, is a group of seven states in which is produced one-fourth as much flour as in the five states of the great spring-wheat region. In no one of the states does the production of large mills account for much over one-fourth of the flour output of the state, and for the group as a whole the large mills provided in 1931 only 21 per cent of the total production. Nearly as large a fraction of the total (20 per cent) was provided by the very small mills, producing less than 5,000 barrels each. In this region the proportion of the total output accounted for by the very small mills has been decreasing since 1899, though in Pennsylvania and Maryland since 1919 it has decreased only slightly; and the proportion of the total output accounted for by small and intermediate mills had increased.

In the states of the Rocky Mountain region the very small mill has never been an important element in the industry, but here, as in the Southeast, the small and intermediate mills continue to account for a large proportion of the total flour output. Throughout the winter-wheat region west of the Appalachians, also, the small and intermediate mills still constitute an important factor in the industry; and in Kentucky and Tennessee, Indiana, Michigan, and Oklahoma, their proportion of the total has not greatly diminished since 1919.

These and other features of the geographical distribution of flour production by classes of mills appear from the estimates of production by states and by size groups presented in Appendix Table III, and the corresponding percentages in Table IV. The broad facts of geographical distribution of production by size groups, and changes in this distribution since 1899, are most readily gained from the maps on pp. 292–93.

Map 4, showing the location of mills on record with the Code Authority of the Flour Milling Industry as of April 1, 1935, omits a large proportion of the mills of the country, especially among the very small mills, yet serves well to indicate regional distribution within states as well as between sections of the country. The other maps are designed to show both absolute flour production by states and by size groups of mills within the states, and proportions of production by mills in the three size groups used for these maps and the corresponding appendix tables. The areas of the circles and of their several segments represent total production for the state and for each of the size groups of mills within the state. The angular width of the segments reflects the proportional distribution of production among size groups.

The data for these tables and maps are chiefly our estimates, and for 1931 the estimates for very small mills are in some cases rather rough approximations, for no census since that of 1921 has included even one-half of the very small mills. Fortunately, however, the census of 1929 appears to have obtained good coverage of mills producing 1–5 thousand barrels, and these in most states account for two-thirds or more of the production of the very small mills. A combination of evidence permits estimates by states of aggregate production by all very small mills which even for 1931 may be regarded as probably very close to the facts except in a few states. Census data afford no satisfactory basis for analysis of the distribution of flour production by size groups and by states for any year since 1931.

In these tables and maps the production of mills of small and intermediate size is combined because in a number of states data are lacking for satisfactory estimates of production by the two size groups separately; and because addition of another size class in the maps would tend to decrease their effectiveness. Trends in the relative importance of mills of small and intermediate size in individual states may be judged from relative changes in the numbers of mills in each class, as recorded in Appendix Table II.

III. SPECIAL PROBLEMS IN MILLING STATISTICS

Proper interpretation of census statistics of flour production requires attention to certain technical aspects of the statistics which are not well understood. The more important of these are discussed in the following paragraphs under an arrangement that gives first attention to subjects likely to be of most general interest. There is included a discussion of the valuable special tabulation prepared by the Bureau of the Census and presented in Appendix Table V. The section closes with some general observations suggested by problems treated in this section and elsewhere in the present study.

Production by Custom Mills

The category of "custom mills" has occasioned some confusion owing to difference of understanding of what constitutes a custom mill. In the *Census of Manufactures* the term has been defined uniformly as applying to establishments doing wholly a custom business. Custom mills have been placed in a separate category for census purposes primarily to mark them off for exclusion from the canvass, or for less detailed presentation of the data obtained when they were canvassed. For the purpose in view, the census definition has the merits of ready application and of narrow limitation of the category. In using the census statistics, however, it is necessary to bear in mind that large numbers of mills doing primarily a custom business would not be classed as custom mills under the census definition.[1]

In the census of 1899 production statistics

[1] The first specific statement of the distinction which we find in reports of the *Census of Manufactures* appears in connection with the statistics for 1909 (p. 405). It is there stated: "Mills reporting the purchase of any part of the grain which they grind are classified as merchant mills, even though a large part of their business may consist in custom grinding. Custom mills, on the other hand, are those engaged exclusively in custom grinding, whether for toll or for a stipulated charge, including those where grain already ground is sometimes given in exchange for the grain to be ground."

for custom mills were tabulated in the same way as statistics for other mills, but in subsequent censuses data for custom mills have either been omitted entirely or tabulated in much less detail than data for other mills. In consequence the only statistics of custom milling of wheat flour directly shown in the census reports are the total quantities of wheat flour reported by all custom mills of the United States in 1909 and 1919. Statistics of wheat flour production by custom mills are not shown by states.

Although the census of 1899 does not segregate the product of custom mills in the published statistics, the census of 1904 contains a retabulation of the data for 1899, by states, in which the production of custom mills is omitted. The original tables for 1899 and the retabulation in the report for 1904 together provide a basis for computing for 1899 both numbers and production of custom flour mills, by states. We thus compute the following data for numbers and production of custom mills reporting wheat flour in 1899, for the United States and selected states.

State	Number	Production (*barrels*) Total	Per Mill
United States	5,746	3,760,317[a]	654
New York	296	327,409	1,106
Pennsylvania	744	324,334	436
Maryland	116	73,468	633
Virginia	608	250,017	411
North Carolina	773	351,144	454
Georgia	375	193,171	515
Tennessee	386	173,945	451
Kentucky	143	22,248	156
Ohio	251	253,131	1,008
Indiana	162	85,084	525
Illinois	137	145,608	1,063
Missouri	232	222,478	959
Iowa	115	229,466	1,995
Wisconsin	103	111,555[a]	1,083
Minnesota	50	63,332	1,267
Kansas	64	25,487	398

[a] The figures published in the 1899 census report contain an error of 1 million barrels in the flour production for Wisconsin, which is carried into the total. In the 1904 report this error was corrected and the corrected figures are here used. There is a small but indeterminable error also in the statistics for Michigan, which results in showing a small negative production for 162 custom mills in that state; and one may suspect that a discrepancy in statistics is accountable likewise for the low production per mill shown above for Kentucky.

Since 1919 virtually no mills doing wholly a custom business have produced as much as 1,000 barrels of flour per year, but in 1899 more than 1,000 custom mills exceeded that amount. The average production per mill, as shown in the tabulation above, is of particular interest in connection with the fact that the average output for all mills producing under 1,000 barrels of flour in 1899 was about 305 barrels per mill. It is apparent that in New York, Ohio, Illinois, and Missouri, and in Wisconsin, Iowa, and Minnesota, in particular, a considerable fraction of the purely custom mills must have obtained an output much in excess of 1,000 barrels each in order to result in such high averages for all custom mills in those states.

For the United States as a whole we estimate numbers and production of custom mills as shown in Table 6. The rapid decline in number of custom mills* producing less than 1,000 barrels annually suggests the explanation of the otherwise puzzling fact that census statistics show an increase between 1904 and 1919 of 60 per cent in numbers of merchant mills producing under 1,000 barrels (from 1,272 to 2,041). The census statistics, covering only merchant mills from 1904, show the effect of a strong tendency among custom mills during this period to resort to some merchant grinding.

TABLE 6.—NUMBERS AND PRODUCTION OF CUSTOM MILLS PRODUCING WHEAT FLOUR, CENSUS YEARS 1899–1919*

(*Production in thousand barrels*)

Year	Under 1,000 barrels		1,000 barrels or more		Total	
	Number	Production	Number	Production	Number	Production
1899.....	4,674	1,402	1,072	2,358	**5,746**	**3,760**
1904.....	3,878	1,241	341	648	4,219	1,889
1909.....	3,000	1,050	168	302	3,168	**1,352**
1914.....	2,599	936	76	122	2,675	1,057
1919.....	2,289	916	161	289	2,450	**1,205**

* Estimates of the Food Research Institute, except figures in bold face, which are census statistics (those for 1899 obtained as explained in the preceding column).

The decline in number of mills in the custom category between 1899 and 1904 appears partly attributable to some change in the basis of classification. The classification of the mills reporting in 1899 was made in preparation for

publication of the report of the 1904 census, long after the 1899 schedules had been received, while for subsequent censuses the classification was made in the course of collection of the current data.

We have prepared the estimates in Table 6 primarily to put into quantitative form the results of an analysis made chiefly to obtain a sound basis for estimating the production of custom mills in 1904 and 1914, when such mills were omitted from the census canvass, and to insure proper inclusion of the production of custom mills producing under 1,000 barrels each after 1919. We make no separate allowance in our estimates for any custom mills producing 1,000 barrels or more after 1919. The number of such mills had fallen to about 76 by 1914 and would doubtless have been negligible in 1919 except for the great stimulus to activity of very small mills resulting from expansion of wheat raising in Eastern states during the war and an extraordinary flour demand in 1919.

The estimates of numbers of custom mills in 1909 and 1919 as given in Table 6 are founded chiefly on estimates made separately by states. These estimates by states (not here reproduced) were based largely on calculations from total numbers of custom mills by states as reported in 1909 and 1919 (including those not producing wheat flour) and proportions of custom mills reporting wheat flour in 1899. Changes in numbers of other very small mills provided a useful subsidiary basis for the estimates. The segregation according to output is based on fairly reliable evidence on average production per mill in each of the two output groups used. The resulting estimates were further checked for consistency of the resulting trends in numbers with other information.

The estimates of numbers of custom mills in 1904 and 1914 are obtained by estimating the numbers of all mills producing under 1,000 barrels and 1–5 thousand barrels, respectively, and deducting the numbers of merchant mills included in those output groups in the census statistics. The numbers thus obtained, multiplied by estimated averages of output, yield the production estimates shown for 1904 and 1914 in Table 6.

Special Census Statistics, 1929–1933

A major contribution toward improving the data on flour production in recent years has been made by the Bureau of the Census through a retabulation of census statistics for 1929, 1931, and 1933 on a new plan. The data appear in Appendix Table V. These tabulations have three main features that are new: (1) They utilize so far as possible the statistics of flour production collected monthly rather than those reported in the biennial censuses of manufactures after the close of the year. The accuracy of the resulting totals is thus considerably improved. (2) They show production separately by mills in five main output classes, and include all flour mills, whether classed, for census purposes, in the "Flour and other grain-mill products" industry or elsewhere. (3) They give separately for each output class the production of mills reporting monthly and of mills not reporting monthly. The two sets of flour statistics collected by the Bureau of the Census are thus for the first time brought into clear and definite relationship and the basis for interpreting the monthly statistics is greatly improved.

A further advantage gained by the retabulation is that it provides statistics which may be accepted with reasonable assurance as covering specifically all reported production of flour by original grinding of grain. This has always been the objective of the compilation of flour production statistics by the Census of Manufactures, but difficulties raised by collection of separate statistics for "prepared flour" were unsatisfactorily handled in the compilations appearing in the published statistics of the *Census of Manufactures* for 1929, 1931, and 1933. The problems involved in this connection are discussed in the next section.

The retabulation of the census data yields for 1929 a total flour production slightly more than 1.1 million barrels larger than the total of the *Census of Manufactures;* and for 1931 the retabulation yields a total nearly 2 million barrels smaller than that of the *Census of Manufactures*. The corresponding totals for 1933 are not comparable because the retabulation includes data for a large number of mills which reported flour production monthly but

did not report detailed statistics of production in the census of manufactures.

An important source of difference between the flour production reported in the census of manufactures and the totals in the special tabulation lies in the fact that a number of mills reported fiscal-year production in the census of manufactures. The monthly reports were uniformly tabulated for calendar years. In transmitting the tables Mr. William L. Austin, Director of the Census, stated: "I am informed that most of the important differences between the amounts reported by identical mills in the monthly canvass and in the Biennial Census appear in the cases of those mills which reported for fiscal years in the Biennial Census." In flour production statistics to be used in calculating disposition of the flour it is important that all the statistics of production relate to the same period of time. On this ground alone the compilation based so far as possible on the monthly reports is clearly to be preferred.

We regard the data of the monthly reports as more trustworthy than the data reported by the census of manufactures on two further grounds also. Because the monthly reports are made currently and call for only a limited amount of information the mill employee filling out the report is less likely to make errors than when filling out the schedule of the census of manufactures. The character of the information called for in the monthly report, moreover, makes it clear that only the results of actual milling operations are to be covered; whereas the schedule of the census of manufactures calls for a "value of products" which is expected to include the results of blending operations as well as actual milling, and may be interpreted by implication to call for inclusion of flour "produced" by blending with purchased flour as part of the production to be reported.

Other differences between the data in Appendix Table V and previously published census statistics are explained in the notes to the table.

Statistics of Prepared Flour

The question whether "prepared flour" reported in biennial census statistics should all be included as part of the total wheat-flour production has occasioned much concern to critical students of the statistics of flour production. Quantities of prepared flour reported are shown below, in thousand barrels, with a segregation between quantities reported by establishments classed for census purposes in the "Flour and other grain-mill products" industry and quantities reported by establishments classified elsewhere.

Census year	Total	In the industry	Outside the industry
1925	3,439	2,529	910
1927	4,493	3,874	619
1929	5,012	2,684	2,328
1931	4,758	2,684	2,073
1933	4,552[a]	2,671[a]	1,881[a]

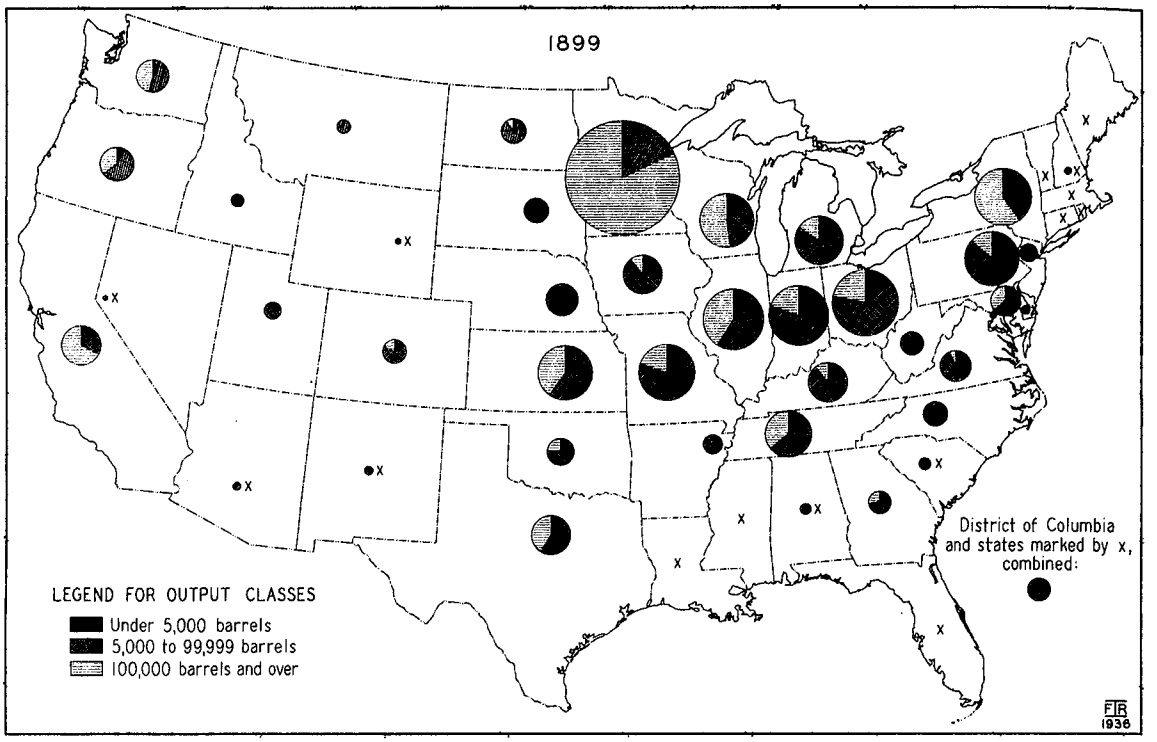
[a] Reported on "standard schedules," which, with minor exceptions, were obtained only from concerns reporting a value of products of $100,000 or more in either 1931 or 1933 or in both years.

"Prepared flour" is defined on census schedules as self-rising flour, and an impression has prevailed that the census statistics of prepared flour cover all self-rising flour. On inquiry from millers, however, we find that it is a common practice to report as prepared flour on census schedules only such self-rising flour as is packaged. Self-rising biscuit flour packed in bags is commonly reported with other wheat flour. Some millers, however, report all self-rising flour as prepared flour, as was the intent of the Bureau of the Census. In consequence of this diversity of practice in reporting, the meaning of the reported figures is uncertain.

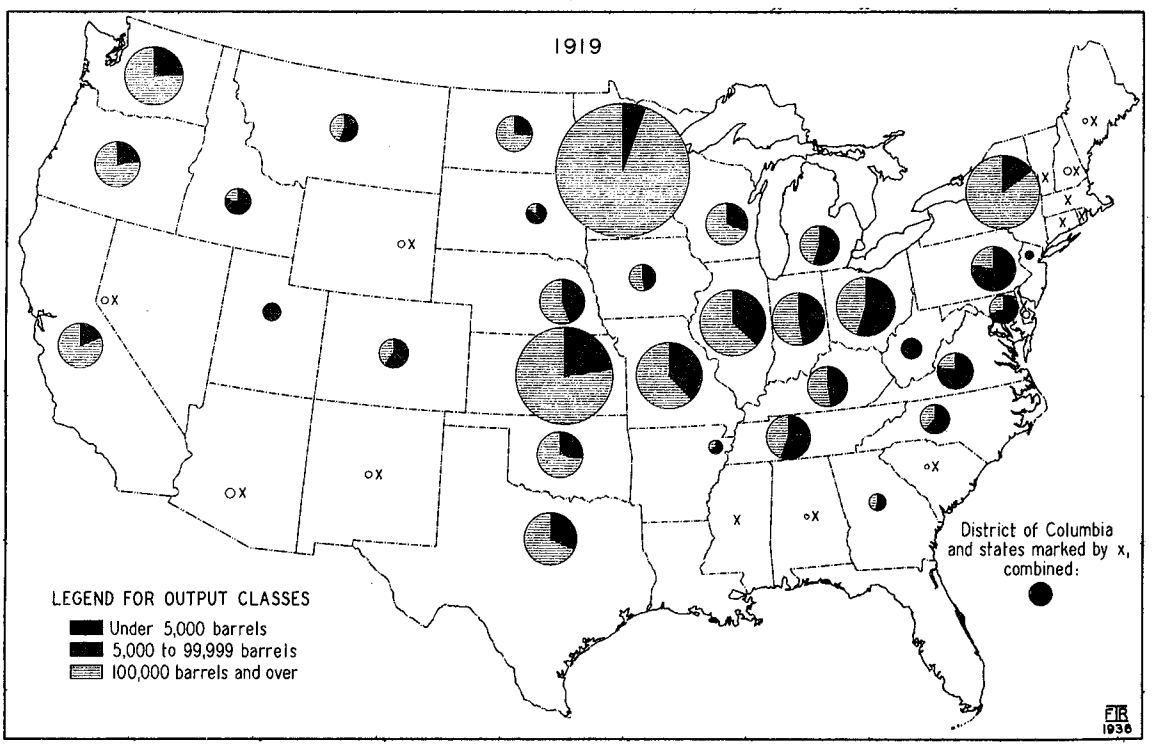
No doubt exists that in censuses prior to that of 1925 wheat flour milled in establishments reporting and used in production of prepared flour had been duly reported under the head of wheat flour. And it appears reasonably certain that very little if any flour has since been reported twice by the same mill—once as production of wheat flour, and again as an ingredient of the reported prepared flour. The change arising from the separate reporting of prepared flour is chiefly that occasion was thus made for the reporting of prepared flour "produced" merely by mixing other ingredients with purchased wheat flour.

With prepared flour being separately reported, it became necessary for the Bureau

MAP 1.—FLOUR PRODUCTION BY STATES, SUBDIVIDED BY OUTPUT CLASSES, 1899*

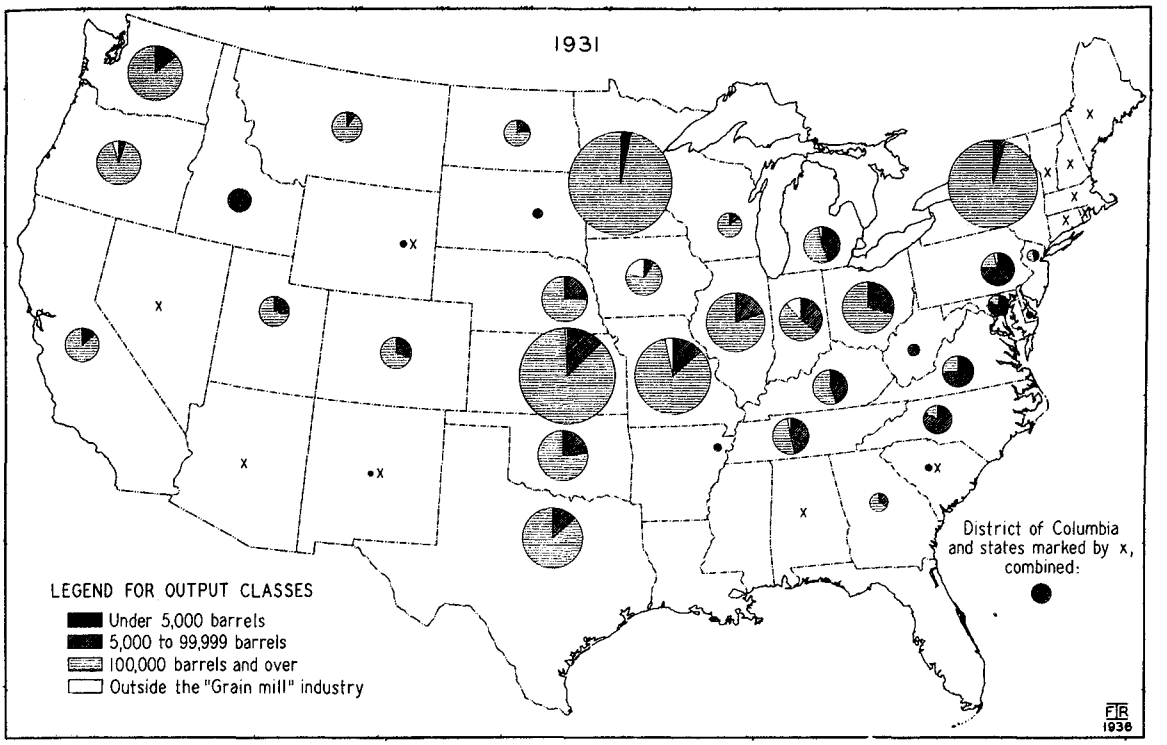


MAP 2.—FLOUR PRODUCTION BY STATES, SUBDIVIDED BY OUTPUT CLASSES, 1919*

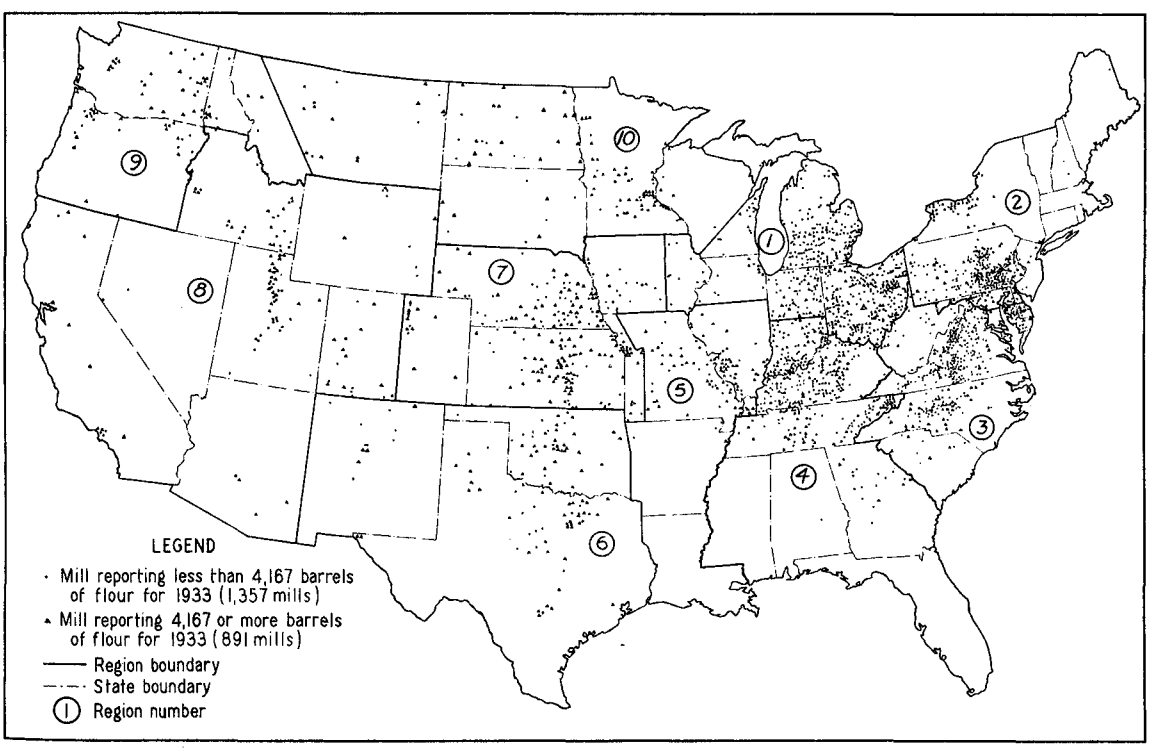


* Data for Maps 1–3 from Appendix Tables III and IV. Areas of the circles and of their segments are proportional to production.

MAP 3.—FLOUR PRODUCTION BY STATES, SUBDIVIDED BY OUTPUT CLASSES, 1931*



MAP 4.—MILLS OF RECORD WITH CODE AUTHORITY OF WHEAT FLOUR MILLING INDUSTRY, 1935†



† Location of 2,248 mills on record as of April 1. Reproduced by courtesy of the Millers' National Federation.

of the Census to determine what portion of the prepared flour production should be regarded as representing original milling of wheat flour, and should therefore be included in the total for wheat-flour production; and what portion of the prepared flour should be excluded from the general total on the ground that it was made from purchased flour, the production of which would have been included in the reports of the establishments in which it was originally milled. A subsidiary difficulty involved the fact that much prepared flour includes cereal ingredients other than wheat flour. The decision of the Bureau of the Census in connection with compilation of the 1925 data was to include with wheat flour all prepared flour reported by establishments classed in the "Flour and other grain-mill products" industry and to exclude from the wheat flour total all prepared flour reported by "outside" establishments.

The effect of the rule thus adopted was to appraise the quantity of purchased wheat flour and of other cereal ingredients, milled or purchased, in the prepared flour reported in 1925 at 910 thousand barrels (the production outside the industry as shown in the foregoing tabulation). No reason appears for supposing that the amounts of purchased wheat flour and of other cereal ingredients used in making prepared flour changed greatly in succeeding years. But owing chiefly to alterations in the classification of reporting establishments, the amount of prepared flour shown as produced by establishments classed for census purposes outside the flour-milling industry declined one-third to 619 thousand barrels in 1927, and then rose to 2,328 thousand barrels in 1929. The rule adopted in 1925, however, resulted in compiling the statistics of total flour production for subsequent years as though the amounts of purchased wheat flour and of other ingredients had in fact declined to 619 thousand barrels in 1927 and risen to 2,328 thousand barrels in 1929.

The application of this rule caused no concern to critical students of the flour-production statistics until the data for 1929 were published. It then appeared that if the amount of purchased wheat flour and of other cereal ingredients used in the prepared flour production of 1925 had indeed been 910 thousand barrels, it certainly could not be supposed to have increased above 1,300 thousand barrels in 1929, even allowing liberally for the fact that curtailed supplies of wheat in the soft red winter-wheat region in 1929 occasioned purchase of unusual amounts of flour for blending purposes by mills in that region. If so the application of the 1925 rule under the altered classification of establishments in 1929 must have resulted in omitting from the flour production total more than 1 million barrels of prepared flour that should have been included. Similar reasoning results in like conclusions with respect to the census statistics for 1931 and 1933.

The problems thus raised seem now satisfactorily solved through the compilation of flour-production statistics in the census special tabulation for 1929, 1931, and 1933 (pp. 290–91) and a special inquiry into the prepared flour statistics made in the Bureau of the Census during 1935. In preparing the special tabulation for 1929, 1931, and 1933 particular care was taken to include all wheat flour produced by original grinding of grain, and no flour produced from purchased flour. Attainment of this end was greatly simplified by use, for the bulk of the reported production, of the statistics obtained monthly, which are believed to apply strictly to flour produced by original grinding of grain.

The special inquiry into the statistics of prepared flour which was made in 1935 covering the prepared flour reported in 1933 showed that in the total of 4,552 thousand barrels reported there was included the equivalent of 971 thousand barrels of purchased wheat flour and of other cereal ingredients.[1] It may reasonably be supposed that in 1925 the amounts of purchased wheat flour and of other cereal ingredients used in the prepared flour reported for that year were not much under this figure and that the decision that had involved appraising the quantity at 910 thousand barrels gave a result about correct

[1] For this comparison we use the census figure for total production of prepared flour, which is calculated at 200 pounds per barrel (making a conservative allowance for non-cereal ingredients), but calculate purchased wheat flour and all other cereal ingredients (from Appendix Table VI) at 196 pounds per barrel.

for that year. Such error as may have been involved in allowing only 619 thousand barrels for the corresponding items in 1927 may reasonably be overlooked. We accordingly accept the original census statistics of total flour production for 1925 and 1927 as substantially unaffected by the separate reporting of prepared flour in those years.

Observations on Census Statistics

The Bureau of the Census strives to provide statistics of maximum accuracy and usefulness. Hence it is appropriate that users of the statistics should give consideration to possibilities of improvement which might be suggested to the Bureau. To people concerned with flour milling, the chief interest in census statistics for the industry pertains to the statistics of physical quantities of products and of materials used, and more particularly to quantities of the chief product, wheat flour. It is therefore pertinent in such a study as this to record observations regarding census procedure most directly related to the problems here considered.

Despite their defect of varying and more or less indeterminable completeness, the monthly and quarterly statistics of flour production and wheat utilization and of wheat and flour stocks are now regarded by many people connected with the milling industry as the most generally useful of census statistics collected for the industry. The value of these data would be considerably enhanced if these reports were required of all establishments producing at the rate of 1,500 barrels of flour in any one month. Such a requirement would assure completeness of the reports as regards mills producing in the two higher output classes: 20–100 thousand barrels, and 100 thousand barrels or more. The gain in usefulness of the reports would arise partly from the added volume of production represented, but more particularly from assurance against erratic fluctuations in completeness that now may result from withdrawal of one or two large mills. Such a requirement would affect only about 25 mills not now reporting and would greatly improve the usefulness of the reports now being made monthly by more than 1,000 mills.

The flour production data reported monthly could be interpreted more reliably in their relation to past statistics if the annual summaries of the reports included a tabulation by output classes. The class limits should of course coincide with those which have been used for the statistics of the census of manufactures, but perhaps with addition of another class.[1]

With respect to the biennial census statistics, two chief observations are indicated. One is that in compilation of the data the Bureau of the Census might well divorce the statistics of flour production and of wheat ground from the statistics that have to be kept on an industry classification. It is a matter of little interest to the users of flour production statistics whether the producing mills are classed for census purposes in one industry or in another. The Bureau has been moving in this direction since 1925, when it began collecting production data by establishments classed elsewhere than in the "Flour and other grain-mill products" industry. Completion of this transition would both simplify and improve the presentation of the statistics.

The very useful tabulation of numbers of mills by output classes would then be made to include all mills producing wheat flour whatever their industry classification. Addition of a table showing production by output groups, for at least the more important states, would add much to the usefulness of the statistics.

The second observation indicated is that statistics of flour production and wheat milled, even for biennial census years, should be based so far as possible on the data of the monthly reports, after the fashion of the census special tabulations presented herewith. These monthly reports are more dependable than

[1] When the classification was first established, in 1899, no one class included over 40 per cent of the total production. Now over 80 per cent of the total is accounted for by a single class, which might be subdivided to advantage. A logical lower limit for an additional class would be 500 thousand barrels. Some 70–80 mills now produce 500 thousand barrels or more. Probably production data for such a class would have to be given in a subsidiary tabulation, for in a number of states the production of these very large mills would have to be combined with that of smaller mills producing 100 thousand barrels or more, in order to avoid disclosing the operations of individual concerns.

the reports on biennial census schedules, because, being prepared currently, they are less subject to error on the part of the mill employee preparing the report; and they may be so compiled as to insure that they apply to a specified 12-month period.

IV. METHODS OF ESTIMATION EMPLOYED

The estimates here presented have involved in the main two separate problems in estimation. One is that of estimating total numbers of mills in categories incompletely covered in the census statistics; the other is that of estimating average production per mill in the several output classes. Only by combining these two separate attacks has it been found possible to obtain well-grounded estimates of production omitted in the census statistics.

For years prior to 1919 it is assumed that the only additions to be made to the census statistics of numbers of mills are for custom mills. For subsequent years many merchant mills producing under 5,000 barrels were omitted also, owing to limitation of the biennial censuses to concerns with a value of products of $5,000 or more. Concerns actually reporting a lower value of products were omitted from tabulations, and in some years considerable numbers of concerns with larger value of products were not canvassed.

Estimates of numbers of omitted mills producing 1–5 thousand barrels have been made by states and are included in the data given in Appendix Table II. A note is there appended to each figure which involves an estimate.

The estimates were made on the assumption that the census statistics of numbers of mills producing 1–5 thousand barrels were complete for 1899 and 1921, and at least substantially complete for 1929. The adequacy of census figures in intervening years was judged, and estimates made where necessary, on the basis of the fact that both numbers of mills and relative numbers in adjacent size classes have changed progressively in individual states much as they have for the United States as a whole, as shown in Charts 2 and 3, pp. 284, 285. Similar charts for an individual state show more irregularity in the trends because the numbers involved are much smaller, and the slopes of the trends differ greatly from state to state; but the tendency toward progressive change is marked in state totals as in national totals. Such charts, made for each state, provided the principal information on which the estimates were founded.

Census statistics of numbers of mills were replaced by estimates only where evidence of defect in the census data was strong. Records of wheat production by states were studied in connection with the charts of numbers of mills, and in many instances census figures that appeared out of line with those for other years were accepted on the ground that shortage of wheat supplies had caused mills to shut down. In the national totals such an effect shows clearly only in the numbers of mills producing 20–100 thousand barrels in 1929, but in individual states the effect of that shortage and others is strongly reflected in reduced numbers of smaller mills in operation.

For 1919 this method was not wholly satisfactory, for it gave no clue to the number of custom mills which produced 1,000 barrels or more merely because of the extraordinary flour demand of that year. The total number of custom mills producing 1,000 barrels or more was estimated in the analysis of production of custom mills (pp. 288–90), and distributed among states having numerous active custom mills.

Omissions of custom mills were found consistently in certain states. These were not generally the states where average production of custom mills in 1899 appeared conspicuously large (p. 289), because changes in the basis of classification transferred the exceptionally large "custom mills" of 1899 to the "merchant mill" category in subsequent census years. The omissions resulting after 1921 from imposition of the $5,000 lower limit did not occur consistently in the same states in successive years owing to the fact that they depended on the thoroughness of the canvass as well as on the character of the mills. In 1923 omissions occurred in nearly two-thirds of the states. In 1925 omissions were generally

larger than in 1923 and occurred in a few more states, but were avoided in some where there had been omissions in 1923. In 1927 omissions, where they ocurred, were commonly as large as or larger than in either of the two previous censuses, but the number of states in which there were omissions was considerably reduced.

The estimates of numbers of mills producing 1–5 thousand barrels each for 1923–1931 inclusive rest heavily on the supposition that the census of 1929 obtained substantially complete coverage of mills in this output group, despite the fact that other censuses beginning with that of 1923 did not. The mills in this group known to have been omitted in the other censuses were chiefly or wholly mills producing between 1 and 2 or 3 thousand barrels. A field force was employed in collection of the data for 1929, and it is the opinion of the Bureau of the Census that a substantially complete canvass was obtained of mills with a value of products of $5,000 or more. Since the value of flour and bran and middlings reported averaged $7.33 per barrel of flour in 1929, few if any mills producing as much as 1,000 barrels should have been omitted on the ground that their value of products fell below the minimum.

The view that the census of 1929 covered substantially all mills producing 1–5 thousand barrels is supported by the fact that the average production per mill for reporting mills in this output class, as revealed by the special tabulation of data for 1929, was 2,345 barrels. This is at least very close to the correct average for all mills producing 1–5 thousand barrels. If there had been serious omission of mills at the lower level of the output range the average would have been considerably higher. Such omission in the statistics for 1931 raised the average for reporting mills in this output class to 2,600 barrels in that year.

In 1929 we find evidence in a number of states of small omissions in the table of numbers of mills in the group producing 1–5 thousand barrels, but these appear to represent chiefly the effect of a reclassification of establishments canvassed, in which a number of small mills were classed for census purposes in the "Feeds, prepared, for animals and fowls" industry which previously had been classed in the "Flour and other grain-mill products" industry. Under the reclassification they were omitted from the tabulation of numbers of mills in the "Flour and other grain-mill products" industry, but their flour production was included in the general census total. In 1931 the number of omitted mills increased greatly in practically all states, partly at least because the low prices of flour and millfeed in that year (averaging, together, $4.55 per barrel of flour) brought the value of products of many mills producing not much over 1,000 barrels close to or even below $5,000, which has been the lower limit of value of product for establishments to be included in the biennial censuses of manufactures.

For national totals of numbers of mills producing 1–5 thousand barrels, 1923–1931, rounded figures have been used indicating 6–23 more mills than are represented in the state estimates, to allow for a tendency of the classification of small mills in the "Feeds, prepared, for animals and fowls" industry in 1929 to result in estimates slightly too low for that year and for other years also.

Numbers of mills producing under 1,000 barrels of flour have to be estimated for each census year since 1899. In a few states—notably Alabama, Mississippi, Arkansas, Texas, Oklahoma and Minnesota—the increase between 1899 and 1909 in numbers of reporting custom mills (whether reporting wheat flour or not) is so great as to suggest the census of 1899 may not have been wholly complete as regards mills producing only a few hundred barrels each. Such omissions, if they occurred, would have had no important effect on the total production recorded. For census years 1904–1919 the method of estimation of omitted mills producing under 1,000 barrels has been discussed above under the head of custom mills (p. 290). Further comment here concerns the estimates for census years 1921–1933.

For 1931 estimates of numbers of mills producing under 1,000 barrels were made by states. Large dependence was placed, for most states, on the numbers of mills included in lists of mills published annually by the *Northwestern Miller*. The list of 1934 is consider-

ably more complete in a number of states than earlier lists, and in such cases it was used, with allowance for a small percentage of mills having gone out of business between 1931 and 1934. Otherwise the list of 1932 was taken as reflecting most accurately the number of mills actually operating in 1931. Mills listed as idle were left out of account.

It is impossible to judge the production of very small mills from their capacity (which is recorded in the *Northwestern Miller* lists) because such mills vary so widely in activity. The number of mills producing under 1,000 barrels was estimated as a first approximation by substracting from the total for each state (determined as described above) the number producing 1,000 barrels or more, as given in Appendix Table II. In a number of states the estimates thus arrived at appeared to us out of line with other information. This was more particularly the case in southeastern states, where very small mills are so numerous. Such mills, doing chiefly or wholly a custom business, are very difficult to get included in a list compiled chiefly by correspondence: it is remarkable, indeed, that the *Northwestern Miller* has been able so nearly to attain completeness in its recent lists.

The preliminary estimates by states founded on the number of active mills included in the lists of the *Northwestern Miller* were next scrutinized for conformity with other information and freely altered where changes appeared necessary. For some of the individual states for which the *Northwestern Miller* lists appeared notably incomplete, the estimates of numbers of mills producing less than 1,000 barrels were necessarily only very rough approximations. Nevertheless, we believe that the errors made tend to offset in the aggregate for all states, and that the United States total of these estimates is unlikely to be greatly in error. An error as great as 20 per cent in this group of mills, however, would affect the estimated production by only 204 thousand barrels, and the resultant error in our estimate of total United States flour production would amount to less than two-tenths of one per cent.

Average production per mill in each output group under 100 thousand barrels was computed for 1899 from the frequency-curve fitted to the census data. The detail in which those data were published for mills producing under 1,000 barrels permitted an accuracy of fit in that range that could not be obtained from the data for later years. These calculated averages multiplied by the known numbers of mills in the output groups provided the estimates of production for mills with output under 100 thousand barrels. The remainder of the production, obtained as a difference, was credited to mills producing 100 thousand barrels or more, and their average per mill computed accordingly. The data do not permit fitting the frequency-curve over the range of mills producing over 100 thousand barrels in order to obtain thereby an independent calculation of the average output of such mills.

For 1914 and subsequent census years, census figures were available for average production per mill in the group producing 100 thousand barrels or more. For these years the averages for mills producing 20–100 thousand barrels could be computed from the residual production. For 1909, 1914, and 1919 the census data permit computation of average output per mill for merchant mills producing under 1,000 barrels and so give reliable indications of averages for all mills producing under 1,000 barrels, allowance being made for the fact that custom mills average lower than merchant mills. The special census tabulation prepared for 1929, 1931, and 1933 yielded accurate averages of output per mill for the two groups producing 20 thousand barrels or more in each year; accurate averages for mills producing 5–20 thousand barrels in each year except 1933; and for 1929 an average for mills producing 1–5 thousand barrels that is probably only slightly above the average for all such mills.

These data, with calculations of averages computed from frequency-distributions for years subsequent to 1899, were reviewed in the light of known tendencies in the industry which would produce trends in the averages, and were found to harmonize well. Information which at first appeared to furnish a basis for only rough estimates of average output per mill in the several size groups was thus found, when completely assembled, to afford

a basis for estimates subject to errors quite negligible for the purpose to be served. The least certain of the estimates of average output per mill are those for mills producing under 1,000 barrels each; and although these estimates are conceivably in error by as much as 10 per cent, or perhaps slightly more, the resulting error in estimated total production for the United States cannot be more than a small fraction of 1 per cent.

The estimates of production by output groups constituted the second main objective of the investigation. In part the data on which they were founded were necessary as a means of attaining the first objective: that of remedying defects of incompleteness and inaccuracy in the previously available statistics. In the main, the estimates of production by output groups rest on the statistics or estimates of numbers of mills in each output group and on the estimates of average production of mills in each group, discussed above.

As noted in the preceding discussion of estimation of average production per mill by output groups, census statistics of production have been available since 1914 for mills producing 100 thousand barrels or more, and the census special tabulation provides for 1929, 1931, and 1933 satisfactory production statistics for certain other output groups. For each census year, 1899–1927, the production in one output group has been obtained as a difference between the total production and the production of the other output groups. The group for which the production has thus been calculated as a residual was in each year that having the smallest number of mills and the largest total production among the groups for which an estimate had to be made. This procedure minimized possible errors in the estimates of production by output groups.

The estimate of total production in each census year, except 1935, was obtained by adding to the reported census production (using the census special tabulation for 1929–1933) the estimated production of omitted mills. The omissions for which estimates were thus made covered custom mills in 1904 and 1914, omitted custom and merchant mills producing under 5,000 barrels in 1921–1933, omitted mills producing 5–20 thousand barrels in 1933, and certain production "outside the industry" in 1919–1923. These additions are summarized in Table 1, p. 275. For 1935 the estimate of total production is a sum of estimates by output groups obtained as described in later paragraphs.

Production "outside the industry," that is, the flour production, estimated or recorded, of establishments classified for census purposes in industries other than "Flour and other grain-mill products," has been left unclassified by size groups for the census years 1919 to 1927 inclusive. The estimation of this production is discussed under the next heading, but it is pertinent to note here that the amount of this production was relatively small in each of these years, ranging from 460 to 663 thousand barrels. Nearly all of it, we judge, was produced by one or two large concerns manufacturing various cereal preparations in addition to flour, and little error would be involved in treating the whole as part of the production of mills with an output of 100 thousand barrels or more. After 1927 the amount of this "outside" production was greatly expanded in consequence of reclassification of concerns among industries, and for these years the census special tabulation provides apportionments by output groups.

In the estimates by states for 1899, 1919, and 1931, it was necessary for several individual states to use averages per mill in some output groups higher or lower than the national averages. In some states an unusual proportion of the mills in a size group are near the upper or the lower limit of the group range. The existence of such a peculiarity in an individual state was commonly apparent from failure of the total of estimates of production by output groups to agree with the reported production, and it was usually possible to determine with confidence which average or averages required adjustment. The only estimates of production by output groups within states which are likely to be in error by more than a few per cent are those in states having only a few mills producing 100 thousand barrels or more, the production of which was not separately published. In such instances full allowance may not have been made for peculiarities in averages for mills in

the lower output groups, resulting in estimating their production too high or too low by as much as perhaps 10 per cent and leaving a corresponding discrepancy in the allowance for mills producing 100 thousand barrels or more. The possibility of such errors was greatly reduced by use of independent information on the approximate total production of the large mills themselves. The census statistics on their production were of course used whenever available.

Special problems of estimation not covered in the foregoing paragraphs were involved in estimation of non-reported production "outside the industry," and in the estimates for 1933 and 1935. In 1925 the Bureau of the Census gave recognition to the desirability of having complete statistics of flour production irrespective of the industry classification of the producing establishment. In that year the Bureau of the Census undertook for the first time to obtain complete statistics of grain ground and of flour and certain other grain products produced by establishments classified for census purposes elsewhere than in the "Flour, feed, and other grain-mill products" industry,[1] chiefly or wholly under the head of "Food preparations not elsewhere classified." The flour thus reported totaled 663 thousand barrels. In 1927 the amount reported by establishments classified outside the "Flour and other grain-mill products" industry was reduced to 460 thousand barrels,[2] but the reduction is attributable chiefly or wholly to a reclassification of establishments.

In 1927 a group of establishments previously included under "Food preparations not elsewhere classified" was transferred to a newly established category of "Cereal preparations" and a large number of establishments previously included in the category of "Flour, feed, and other grain-mill products" was transferred to a newly established category of "Feeds, prepared, for animals and fowls." We infer that in the attendant reconsideration of industry classification some concerns previously included in another industry category were transferred to the newly named "Flour and other grain-mill products" industry; and that it is such transfers that account for the reduction between 1925 and 1927 in the amount of flour accounted for by establishments classified "outside the industry."

Accordingly it appears that the volume of flour production "outside the industry" and unreported prior to 1925 must be estimated from the single figure giving the amount so reported in 1925. We take the round figure of 650 thousand barrels as the best available approximation to this quantity. There is reason to suppose that collection of data on flour production "outside the industry" in 1925 may have resulted in inclusion within the industry of establishments that previously had been elsewhere classified. If so, the "outside production" for earlier years should be set at a higher figure than for 1925; but in the absence of more definite evidence we prefer to estimate the "outside production" conservatively at a round figure slightly below the amount reported for 1925.

No basis has been found for judging whether this "outside production" had been increasing or decreasing in the period immediately preceding 1925, but it appears unreasonable to use so large estimates for all years back to 1899. In these circumstances we include an estimate for "outside production" only in the period for which census statistics have been available at 2-year intervals, and make no estimate for such production in earlier years. This solution of the difficulty involves a minor inconsistency in our estimates, but one that occurs between two years rather widely separated (1914 and 1919), and between which such marked changes had occurred in flour production and consumption that the inconsistency cannot seriously affect any conclusions that may be drawn from the data.

The estimates for 1933 have available for their basis much less satisfactory data than the estimates for earlier years, owing to the great incompleteness of the census statistics of production for that year. It has been necessary to estimate the numbers of mills with output under 20 thousand barrels by projecting past trends in numbers of mills in these

[1] Elsewhere in this study we refer to this industry by its later designation, "Flour and other grain-mill products."

[2] This figure was not published, but is reliably deducible from published statistics.

output groups, taking account of the known change in numbers of mills producing 20–100 thousand barrels and information on special factors affecting the numbers of smaller mills in 1933. These estimates, with estimates of average output per mill, yield the production estimates for mills with output under 20 thousand barrels. The amount of production thus estimated totals 8,254 thousand barrels; and this estimate must be regarded as subject to a possible error perhaps as great as 5 per cent, or some 400 thousand barrels. The estimates of total United States production for 1933 may therefore be in error by nearly one-half of one per cent.

Our estimates for 1935 involve only production of flour and a derivative calculation of consumption. For the two higher output groups, which account for over 92 per cent of the total, the estimates rest largely on the production statistics reported monthly to the Bureau of the Census. The estimation of total production from these monthly data presents problems beyond the scope of the present study, but it is pertinent here to state specifically how the data have been used for present purposes.

The following tabulation shows the derivation of our estimates for 1935, followed by comparable data for 1933. Estimated figures are distinguished by italics and all are in thousand barrels.

Output class	Mills reporting monthly	Mills not reporting monthly	Total
1935			
Under 1,000			*940*
1,000–4,999	*3,993*	*3,707*	*2,400*
5,000–19,999			*4,360*
20,000–99,999	*12,250*	*450*	*12,700*
100,000 or more	*80,500*	*400*	*80,900*
Total	96,743	*4,557*	*101,300*
1933			
Under 1,000	4	*974*	*978*
1,000–4,999	528	*2,048*	*2,576*
5,000–19,999	3,398	*1,302*	*4,700*
20,000–99,999	12,618	627	13,243
100,000 or more	80,587	509	81,096
Total	97,133	*5,460*	*102,593*

For the three lower output groups, our estimates are based on past trends with allowance for an advantage which these small and very small mills have received from expansion in custom milling. Between 1927 and 1929 the production of such mills declined about 877 thousand barrels in continuation of a steady downward trend over previous years. We believe that since 1929 the decrease has proceeded less rapidly, and, in estimating 1935 production of these mills at 7,700 thousand barrels, we put their production only 554 thousand barrels below our estimate for the same groups in 1933.

Some students of flour production will doubtless hold that the estimate of 1935 production of the small and very small mills should be set higher than the 1933 estimate for such mills, and perhaps higher even than the 1931 estimate. There are no statistics now available which provide any clear, direct evidence on the subject.[1] We make our estimate on the basis of our best judgment, in the light of the facts regarding past trends of production of these mills; and we present the estimates in detail, by size groups, so that any who may disagree with this aspect of the estimates may make such adjustments as they wish.

In order to arrive at estimates of production in the two higher output groups based primarily on the monthly reports of flour production, it is necessary first to apportion the reported production by output groups. The Bureau of the Census publishes production as reported monthly by *capacity* groups rather

[1] One might suppose that the statistics of the monthly milling reports would reflect approximately the trend of production of the small and very small mills, for a large fraction of the production of all such mills producing as much as 5,000 barrels each is covered by these reports. These statistics fail, nevertheless, to give any trustworthy indication of the trend of total production of small and very small mills because they are accompanied by no indication of the extent to which they have been improved in percentage of the production covered. Effort is made to provide such an indication for the reporting mills as a whole through statement of the percentage (or absolute amount) of the 1933 census production accounted for by concerns currently reporting. This statement fails now to give any indication of changes in completeness of coverage among small mills because most such mills were not called upon to report detailed production data in the 1933 census of manufactures, and the Bureau of the Census has made no use, for purposes of this comparison, of 1933 production as actually reported monthly by most of the small mills which are now reporting.

than by *output* groups. The breakdown of the total production reported monthly for 1935 into production by output groups is made for the foregoing tabulation on the basis of the published figures for capacity groups, relying on two facts: (1) the production of mills with capacity of 201–600 barrels daily corresponds roughly with production of mills with annual output of 20–100 thousand barrels; and (2) production of mills with capacity in excess of 600 barrels daily corresponds roughly with production of mills with annual output of 100 thousand barrels or more. If total production had changed greatly between 1933 and 1935, it would be improper to assume that the changes within *output* groups was the same as the changes between the roughly corresponding *capacity* groups; but since production was so nearly the same in 1935 as in 1933, such an assumption is probably justified for the present calculation.[1]

The estimates of production of *non-reporting* mills in these output groups rest heavily on the fact that "concerns" which were reporting in January 1936 had produced 282 thousand barrels more in 1933 than concerns which reported monthly during 1933.[2] Presumably the concerns added to the reporting list between 1933 and 1935 had reported considerably more than 282 thousand barrels of flour in the biennial census of 1933, since this figure represents the difference between 1933 reported production of concerns added to the list and 1933 reported production of concerns dropped from the list. Of the concerns dropped from the reporting list, some at least had discontinued production. Most of the net addition of 282 thousand barrels is to be attributed to changes in the reporting list involving mills that produced over 20 thousand barrels of flour in 1933, since in that census detailed production data were obtained from only a small percentage of mills producing less than 20 thousand barrels of flour. Not all of the concerns added to the reporting list by January 1936 had been reporting monthly throughout 1935.

Appraising the significance of these various facts as best we can on rather slender evidence, we judge that improvements in coverage of the monthly reports has resulted in leaving only about 850 thousand barrels of production unreported by mills with output of 20 thousand barrels or more. The unreported production of mills producing 20–100 thousand barrels is probably fairly accurately appraised at 450 thousand barrels. The estimate of production by non-reporting mills producing 100 thousand barrels or more is much less confidently estimated at about 400 thousand barrels.

It is in connection with this estimate of production by non-reporting mills producing 100 thousand barrels or more that our estimate of total production is subject to its largest possibility of error. In 1933 only two mills with output of 100 thousand barrels or more were not reporting monthly, their combined production being 509 thousand barrels. We surmise that one of these, producing only slightly over 100 thousand barrels, reported monthly during 1935. It is possible that the other was out of operation in 1935, and that no mill actually producing 100 thousand barrels or more was failing to report monthly. On the other hand, it is possible that since 1933 one or more large mills have been established or have resumed operation that were not covered in the monthly reports for 1935. To reflect this range of possibilities, the estimate of production of non-reporting mills in the highest output group might well be stated as a range, from zero to 1 million barrels. Accordingly, our estimate of 1935 flour production is subject to a possible error

[1] Reported production of mills with capacity of 201–600 barrels daily decreased from 11,916 thousand barrels in 1933 to 11,546 thousand in 1935; and reported production of mills with capacity of over 600 barrels daily decreased from 80,289 to 80,218 thousand barrels. The class which must be described technically as including mills with capacity "over 600 barrels" in fact probably includes not more than one or two mills with rated capacity under 650 barrels.

[2] The report for January states that the 935 concerns reporting for the month, "446 which reported detailed production data at the biennial Census of Manufactures, 1933, accounted for 94,231,381 barrels of the total wheat flour, 95,666,407 barrels (revised final figure), reported for that year." It appears therefore that concerns which *did not* report monthly production in January 1936 had reported detailed production data in the biennial census which included 1,435 thousand barrels of flour. According to the data of Appendix Table V, the biennial census of 1933 included 1,717 thousand barrels of flour produced by mills which did not report monthly during 1933.

of at least half a million barrels arising from uncertainty whether one or perhaps two or three large mills were failing to report monthly production during 1935. Such uncertainty in estimates of total production based on the monthly reports is inevitable unless assurance can be obtained that all large mills are reporting.

This study has been prepared by Holbrook Working.

Grateful acknowledgment is due to the Bureau of the Census for a special compilation of data for 1929, 1931, and 1933, presented in Appendix Table V.

Completion of the study with the thoroughness and detail in which it is here presented has been made possible by a grant of funds from the Wheat Flour Institute of the Millers' National Federation.

APPENDIX

TABLE I.—NUMBERS OF MILLS AND PRODUCTION OF WHEAT FLOUR BY OUTPUT CLASSES, FOR THE UNITED STATES, CENSUS YEARS, 1899–1933*

(Numbers and barrels)

Output class	Census statistics			Food Research Institute estimates		
	Number of mills[a]	Average output	Production	Number of mills	Average output	Production
1899						
Under 1,000	5,525	...	.....	5,525	305	1,685,000
1,000–4,999	4,310	...	.....	4,310	2,616	11,275,000
5,000–19,999	2,584	...	.....	2,584	9,244	23,886,000
20,000–99,999	634	...	.....	634	39,568	25,086,000
100,000 and over	135	...	.....	135	308,089	41,592,094
Unclassified	0		0	0		0
Total	13,188		103,524,094	13,188		103,524,094
1904						
Under 1,000	1,272	...	.....	5,150	330	1,700,000
1,000–4,999	3,502	...	.....	3,843	2,530	9,723,000
5,000–19,999	2,123	...	.....	2,123	9,300	19,744,000
20,000–99,999	622	...	.....	622	41,300	25,688,000
100,000 and over	166	...	.....	166	295,246	49,047,000
Unclassified	0		0	0		0
Total	7,685		104,013,278	11,904		105,902,000
1909						
Under 1,000	1,721	385[b]	661,839[b]	4,720	363	1,713,000
1,000–4,999	3,145	...	.....	3,313	2,440	8,084,000
5,000–19,999	1,733	...	.....	1,733	9,350	16,204,000
20,000–99,999	550	...	.....	550	43,000	23,650,000
100,000 and over	193	...	.....	193	297,707	57,457,461
Unclassified	...	...	1,351,816[c]	0		0
Total	7,342		107,108,461	10,509		107,108,461
1914						
Under 1,000	1,821	394[b]	717,020	4,420	374	1,653,000
1,000–4,999	2,920	...	.....	2,996	2,300	6,891,000
5,000–19,999	1,377	...	.....	1,377	9,400	12,944,000
20,000–99,999	540	...	.....	540	44,748	24,164,050
100,000 and over	218	329,399[b]	71,808,950	218	329,399	71,808,950
Unclassified	0		0	0		0
Total	6,876		116,403,770	9,551		117,461,000
1919						
Under 1,000	2,041	426[b]	869,831[b]	4,330	412	1,784,000
1,000–4,999	2,739	...	.....	2,900	2,230	6,467,000
5,000–19,999	1,185	...	.....	1,185	9,400	11,139,000
20,000–99,999	494	...	.....	494	47,472	23,451,237
100,000 and over	274	331,495	90,829,763	274	331,495	90,829,763
Unclassified	...	...	1,205,068[c]	...	.....	650,000[d]
Total	6,733		133,670,672	9,183		134,321,000

* Census statistics are from reports of the *Census of Manufactures* except as otherwise noted. Under the head of "Food Research Institute estimates" are included also all census figures used without change. Dots (...) indicate that data are not available. For 1935 we have estimated production by output groups (p. 301), but not numbers of mills.

[a] Census statistics of numbers of mills producing wheat flour include custom mills in 1899, but only merchant mills in subsequent years.

[b] Computed from census statistics.

[c] Production of custom mills; included in total production, although the number of custom mills is not included in census statistics of numbers of mills.

[d] Production of wheat flour other than prepared flour by establishments in industries other than "Flour and other grain-mill products"; chiefly the product of a few large establishments. The number of such establishments is not included in the census statistics of numbers of mills, nor, where this item appears, in our estimates of numbers of mills.

[e] Unpublished figures supplied by the Bureau of the Census.

[f] Including prepared flour, which is omitted from the corresponding published figure.

[g] Corrected for error in published statistics for Minnesota.

[h] From special tabulation prepared by the Bureau of the Census (Table V).

TABLE I (*Continued*)*

(*Numbers and barrels*)

Output class	Census statistics			Food Research Institute estimates		
	Number of mills[a]	Average output	Production	Number of mills	Average output	Production
1921						
Under 1,000	964	540[b]	520,116[b]	3,700	410	1,517,000
1,000–4,999	2,256	...	.....	2,256	2,250	5,076,000
5,000–19,999	930	...	.....	930	9,400	8,742,000
20,000–99,999	420	...	.....	420	46,641	19,589,339
100,000 and over	239	321,835	76,918,661	239	321,835	76,918,661
Unclassified	0		0	...	.....	650,000[d]
Total	4,809		110,846,277	7,545		112,493,000
1923						
Under 1,000	741	521[b]	386,389[b]	3,200	410	1,312,000
1,000–4,999	1,686	...	.....	1,880	2,300	4,324,000
5,000–19,999	769	...	.....	769	9,400	7,229,000
20,000–99,999	386	...	.....	386	46,053	17,776,362
100,000 and over	247	344,031	84,975,638	247	344,031	84,975,638
Unclassified	0		0	...	.....	650,000[d]
Total	3,829		114,438,544	6,482		116,267,000
1925						
Under 1,000	643	507[b]	325,956[b]	2,850	415	1,183,000
1,000–4,999	1,341	...	.....	1,600	2,300	3,680,000
5,000–19,999	667	...	.....	667	9,400	6,270,000
20,000–99,999	351	...	.....	351	49,380	17,332,366
100,000 and over	247	351,443	86,806,475	247	351,443	86,806,475
Unclassified	...	...	663,159[d]	...	.....	663,159[d]
Total	3,249		114,689,930	5,715		115,935,000
1927						
Under 1,000	622	...	.....	2,650	420	1,113,000
1,000–4,999	1,275	...	.....	1,450	2,300	3,335,000
5,000–19,999	642	...	.....	642	9,400	6,035,000
20,000–99,999	352	...	.....	352	47,626	16,764,506
100,000 and over	255	358,712	91,471,494	255	358,712	91,471,494
Unclassified	...		.....	...	.....	460,000[d]
Total	3,146		118,132,027	5,349		119,179,000
1929						
Under 1,000	385	...	.....	2,500	425	1,062,000
1,000–4,999	1,231	...	.....	1,290	2,300	2,967,512
5,000–19,999	552	...	.....	592[h]	9,421	5,577,031[h]
20,000–99,999	285	...	.....	288[h]	51,329	14,782,775[h]
100,000 and over	240	394,300	94,632,085[e,f]	267[h]	365,939	97,705,682[h]
Unclassified	...	...	1,122,000[d,e]	0		0
Total	2,693		120,039,673	4,937		122,095,000
1931						
Under 1,000	186	...	.....	2,400	425	1,020,000
1,000–4,999	821	...	.....	1,200	2,300	2,760,306
5,000–19,999	517	...	.....	544[h]	9,305	5,062,172[h]
20,000–99,999	273	...	.....	299[h]	51,236	15,319,418[h]
100,000 and over	237	386,006	92,134,467[e,g]	251[h]	361,387	90,708,104[h]
Unclassified	...	...	2,503,166[d,e]	0		0
Total	2,034		115,364,274	4,694		114,870,000
1933						
Under 1,000	...	...	.....	2,300	425	978,000
1,000–4,999	...	...	.....	1,120	2,300	2,575,919
5,000–19,999	...	...	.....	500	9,400	4,700,000
20,000–99,999	...	...	.....	261[h]	50,738	13,242,560[h]
100,000 and over	...	...	.....	228[h]	355,686	81,096,521[h]
Unclassified	...	...	1,215,585[d]	0		0
Total	...		95,666,407	4,409		102,593,000

* For footnotes, see preceding page.

TABLE II.—NUMBERS OF MILLS PRODUCING 1,000 OR MORE BARRELS OF FLOUR, BY OUTPUT CLASSES AND BY STATES, CENSUS YEARS 1899–1931*

State and census year	Output class[a]			
	1-5	5-20	20-100	100 or more
Alabama[b]				
1899	17	3	1	..
1904	7	1	..	..
1929	1	1	..	..
1931	1	[g]..	..	..
Arizona[b]				
1899	4	5	1	..
1904	4	4	1	..
1927	1	1	4	..
Arkansas				
1899	71	34	2	..
1904	54	21	2	..
1909	30	6	2	..
1914	30	9	2	..
1919	53	7	1	1
1921	29	2	2	..
1923	15[d]	3	1	..
1925	8	2	1	..
1927	7	2	2	..
1929	4	1	2	..
1931	3	1	2	..
California				
1899	30	28	11	6
1904	31	22	18	4
1909	27[c]	19	9	4
1914	23	12	9	5
1919	21	12	10	6
1921	15	8	7	5
1923	14[d]	6	7	7
1925	14[d]	3	8	5
1927	14	3	7	4
1929	13	1	5	5
1931	12[d]	1	5	5
Colorado				
1899	12	12	17	1
1904	12	17	13	1
1909	13	14	10	2
1914	13	12	13	4
1919	15	10	18	4
1921	15	11	16	4
1923	16	7	14	5
1925	15[d]	9	12	6
1927	15	7	10	6
1929	20	5	9	6
1931	14	5	8	6
Delaware[b]				
1899	27	7	1	..
1904	31	7	1	..
1921	19	6	..	..
1923	11	4	..	..
1925	11	4	..	..
1927	13	4	..	..
1929	15	6	..	..
1931	12[d]	4	..	..
D. of C.[b]				
1899	..	..	2	..
1904	..	..	2	..
1929	..	..	1	..
1931	..	..	1	..
Georgia				
1899	76	9	5	1
1904	35	5	6	1
1909	18	5	3	1
1914	14[c]	3	3	1
1919	14[c]	3	5	1
1921	14	3	3	2
1923	13[d]	1	3	2
1925	13[d]	..	3	2
1927	13[d]	2	2	2
1929	13	3	1	1
1931	12[d]	4	2	1
Idaho				
1899	11	17	4	..
1904	10	13	5	..
1909	19	21	4	..
1914	18	15	9	..
1919	23	12	15	2
1921	19	9	13	..
1923	13	6	13	1
1925	12[d]	6	13	1
1927	11	5	15	1
1929	11	6	14	..
1931	10[d]	8	14	..
Illinois				
1899	129	131	50	12
1904	106	89	47	12
1909	87	76	47	12
1914	83	52	42	12
1919	57	53	38	15
1921	49	47	35	10
1923	42[d]	35	31	11
1925	35[d]	27	22	11
1927	28[d]	20	23	11
1929	23[d]	12	21	8
1931	20[d]	14	17	9
Indiana				
1899	245	235	44	8
1904	240[c]	199	32	7
1909	227	148	28	8
1914	197	105	29	7
1919	179	81	16	9
1921	160	52	17	8
1923	136[d]	49	16	8
1925	115[d]	43	15	8
1927	99	36	17	9
1929	80	25	11	5
1931	90[d]	39	10	6
Iowa				
1899	129	107	21	2
1904	98	62	13	3
1909	64	44	11	3
1914	52	25	11	4
1919	46	21	10	1
1921	44	13	5	2
1923	27	11	5	4
1925	23	8	3	3
1927	19	7	4	3
1929	18	6	2	4
1931	20[d]	7	1	4
Kansas				
1899	73	97	48	13
1904	55	75	78	21
1909	32	61	81	35
1914	23	41	63	45
1919	41	38	59	52
1921	25	29	50	55
1923	18	17	59	43
1925	16	18	52	41
1927	21	10	36	51
1929	17	18	26	49
1931	15[d]	15	27	46
Kentucky				
1899	170	117	17	1
1904	189	99	14	3
1909	188	99	14	2
1914	180	94	10	2
1919	166	54	10	4
1921	146	50	5	2
1923	120[d]	43	6	4
1925	105[d]	37	4	4
1927	105[d]	45	5	4
1929	96	40	4	3
1931	98[d]	41	5	3

* Statistics from *Census of Manufactures* except as noted. Dots (...) indicate no mills reporting. Reasonably complete census statistics of numbers of mills producing less than 1,000 barrels each are available by states only for 1899. United States totals of numbers of mills by output classes, given in Table I, are sums of the numbers shown above with the following exceptions: (*a*) for 1929 and 1931 the data of Table I are based on Table V and include mills classified outside the "Flour and other grain-mill products" industry for which numbers by states and by output classes are not given in the *Census of Manufactures* or elsewhere; and (*b*) the numbers of mills producing 1–5 thousand barrels as shown in Table I include mills which cannot be distributed by states, numbering in 1923, 6; 1925, 15; 1927, 12; 1929, 22; and 1931, 23.

[a] The class limits stated here in thousand barrels are, more precisely, 1,000–4,999, 5,000–19,999, 20,000–99,999, and 100,000 or more barrels, respectively.

[b] Numbers for all years included in "Special group."

[c] Including some custom mills (estimated) in addition to the number of merchant mills recorded in census statistics.

[d] Including an estimate for merchant mills omitted from census statistics.

TABLE II (*Continued*)

State and census year	Output class[a]			
	1–5	5–20	20–100	100 or more
Maine[b]				
1899	7	1	..	..
1904	5	2	..	..
Maryland				
1899	128	36	6	2
1904	130[c]	39	5	1
1909	120[c]	37	3	2
1914	105[c]	32	6	2
1919	106[c]	24	10	2
1921	66	23	6	2
1923	60[d]	23	7	3
1925	56[d]	21	6	1
1927	52[d]	16	7	2
1929	49	19	3	2
1931	46[d]	18	6	1
Massachusetts[b]				
1899	2	..	..	..
1904	2	..	..	..
Michigan				
1899	236	137	37	4
1904	205[c]	110	27	7
1909	178	87	21	7
1914	142	70	21	5
1919	112	45	16	5
1921	100	38	16	4
1923	85	33	17	4
1925	75[d]	27	20	5
1927	68[d]	26	20	5
1929	63	22	13	4
1931	60[d]	20	12	4
Minnesota				
1899	93	151	52	24
1904	110	130	44	34
1909	96	87	33	32
1914	80	67	30	34
1919	82	50	18	40
1921	60	30	17	36
1923	45[d]	30	13	37
1925	40[d]	28	12	36
1927	35[d]	21	11	34
1929	30[d]	15	10	34
1931	30[d]	16	6	28
Mississippi[b]				
1899	2	..	..	..
Missouri				
1899	330	165	44	9
1904	282	125	42	10
1909	237	105	32	14
1914	219	84	39	13
1919	186	66	34	21
1921	142	55	31	13
1923	117	44	28	16
1925	87	30	31	13
1927	68	28	22	18
1929	56	18	26	14
1931	50	15	17	17
Montana				
1899	4	7	4	..
1904	4	4	4	..
1909	3	5	4	..
1914	9	9	6	2
1919	18	8	12	3
1921	18	6	11	4
1923	16[d]	5	7	6
1925	15[d]	4	5	6
1927	14	6	5	7
1929	12	4	6	6
1931	12[d]	5	2	7
Nebraska				
1899	93	110	18	..
1904	89	97	16	1
1909	86	79	23	1
1914	74	73	18	3
1919	84	53	17	8
1921	75	42	11	6
1923	69	32	13	6
1925	50	30	8	9
1927	46	30	10	8
1929	37[d]	27	12	7
1931	30[d]	24	12	9
Nevada[b]				
1899	9	1	..	..
1904	3	4	..	..
New Hampshire[b]				
1899	..	..	1	..
1904	..	..	1	..
New Jersey				
1899	59	27	1	..
1904	50[c]	24	1	..
1909	40	17	1	..
1914	25	10	1	..
1919	19	8	..	..
1921	14	4	1	..
1923	13[d]	2	1	..
1925	13[d]	3	..	1
1927	12[d]	2	1	1
1929	12	2	1	1
1931	12[d]	2	1	1
New Mexico[b]				
1899	19	9	..	..
1904	5	6	..	..
1929	8	4	..	..
1931	7	3	..	..
New York				
1899	127	80	23	14
1904	107[c]	64	22	14
1909	86	49	19	11
1914	69	42	19	13
1919	59	41	17	12
1921	41	39	14	10
1923	39	36	12	10
1925	33[d]	32	9	10
1927	28[d]	31	12	11
1929	24	24	11	12
1931	17	13	9	11
North Carolina				
1899	202	36	1	..
1904	180[c]	37	2	..
1909	160[c]	34	3	..
1914	170[c]	49	5	..
1919	180[c]	38	1	4
1921	95	34	6	3
1923	90[d]	29	6	4
1925	85[d]	31	7	4
1927	80[d]	36	11	4
1929	78	31	10	1
1931	70[d]	27	12	2
North Dakota				
1899	23	25	17	1
1904	23[c]	26	13	3
1909	23[c]	26	15	7
1914	22[c]	15	13	7
1919	39[c]	13	11	7
1921	21	11	8	6
1923	12[d]	8	8	8
1925	7	5	6	6
1927	6	6	5	5
1929	7	7	3	5
1931	9[d]	9	3	5
Ohio				
1899	375	282	51	5
1904	353	226	34	6
1909	296	188	33	10
1914	282	145	23	11
1919	243	131	27	10
1921	209	90	18	8
1923	175	72	22	9
1925	141	63	18	11
1927	121	66	19	7
1929	86	45	13	8
1931	93[d]	48	14	8
Oklahoma[e]				
1899	14	26	16	1
1904	18	31	28	1
1909	16	34	22	5
1914	15	16	18	7
1919	28	18	17	13
1921	24	12	17	9
1923	11	8	14	8
1925	8	5	11	11
1927	6	8	9	12
1929	6[d]	5	12	12
1931	6[d]	6	12	12
Oregon				
1899	48	52	13	3
1904	41	35	9	2
1909	46	38	8	3
1914	30	21	9	3
1919	25	26	13	9
1921	22	16	10	7
1923	20	11	9	7
1925	15	14	5	8
1927	15	12	3	8
1929	12[d]	12	3	9
1931	10[d]	7	1	9

[c] Includes Indian Territory for 1899 and 1904.

TABLE II (*Concluded*)

State and census year	Output class[a]			
	1-5	5-20	20-100	100 or more
Pennsylvania				
1899	556	185	25	5
1904	457	139	23	6
1909	427	141	14	3
1914	392	114	24	4
1919	316	111	23	4
1921	290	95	18	3
1923	250[d]	75	17	2
1925	220[d]	70	19	1
1927	196	67	21	2
1929	181	59	9	3
1931	160[d]	52	15	3
South Carolina[b]				
1899	39	8	1	..
1904	15	2	..	..
1929	7	2	1	..
1931	5[d]	..	2	..
South Dakota				
1899	27	55	7	..
1904	35[c]	53	14	1
1909	31	33	11	1
1914	28	24	9	2
1919	26	17	7	1
1921	17	13	2	1
1923	14	8	1	1
1925	12[d]	7	3	1
1927	13	4	2	1
1929	10	4	3	..
1931	8	3	3	..
Tennessee				
1899	209	98	16	6
1904	215[c]	113	11	5
1909	205[c]	78	10	5
1914	205	63	17	5
1919	186[c]	46	11	6
1921	117	43	13	4
1923	100[d]	40	11	5
1925	77	28	15	5
1927	85[d]	35	13	7
1929	83	36	8	6
1931	68[d]	30	13	6
Texas				
1899	23	42	25	6
1904	30	48	32	8
1909	20	33	22	9
1914	21	16	32	11
1919	51	25	20	14
1921	46	16	21	13
1923	35[d]	16	15	15
1925	21	4	16	17
1927	20	5	18	15
1929	15[d]	10	13	17
1931	12[d]	9	12	19
Utah				
1899	42	33	3	..
1904	37[c]	29	3	..
1909	35[c]	28	4	..
1914	34[c]	27	6	..
1919	46[c]	23	4	..
1921	40	20	2	2
1923	37[d]	19	1	2
1925	35[d]	21	1	3
1927	35	18	3	3
1929	28[d]	16	4	3
1931	25[d]	13	2	3
Vermont[b]				
1899	1	..	..	..
1904	1	..	..	..
Virginia				
1899	281	56	12	1
1904	260[c]	59	12	2
1909	220[c]	47	13	4
1914	224	59	12	4
1919	240[c]	63	11	2
1921	171	52	14	2
1923	145[d]	54	7	4
1925	125[d]	47	7	5
1927	110[d]	51	13	3
1929	100[d]	45	10	2
1931	98[d]	43	10	3
Washington				
1899	12	24	16	4
1904	13[c]	26	22	6
1909	14	16	24	6
1914	13	14	22	8
1919	9	15	23	13
1921	11	15	12	13
1923	12[d]	12	9	10
1925	15	8	9	9
1927	7	5	10	10
1929	7	4	7	11
1931	7[d]	4	8	7
West Virginia				
1899	151	29	5	..
1904	120[c]	19	8	..
1909	100[c]	25	6	..
1914	83[c]	14	5	..
1919	90[c]	15	5	..
1921	57	12	4	..
1923	42	9	3	..
1925	30[d]	9	3	..
1927	25[d]	6	4	..
1929	22[d]	3	3	..
1931	20[d]	3	3	..
Wisconsin				
1899	200	103	16	6
1904	154	59	17	7
1909	95	34	14	6
1914	60	24	8	4
1919	64	29	7	5
1921	46	17	9	4
1923	34	7	4	4
1925	30	9	..	4
1927	25	7	2	1
1929	18[d]	9	2	1
1931	10[d]	4	1	2
Wyoming[b]				
1899	4	4	..	..
1904	8	2	..	..
1927	2	4	1	..
1929	..	3	2	..
1931	3	2	1	..
Special Group[f]				
1899	131	38	7	..
1904	100[c]	28	5	..
1909	74	19	6	..
1914	61	21	6	..
1919	76	29	8	..
1921	58	23	6	1
1923	39	18	6	1
1925	39[d]	18	7	..
1927	39[d]	19	10	..
1929	37	18	8	1
1931	30[d]	11	8	..

[f] Includes data for states covered by note *b* for years for which separate data are given above, as well as for other years.

TABLE III.—PRODUCTION OF FLOUR IN THREE BROAD OUTPUT CLASSES, BY STATES, 1899, 1919, 1931*

(Thousand barrels)

State	Under 5,000			5,000–99,999			100,000 and over			Outside industry
	1899	1919	1931	1899	1919	1931	1899	1919	1931	1931
United States	12,960	8,251	3,637[a]	48,972	34,591	19,353[a]	41,592	90,829[b]	92,133[a]	2,503[c]
Alabama[d]	88	...	7	56	...	0	0	0	0	...
Arizona[d]	11	...	...	55	...	...	0	0	0	...
Arkansas	266	160	21	400	100	86	0	126[c]	0	...
California	92	54	30	763	569	236	1,805	2,763[b]	1,601[b]	...
Colorado	36	40	38	795	850	450	181[c]	592[b]	1,128[c]	...
Connecticut[d]	2	...	0	0	0	0	0	0	0	...
Delaware[d]	79	...	34	79	...	38	0	0	0	...
District of Columbia[d]	0	...	0	65	...	0	0	0	0	...
Florida[d]	1	...	0	0	...	0	0	0	0	...
Georgia	303	55	39	281	230	140	205[c]	240[c]	383[c]	...
Idaho	29	60	30	232	800	790	0	250	0	...
Illinois	408	160	55	3,189	2,496	1,089	2,482	4,618[b]	4,562[b]	...
Indiana	735	460	248	3,913	1,597	930	1,170	2,272[b]	1,738[b]	380[c]
Iowa	408	125	64	1,820	670	134	275[c]	470[c]	1,442[b]	450[c]
Kansas	213	105	39	2,796	3,532	1,965	2,025	12,524[b]	13,486[b]	130[c]
Kentucky	517	450	283	1,754	860	562	279[c]	1,435[b]	1,080[b]	...
Louisiana[d]	1	0	0	0	0	0	0	0	0	...
Maine[d]	21	...	...	6	...	...	0	0	0	...
Maryland	368	265	129	570	650	422	538[c]	400[c]	137[c]	...
Massachusetts[d]	7	...	...	0	...	...	0	0	0	...
Michigan	657	326	196	2,730	1,082	806	626	1,161[b]	1,180[b]	63[c]
Minnesota	287	220	83	3,853	1,394	522	18,565	26,912[b]	17,224[f]	...
Mississippi[d]	5	...	0	0	...	0	0	0	0	...
Missouri	922	520	154	3,266	2,190	1,165	1,058	4,463[b]	8,001[b]	340[c]
Montana	12	52	37	245	655	114	0	557[b]	1,355[b]	...
Nebraska	255	204	92	1,567	1,307	802	0	1,906[b]	2,574[b]	...
Nevada[d]	24	...	...	7	...	...	0	0	0	...
New Hampshire[d]	7	...	...	56	...	...	0	0	0	...
New Jersey	178	58	32	288	68	70	0	0	137[c]	...
New Mexico[d]	52	...	18	64	...	26	0	0	0	...
New York	432	190	78	1,750	1,166	452	3,253	7,726[b]	12,258[b]	...
North Carolina	633	532	207	312	375	870	0	556[b]	240[c]	...
North Dakota	61	100	28	864	480	240	104[c]	1,669[b]	905[c]	...
Ohio	1,136	640	262	4,625	2,520	1,057	1,605	2,666[b]	3,099[b]	...
Oklahoma	42[g]	85	21	876[h]	885	813	298[c]	2,505[b]	3,367[b]	...
Oregon	142	68	34	1,045	691	119	640	2,586[b]	2,939[b]	150[c]
Pennsylvania	1,701	920	483	2,399	1,696	993	675	768[b]	369[b]	80[c]
Rhode Island[d]	1	...	...	0	0	0	0	0	0	...
South Carolina[d]	129	...	18	75	...	53	0	0	0	...
South Dakota	72	67	23	843	450	156	0	130[c]	0	...
Tennessee	666	630	230	1,578	1,186	844	1,269	1,441[b]	1,177[b]	70[c]
Texas	73	140	34	1,468	1,321	793	1,064	3,137[b]	5,300[b]	...
Utah	127	110	64	387	450	341	0	0	1,093[b]	...
Vermont[d]	6	...	...	0	...	...	0	0	0	...
Virginia	778	673	317	861	1,195	842	120[c]	510[c]	422[b]	...
Washington	37	35	23	977	1,425	680	855	4,459[b]	4,086[b]	...
West Virginia	385	280	85	382	387	210	0	0	0	...
Wisconsin	605	190	69	1,645	664	90	2,500	1,987[b]	850[c]	...
Wyoming[d]	10	...	12	35	...	73	0	0	0	...
Special Group	444	277	109	498	650	570	0	0	0	...

* Except as otherwise noted, these statistics are estimates by the Food Research Institute. Dots (...) indicate that separate estimates are not available.

[a] These totals do not agree with Table I because the superior data of the census special tabulation (Table V) were used for that table, whereas for estimates by states the statistics of the *Census of Manufactures* must be used.

[b] Data from the *Census of Manufactures*.

[c] Figure obtained by correspondence from the Bureau of the Census covering the wheat flour production of establishments classed for census purposes in the "Cereal preparations" and "Feeds, prepared, for animals and fowls" industries. Includes 840 thousand barrels for which we are unable to estimate the distributon by states. The estimates by states cover chiefly the production of a few large establishments classified in the "Cereal preparation" industry. For 1919 we estimate 650 thousand barrels of production outside the industry which is not distributed by states nor included in this table.

[d] Included for all years in the "Special group" of 16 states and the District of Columbia for which separate estimates cannot be made for 1919.

[e] Estimate subject to wider margin of error than most other estimates in this table.

[f] Corrected figure from Bureau of the Census. The United States total is corrected correspondingly.

[g,h] Including 21 and 219 thousand barrels, respectively, in Indian Territory.

TABLE IV.—TOTAL PRODUCTION OF FLOUR BY STATES, AND PERCENTAGES IN THREE BROAD OUTPUT CLASSES, 1899, 1919, 1931*

State	Production (*Thousand barrels*)			Percentages									
				Under 5,000			5,000-99,999			100,000 and over			Outside industry 1931
	1899	1919	1931	1899	1919	1931	1899	1919	1931	1899	1919	1931	
United States	103,524	133,671[a]	116,786[b]	12.5	6.1	3.1	47	26	17	40	68	78	2
Alabama[c]	144	...	7	61.0	...	100.0	39	..	0	0	0	0	..
Arizona[c]	66	...	...	16.9	...	...	83	..	..	0	0	0	..
Arkansas	606	386	107	34.0	41.5	19.6	66	26	80	0	33	0	..
California	2,660	3,386	1,867	3.5	1.6	1.6	29	17	13	68	82	86	..
Colorado	1,012	1,482	1,616	3.6	2.7	2.3	78	57	28	18	40	70	..
Connecticut[c]	2	...	0	100.0	...	0	0	0	0	0	0	0	..
Delaware[c]	158	...	72	49.9	...	47.2	50	..	53	0	0	0	..
D. of C.[c]	65	...	...	0	...	...	100	..	..	0	0	0	..
Florida[c]	1	...	0	100.0	...	0	0	..	0	0	0	0	..
Georgia	789	525	562	38.4	10.5	6.9	36	44	25	26	46	68	..
Idaho	261	1,110	820	11.2	5.4	3.7	89	72	96	0	22	0	..
Illinois	6,079	7,274	5,706	6.7	2.2	.9	52	34	19	41	64	80	..
Indiana	5,818	4,329	3,296	12.6	10.6	7.5	67	37	28	20	52	52	12
Iowa	2,503	1,265	2,090	16.3	9.9	3.1	73	37	6	11	53	69	22
Kansas	5,034	16,161	15,620	4.2	.6	.2	56	22	13	40	78	86	1
Kentucky	2,550	2,745	1,925	20.3	16.4	14.7	69	31	29	11	52	56	..
Louisiana[c]	1	0	0	100.0	0	0	0	0	0	0	0	0	..
Maine[c]	27	...	0	77.8	...	0	22	..	0	0	0	0	..
Maryland	1,476	1,315	688	24.9	20.2	18.8	39	49	61	36	30	20	..
Massachusetts[c]	7	...	...	100.0	...	...	0	..	..	0	0	0	..
Michigan	4,013	2,569	2,245	16.4	12.7	8.8	68	42	36	16	45	52	3
Minnesota	22,705	28,526	17,829	1.3	.8	.5	17	5	3	82	94	97	..
Mississippi[c]	5	...	0	100.0	...	0	0	..	0	0	0	0	..
Missouri	5,246	7,173	9,660	17.6	7.3	1.6	62	30	12	20	62	83	3
Montana	257	1,264	1,506	4.5	4.1	2.4	96	52	8	0	44	90	..
Nebraska	1,822	3,417	3,468	14.0	5.9	2.7	86	38	23	0	56	74	..
Nevada[c]	31	...	...	76.3	...	...	24	..	..	0	0	0	..
New Hampshire[c]	63	...	...	10.7	...	...	89	..	..	0	0	0	..
New Jersey	466	126	239	38.3	46.0	13.4	62	54	29	0	0	57	..
New Mexico[c]	116	...	44	44.8	...	40.9	55	..	59	0	0	0	..
New York	5,435	9,082	12,788	7.9	2.1	.6	32	13	3	60	85	96	..
North Carolina	945	1,463	1,317	67.0	36.4	15.7	33	26	66	0	38	18	..
North Dakota	1,029	2,249	1,173	6.0	4.5	2.4	84	21	21	10	74	77	..
Ohio	7,366	5,826	4,418	15.4	11.0	5.9	63	43	24	22	46	70	..
Oklahoma	1,216[d]	3,475	4,201	3.5	2.4	.5	72	26	19	24	72	80	..
Oregon	1,827	3,345	3,242	7.8	2.0	1.0	57	21	4	35	77	91	4
Pennsylvania	4,775	3,384	1,925	35.6	27.2	25.1	50	50	52	14	23	19	4
Rhode Island[c]	1	...	...	100.0	...	...	0	0	..	0	0	0	..
South Carolina[c]	204	...	71	63.3	...	25.4	37	..	75	0	0	0	..
South Dakota	915	647	179	7.9	10.4	12.8	92	70	87	0	20	0	..
Tennessee	3,513	3,257	2,321	19.0	19.3	9.9	45	36	36	36	44	51	3
Texas	2,605	4,598	6,127	2.8	3.1	.5	56	29	13	41	68	86	..
Utah	514	560	1,498	24.7	19.6	4.3	75	80	23	0	0	73	..
Vermont[c]	6	...	0	100.0	...	0	0	..	0	0	0	0	..
Virginia	1,759	2,378	1,581	44.2	28.3	20.0	49	50	53	7	21	27	..
Washington	1,869	5,919	4,789	2.0	.6	.5	52	24	14	46	75	85	..
West Virginia	767	667	295	50.2	42.0	28.8	50	58	71	0	0	0	..
Wisconsin	4,750	2,841	1,009	12.7	6.7	6.8	35	23	9	52	70	84	..
Wyoming[c]	45	...	85	23.2	...	14.1	77	..	86	0	0	0	..
Special Group	942	927	679	47.1	29.9	16.1	53	70	84	0	0	0	..

* Based on data in Table III.

[a] Excluding 650 thousand barrels (estimated) production outside the "Flour and other grain-mill products" industry.

[b] This total does not agree with Table I because the superior data of the census special tabulation (Table V) were used for that table, whereas for estimates by states the statistics of the *Census of Manufactures* must be used.

[c] Included in "Special group."

[d] Including 240 thousand barrels in Indian Territory.

TABLE V.—NUMBERS OF MILLS AND PRODUCTION OF FLOUR BY MILLS REPORTING MONTHLY AND BY OTHER MILLS REPORTING IN THE CENSUS OF MANUFACTURES, BY OUTPUT CLASSES, 1929, 1931, AND 1933*

(Production in barrels)

Output class	All reporting mills		Mills reporting monthly for 12 months[a]		Mills not reporting monthly[b]		Mills reporting monthly for part of the year[b]	
	Number[c]	Production[d]	Number[c]	Production	Number	Production	Number	Production
	1929							
United States total..	2,775	121,186,970	1,006	114,780,399	1,743	5,766,388	26	640,183
Under 1,000	390	219,305	8	5,135	382	214,170	..	.....
1,000-4,999	1,238	2,902,177	126	419,744	1,112	2,482,433	..	.....
5,000-19,999	592	5,577,031	350	3,559,101	224	1,808,741	18	209,189
20,000-99,999	288	14,782,775	258	13,456,979	23	1,003,808	7	321,988
100,000 or more.....	267	97,705,682	264	97,339,440	2	257,236	1	109,006
	1931							
United States total..	2,120	113,380,080	969	107,956,335	1,151	5,423,745	..	.....
Under 1,000	178	85,122	14	5,530	164	79,592	..	.....
1,000-4,999	848	2,205,264	120	411,994	728	1,793,270	..	.....
5,000-19,999	544	5,062,172	309	3,127,701	235	1,934,471	..	.....
20,000-99,999	299	15,319,418	279	14,483,300	20	836,118	..	.....
100,000 or more.....	251	90,708,104	247	89,927,810	4	780,294	..	.....
	1933							
United States total..	1,089	98,850,179	955	97,132,944	134	1,717,235	..	.....
Under 1,000	28	15,307	7	4,444	21	10,863	..	.....
1,000-4,999	210	675,805	157	527,759	53	148,046	..	.....
5,000-19,999	362	3,819,986	318	3,397,585	44	422,401	..	.....
20,000-99,999	261	13,242,560	247	12,615,576	14	626,984	..	.....
100,000 or more.....	228	81,096,521	226	80,587,580	2	508,941	..	.....

* A special tabulation prepared by the Bureau of the Census (see pp. 290-91).

[a] Production as reported monthly for the calendar year. Includes data for a few mills that reported for slightly less than twelve months, the production of which could be more reliably appraised from the available monthly reports than from the census of manufactures schedule for the same mills.

[b] Production as reported in the census of manufactures.

[c] The total numbers for 1929 and 1931 are larger than shown in tables in the *Census of Manufactures* for mills classed in the "Flour and other grain-mill products" industry owing to inclusion here of mills classed, for census purposes, in other industries. By output groups, differences arise also from use of somewhat different production figures for this table.

[d] Totals for 1929 and 1931 differ from census of manufactures totals largely owing to use of calendar year production for some mills which reported for fiscal years in the census of manufactures. For 1933, includes production of mills reporting total value of products less than $100,000 annually which were not called upon to report detailed production data in the census of manufactures for that year.

[e] Numbers are lower than in previously published tables owing to exclusion here of mills reported idle throughout the year.

TABLE VI.—PRODUCTION OF PREPARED (SELF-RISING) FLOUR REPORTED FOR 1933, CLASSIFIED BY KIND, SOURCE, AND INGREDIENTS*

(Barrels of 196 pounds)

Kind	Total product	Source	Cereal ingredients					Leavening, seasoning, shortening, etc. (pounds)
			Wheat flour	Corn meal and flour	Buckwheat flour	Rice flour	All other flour	
All kinds	4,645,305[a]	Total	4,003,957	173,514	59,293	37,726	37,210	65,386,369
		Ground	3,340,433	89,346	29,544	27,586	21,113	
		Purchased	663,524	84,168	29,749	10,140	16,097	
Self-rising wheat flour ("Biscuit")	3,819,679	Total	3,621,285	0	0	0	0	38,885,251
		Ground	3,009,722	0	0	0	0	
		Purchased	611,563	0	0	0	0	
Pancake flours	657,356	Total	278,877	173,450	59,293	37,719	36,477	14,021,859
		Ground	228,958	89,292	29,544	27,579	20,380	
		Purchased	49,919	84,158	29,749	10,140	16,097	
Doughnut, cake, muffin, and pie-crust flours	168,269	Total	103,795	64	0	7	733	12,479,259
		Ground	101,752	54	0	7	733	
		Purchased	2,043	10	0	0	0	

* Data from *Report on Special Survey for the Purpose of Determining the Constituents of Prepared Flour . . . . 1933*, prepared by Herbert C. Marshall and published in mimeographed form by the Bureau of the Census. As there published, the statistics are in pounds. The data represent only prepared flour reported on the "standard schedule," covering production of mills with value of products of $100,000 or more in either 1931 or 1933, other mills reporting through central administrative offices, and smaller mills in Massachusetts.

[a] Including non-cereal ingredients. Statistics in the *Census of Manufactures*, 1933, Table 2, show a total of 4,552 thousand barrels because the conversion is there made at 200 pounds per barrel. The total of *cereal ingredients* as computed above is 4,312 thousand barrels.

TABLE VII.—AVERAGE CAPACITY AND RATE OF OPERATION OF MILLS REPORTING MONTHLY AND QUARTERLY, BY CAPACITY GROUPS, 1932–1935*

Capacity group	1932			1933			1934			1935		
	Number of mills	Average 24-hour capacity (bbl.)	Rate of operation[a] (days)	Number of mills	Average 24-hour capacity (bbl.)	Rate of operation[a] (days)	Number of mills	Average 24-hour capacity (bbl.)	Rate of operation[a] (days)	Number of mills	Average 24-hour capacity (bbl.)	Rate of operation[a] (days)
Under 50	6	40	136	10	35	102	603	29	34	524	29	31
50	48	49	97	52	50	85	436	50	42	392	50	41
51-99	116	73	100	133	72	89	375	71	53	335	71	51
100	102	100	94	105	100	87	183	100	67	162	100	74
101-200	195	158	94	200	157	87	265	154	72	241	156	77
201-300	105	268	104	101	269	92	104	268	86	105	268	87
301-400	62	365	135	60	364	110	62	367	111	59	370	110
401-500	71	488	130	74	484	122	77	485	117	72	484	118
501-600	41	578	129	39	584	116	42	583	116	40	582	114
601-700	30	688	133	28	674	120	26	676	121	26	675	114
701-800	27	750	174	27	784	169	26	772	161	25	772	156
801-900	11	875	124	12	877	146	14	879	170	13	881	164
901-1,000	35	996	166	35	985	170	31	991	158	30	997	144
Over 1,000	161	2,377	180	161	2,361	176	159	2,387	181	159	2,389	181

* Compiled from census statistics of mills reporting monthly, 1932 and 1933, and monthly and quarterly, 1934 and 1935.

[a] Number of days of 24-hour operation that would have sufficed to produce the reported output for the year. This measure of activity is used in preference to percentage of capacity operation to avoid implying that some particular rate of operation is normal.

For mills in the lower capacity groups the averages for 1932 and 1933 reflect a selection of only the most active of such mills for the reporting group. Some influence from such selection is doubtless present also in the averages for 1934 and 1935.

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