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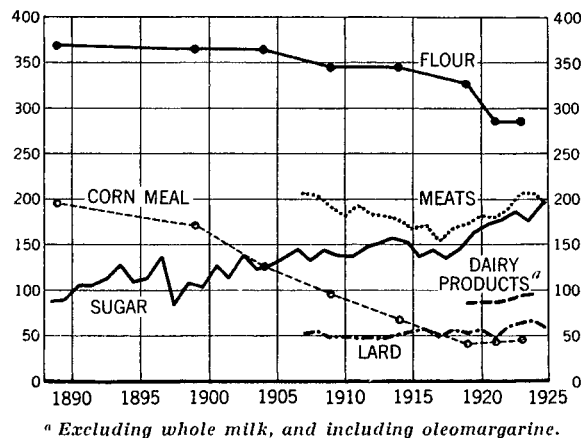
OF THE FOOD RESEARCH INSTITUTE

VOLUME II

NUMBER 8

THE DECLINE IN PER CAPITA CONSUMPTION OF FLOUR IN THE UNITED STATES

APPARENT CONSUMPTION OF IMPORTANT FOODS
(Thousand calories per capita)



The decline in per capita consumption of flour in the United States is part of a complex system of changes in consumption of the various important foods, as suggested by the curves in the chart above. For the later years the statistics cover foods representing about 80 per cent of the total energy value of all foods consumed in the United States. This study considers the fundamental factors responsible for the decline in per capita flour consumption and attempts to predict their influence in the next few years.

STANFORD UNIVERSITY, CALIFORNIA

July 1926

THE FOOD RESEARCH INSTITUTE

STANFORD UNIVERSITY, CALIFORNIA

Established in 1921 jointly by the Carnegie Corporation of New York and the Trustees of Leland Stanford Junior University, for research in the production, distribution, and consumption of food

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The central feature of the series is a periodic analysis of the world wheat situation with special reference to the outlook for supplies, requirements, trade, and prices. The volume opens with a review of the previous crop year. Subsequently three surveys of current developments are made at intervals of about four months.

These surveys are supplemented by intensive studies bearing on the appraisal of the wheat situation and outlook and upon related matters of national policy. Typical subjects are indicated in the list of studies shown on the fourth cover page of this issue.

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WHEAT STUDIES

OF THE FOOD RESEARCH INSTITUTE

VOL. II, No. 8

STANFORD UNIVERSITY, CALIFORNIA

JULY 1926

THE DECLINE IN PER CAPITA CONSUMPTION OF FLOUR IN THE UNITED STATES

SUMMARY

Statistics recently compiled by the Department of Agriculture show a striking decline since 1904 in the per capita consumption of flour in the United States. Prior to 1904, per capita flour consumption in the United States changed only slightly, according to these figures, but between 1904 and 1923 (the last year for which census data are available) it is shown to have declined over 21 per cent. If the figures compiled by the Department of Agriculture are to be trusted, the United States consumed in 1923 some 26,800,000 barrels less flour than it would have used if the 1904 rate of per capita consumption had been maintained. This amount is greater than the total flour exports of the United States in any twelve months of its history, except for one year during the war, and more than double the average annual exports of the ten years before the war.

The statistics compiled by the Department of Agriculture indicate further that the decline in per capita consumption of flour, while gradual and subject to certain interruptions, has been proceeding at an increasing rate. In the fifteen years between 1904 and 1919 consumption per capita appears to have decreased 10 per cent, while

in the next four years, 1919-23, it appears to have decreased 12 per cent. Does this more rapid decrease in recent years indicate that the forces which have reduced average flour consumption are steadily gaining strength and that the decline is gathering momentum? Or has the decrease

resulted from certain specific changes which are not continuing and may even be reversed?

Careful analysis of the data on which the Department of Agriculture figures are based indicates that they give a reliable measure of the trend of consumption. The actual consumption each year cannot differ much from this calculated disappearance, and the trend of disappearance as thus shown

may be accepted as a trustworthy statement of the trend of consumption. Additional independent evidence of the decline in flour consumption is found in the figures on per capita disappearance of wheat in the United States.

Study of the causes responsible for the decline in flour consumption per capita indicates that the most important factors have been a tendency to replace the cereals with sugar, a decrease in total food requirements per capita, a tendency to a more

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diversified diet, and a shift to more expensive foods generally, the last resulting chiefly from the increased prosperity of the laboring classes since the war. A minor part has been played by other factors which are discussed in detail.

Analysis of the causes which have affected flour consumption in past years shows also the changes that may be expected in the future. Three groups of factors that have been important in the past will probably cease to operate or will have little further

effect on flour consumption in the United States during the next several years. These are: first, the sudden increase in the prosperity of the laboring classes, which took place mostly between 1919 and 1923; second, the tendency to diversify the diet; and third, the decline in total food requirements per capita. The fourth factor, the substitution of sugar for the cereals, has had a profound influence in the past and may affect flour consumption even more in the future.

I. EVIDENCE OF DECLINING FLOUR CONSUMPTION

STATISTICS OF FLOUR CONSUMPTION

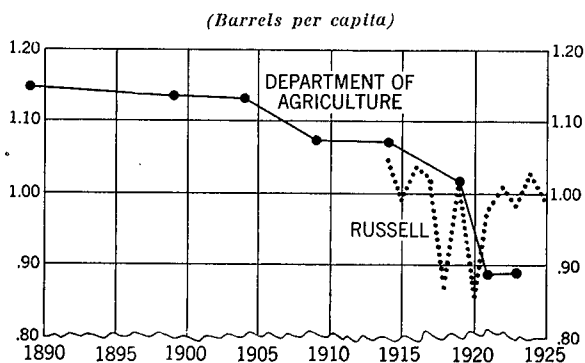
The fact of a sharp decline in per capita flour consumption in recent years is inferred from the flour disappearance figures compiled by the Bureau of Agricultural Economics of the United States Department of Agriculture, shown by the solid line in Chart 1. Table 1 shows the details of the calculations, as most recently published by the Department. Between 1879 and 1904 there appears to have been a slight decline in per capita flour consumption, amounting to about 2 per cent in the twenty-five years. The next fifteen years, 1904-19, show a decline of 10 per cent; and the last four years, 1919-23, a further decline of 12 per cent.

The 1925 figure, which is shown in the table as slightly higher than that for 1923, is omitted from the chart, as subject to a larger margin of error. It is based upon the "monthly census milling reports raised to represent all merchant mills reporting in 1923." The 968 identical mills which reported monthly throughout 1925 are stated by the Department of Commerce to have produced in 1923 approximately 87 per cent of the output reported for that year, leaving the output of the remaining mills to be estimated. The usual assumption is that these other mills produced 13 per cent of the total output in 1925 as they did in 1923, but a similar assumption has been found erroneous in previous years.¹ The Department's figure for 1925 certainly cannot command the same confidence as its figures

for the earlier years, and for present purposes it is desirable to await the results of the biennial census of 1925.

Two sorts of errors enter to prevent the disappearance figures from giving an accu-

CHART 1.—APPARENT PER CAPITA CONSUMPTION OF FLOUR, DERIVED FROM TWO SERIES OF PRODUCTION ESTIMATES, SINCE 1889*



* See Tables 1 (opposite) and 3 (p. 270).

rate measure of consumption. In the first place, flour production figures at best are not absolutely correct, and where they are not comprehensive the supplementary estimates are subject to certain errors. In the second place, statistics of flour stocks were not available for 1879, and for subsequent years they are certainly incomplete, probably in varying degrees. Quite possibly the changes in stocks from year to year are appreciably greater than the trade figures indicate. With these qualifications, however, the Department's estimates seem to present a reasonably reliable measure of the trend of flour consumption.

¹ Cf. p. 272 below.

Russell's estimates of flour production in recent years, as we point out below, fail to show such a decline in flour consumption, but rather indicate, as shown by the dotted line on Chart 1, a slight upward trend since 1919. It is therefore pertinent to examine

mills with a value of product between \$500 and \$5,000 of too little importance to require the inclusion of estimates of their production. The census of manufactures found that in 1921 the total value of products of flour and other grain mills with a value of

TABLE 1.—SUPPLY, DISPOSITION, AND PER CAPITA DISAPPEARANCE OF WHEAT FLOUR, CENSUS YEARS 1879-1925, AS ESTIMATED BY U.S. DEPARTMENT OF AGRICULTURE*

Year	Stocks Jan. 1 (thou- sand barrels)	Output (thou- sand barrels)	Imports (thou- sand barrels)	Total supply (thou- sand barrels)	Exports (thou- sand barrels)	Stocks Dec. 31 (thou- sand barrels)	Disappear- ance (thou- sand barrels)	Popula- tion July 1 sands) (thou-	Per capita disappearance		Bushels of wheat per barrel of flour
									As flour (barrels)	As wheat (bushels)	
1879.....	.....	62,840	15	62,855	6,125	.....	56,730	49,093	1.1556	5.60	4.85
1889.....	2,102	80,949	1	83,052	10,451	1,657	70,944	61,775	1.1484	5.48	4.77
1899.....	1,654	103,524	1	105,179	18,717	1,605	84,857	74,799	1.1345	5.37	4.73
1904.....	1,776	105,365	26	107,167	11,543	2,218	93,406	82,601	1.1308	5.38	4.76
1909.....	1,701	107,108	113	108,922	9,688	1,907	97,327	90,691	1.0732	5.04	4.70
1914.....	2,385	117,756	79	120,220	12,769	2,596	104,855	97,928	1.0707	5.03	4.70
1919.....	1,592	133,671	17	135,280	26,450	2,158	106,672	105,003	1.0159	4.70	4.63
1921.....	2,170	112,051	966	115,187	16,801	2,024	96,362	108,445	0.8886	4.19	4.71
1923.....	2,293	115,644	268	118,205	16,310	2,406	99,489	111,693	0.8907	4.20	4.71
1925.....	2,035	117,214	11	119,260	11,119	1,993	106,148	115,378	0.9200	4.32	4.70

* *Crops and Markets, Monthly Supplement*, April 1926, p. 108. Sources, fully stated in footnotes, may be summarized as follows: *stocks*—from *Daily Trade Bulletin*, Chicago, "World available" supply table; *production*—from census reports, supplemented, except in decennial years, by estimates for production of custom mills; *trade*—from Department of Commerce; *population*—as estimated by Census Bureau; and *conversion ratios*—as shown by census reports.

the derivation of the estimates of the Department of Agriculture, and then to consider the grounds for preferring them to Russell's estimates.

ESTIMATES OF THE DEPARTMENT OF AGRICULTURE

The flour production estimates of the Department of Agriculture are based primarily on census enumerations, and are made only for census years. They represent the output shown by the census, supplemented by estimates of production by custom mills, which were omitted in the quinquennial and biennial censuses. In 1921 and 1923 the census not only omitted custom mills, but included no production figures for merchant mills with a product valued at less than \$5,000. No census has included merchant mills with a value of product less than \$500.¹ The Department of Agriculture apparently considers the omission in 1921 and 1923 of figures for flour

product between \$500 and \$5,000 was only 0.3 per cent of the value of the products of all mills reporting, and in 1919, only 0.2 per cent. Since a considerable proportion of this small percentage must represent products other than flour, it is clear that the omission of the flour production of these small mills can have no significant effect on the figures.

The flour production of custom mills, omitted from all but the decennial censuses, is of considerably greater importance. This omission the Department of Agriculture has endeavored to correct by assuming that the production of custom mills in 1904 and in 1914 was the same as in 1909, namely, 1,351,816 barrels; and in 1921, 1923, and 1925 was the same as in 1919, namely, 1,205,068 barrels.

For the sake of a readier appraisal of possible errors in the Department of Agriculture figures, arising from inaccurate estimates for classes of mills not included in the censuses, we show in Table 2 the number and production of various sizes of merchant mills and of custom mills as re-

¹ Cf. *Census of Manufactures, 1923*, "Flour-Mill and Grain-Mill Products," p. 3.

ported in recent censuses. This table reveals clearly the relative insignificance, in total output, of the custom mills and of merchant mills producing under 1,000 barrels a year, despite their large numbers. In no year did these small merchant mills report as much as $\frac{2}{3}$ of one per cent of the total reported production, while by 1919 the custom mills had so declined in importance that they produced less than 1 per cent of the total

deserves consideration. In a previous number of *WHEAT STUDIES*¹ it has been shown that the census figures on wheat acreage have been grossly in error in certain years. The problem of collecting accurate figures of wheat acreage on a million or more farms, many of them difficult to reach and easy to overlook, is very different, however, from the problem of collecting accurate figures of flour output where some 98

TABLE 2.—NUMBER OF FLOUR MILLS AND PRODUCTION BY CLASSES, AS REPORTED IN SUCCESSIVE CENSUS ENUMERATIONS, 1904-23*

Year	Number of mills				Production (thousand barrels)				
	Merchant mills			Custom mills	Merchant mills				Total reported
	100,000 barrels and over	1,000 to 100,000 barrels	Less than 1,000 barrels		100,000 barrels and over	1,000 to 100,000 barrels	Less than 1,000 barrels	Custom mills	
1904.....	166	6,247	1,272	.....^a	104,013 ^b	...	...	.....^a	104,013
1909.....	193	5,428	1,721	11,961 ^c	105,095	661	...	1,352	107,108
1914.....	218	4,837	1,821	.....^a	71,809	43,878	717	.....^a	116,404
1919.....	274	4,418	2,041	10,427 ^c	90,830	40,766	870	1,205	133,671
1921.....	239	3,606	964 ^d	.....^a	76,919	33,407	520 ^a	.....^a	110,846
1923.....	247	2,841	741 ^d	.....^a	84,976	29,077	386 ^a	.....^a	114,439

* Data from *Census of Manufactures, 1905*, Part III, 349, 351; *Thirteenth Census of the United States, 1910*, X, 419-20; *Census of Manufactures, 1914*, II, 404-06; *Fourteenth Census of the United States, 1920*, X, 114-15; *Biennial Census of Manufactures, 1921*, pp. 105-09; *Census of Manufactures, 1923*, "Flour-Mill and Grain-Mill Products," pp. 18-22.

^a No data collected by census.

^b Includes merchant mills with product of less than 1,000 barrels.

^c Custom mills are not segregated as to type of product, and some of the mills here included may grind coarse grains but no wheat.

^d The figures in this group for 1921 and 1923 are not comparable with earlier years owing to the omission of mills with a product valued at less than \$5,000 (roughly equivalent to 800 barrels of flour).

reported flour output of the country. It appears also that the output of these smaller mills has been declining. The great decrease, in 1921 and 1923, in the number and output of merchant mills producing less than 1,000 barrels is due, however, to the omission of all mills with a value of product under \$5,000; at the average value of product of the remaining mills in this class, \$6.02 per barrel in 1923, this meant the omission of most mills producing less than about 800 barrels a year. Complete omission of production figures for all custom mills and for merchant mills with an output under 1,000 barrels would have reduced the apparent flour consumption in 1919 by less than 0.02 barrel per capita. Any error in the Department's allowance for these mills can scarcely have resulted in an error as great as 0.01 barrel per capita in any year.

The possibility that significant errors are present in the census figures themselves

per cent of the output is produced by fewer than 7,000 mills, centrally located and easily reached. The fact that a census of wheat acreage has been seriously incomplete gives no substantial reason for expecting a census of flour milling to be likewise incomplete.

Furthermore, if the downward trend in apparent consumption of flour per capita is to be accounted for, even partly, on the ground of incomplete census enumerations, it must be on the assumption that the census enumerations have become progressively less adequate. This assumption would run directly counter to such evidence as is available on the reliability of the successive census enumerations. Altogether, the supposition that the changes in per capita consumption of flour indicated by these figures arise to any appreciable extent

¹ June 1926, II, 237-64, especially pp. 238, 240, 245-46.

from errors in the census enumerations seems quite untenable.

There remains for consideration the item of flour stocks used by the Department of Agriculture in arriving at its figures for flour disappearance. The statistics of flour stocks are those of the *Chicago Daily Trade Bulletin*. These figures are based in part on actual returns of stocks at leading points and on estimates for a few other points. They include supplies at the leading cities and at country points, small mills, etc., but are in no sense comprehensive. Russell's estimates of flour stocks include, in addition to the *Daily Trade Bulletin* figures, flour on the piers in New York and an estimate for mill holdings and transit holdings based on a percentage of the week's output. His figure is therefore much larger than that of the *Daily Trade Bulletin*, but contains a much larger element of estimate. The Census Bureau collected reports, as of December 31, 1925, of flour stocks in the hands of city mills (partly outside the mills proper), and henceforth will compile similar data quarterly. The three sets of figures for January 1, 1926, compare as follows:

<i>Daily Trade Bulletin</i>	1,993,000 barrels
Russell	6,900,000 barrels
Census Bureau	4,584,000 barrels

The census figure represents reports from mills which in 1923 produced 88 per cent of the total flour production of merchant mills, and probably would be around 5,000,000 barrels if all were included. These three figures of stocks overlap more or less, but even the largest is far from constituting an approximate inventory of aggregate flour stocks in the country on January 1. Very probably this aggregate would be at least 10 million barrels in an average year, and possibly as high as 15 million or more.

Since the figures for flour stocks used in the estimate of the Department of Agriculture are far too low, the inference follows that the variation in aggregate flour stocks from year to year may easily be much greater than the quoted figures show.¹ In particular years this variation may not be

unimportant. From May 1920 to the middle of 1921, for example, price movements and financial considerations were such as to make for heavy reduction in flour inventories all along the line. As a matter of fact, the *Daily Trade Bulletin* figures show a decline from 2,499,000 on April 1, 1920, and 2,283,000 on July 1, 1920, to 1,478,000 on July 1, 1921; but the figures show only a moderate decline from January 1, 1921, to January 1, 1922. The full reduction may have been much greater, and the true per capita consumption may have been appreciably larger in 1921 than the estimate shows. Different conditions may have led to an overstatement of consumption in 1919.

On the other hand, variations in flour stocks on January 1 cannot be large in proportion to the annual output, and since errors in reckoning these variations cannot be cumulative, there is no ground for questioning the general trend of the flour consumption figures. We may question whether actual consumption dropped as much as 12 per cent from 1919 to 1921, but the downward trend from 1919 to 1923, as well as that from 1904 to 1919, cannot readily be called in question. We conclude, therefore, that the Department's calculations deserve substantial credence as a measure of the declining trend of per capita flour consumption.

RUSSELL'S ESTIMATES

The estimates of flour production since 1914 published by A. L. Russell, as we have noted, yield per capita consumption figures differing considerably from those derived from the census enumerations. The data are presented in Table 3 (p. 270), and the per capita figures are shown graphically in Chart 1 (p. 266). In particular, they indicate a stationary or increasing consumption per capita since 1919 and considerably more fluctuation from year to year than is suggested by the figures based on the census enumerations.

There is no indication that Mr. Russell's figures are intended to be taken as more reliable than the census. They seem to have been prepared to supply monthly and weekly figures not available from the census (except in the form of the incomplete

¹ The tendency of mills and bakeries to carry low inventories on January 1, for balance sheet reasons, reduces the importance of this consideration.

monthly returns which have been gathered by the Census Bureau since May 1923), to provide figures more promptly available than any collected by the Census Bureau, and to fill the gaps between census enumerations. In considering the reliability of his yearly totals we are examining a feature of the data which is distinctly subsidiary to their principal purpose.

ducing mills of the country and as a matter of subsequent investigation were found to cover about 95 per cent of the capacity and between 97 and 98 per cent of the output of the country."¹ Apparently this degree of completeness was maintained until the end of May 1920, so that the Grain Corporation figures for these years closely approximate the census in completeness. So far as can

TABLE 3.—SUPPLY, DISPOSITION, AND PER CAPITA DISAPPEARANCE OF WHEAT FLOUR, CALENDAR YEARS 1914-25, BASED ON RUSSELL'S ESTIMATES OF PRODUCTION*

Year	Stocks Jan. 1 (thousand barrels)	Output (thousand barrels)	Imports (thousand barrels)	Total supply (thousand barrels)	Exports (thousand barrels)	Stocks Dec. 1 (thousand barrels)	Disappear- ance (thousand barrels)	Population July 1 (thousands)	Per capita disappear- ance (barrels)
1914.....	2,385	116,423	79	118,887	12,769	2,596	103,522	98,974	1.0460
1915.....	2,596	114,632	244	117,472	15,662	2,226	99,584	100,390	.9920
1916.....	2,226	119,947	186	122,359	14,379	2,290	105,690	101,787	1.0383
1917.....	2,290	117,785	642	120,717	13,926	1,428	105,363	103,234	1.0206
1918.....	1,428	112,206	167	113,801	21,706	1,592	90,503	104,377	.8671
1919.....	1,592	133,088	17	134,697	26,450	2,158	106,089	105,007	1.0103
1920.....	2,158	109,754	801	112,713	19,854	2,170	90,689	106,422	.8522
1921.....	2,170	121,225	966	124,361	16,801	2,024	105,536	108,370	.9738
1922.....	2,024	125,604	694	128,322	15,025	2,293	111,004	109,742	1.0115
1923.....	2,293	125,761	268	128,322	16,310	2,406	109,606	111,469	.9833
1924.....	2,406	132,011	65	134,482	15,990	2,035	116,457	113,454	1.0265
1925.....	2,035	125,200	11	127,246	11,119	1,993	114,134	115,058	.9920

* Production estimates compiled from *Russell's Commercial Review*; other data as in Table 1 (p. 267) except for slight differences in population figures. The Department of Agriculture appears to have used unpublished estimates of the Census Bureau. The population estimates used here are those of the National Bureau of Economic Research. The differences between the two sets of estimates appear to be insignificant.

Russell's estimates of flour production for the period from January 1914 to May 1920 appear to be based primarily on investigations made and returns received by the United States Food Administration Grain Corporation and by its successor, the United States Grain Corporation, for both of which Mr. Russell was statistician. For the subsequent period they are understood to be based on reports published weekly by the *Northwestern Miller* with estimates for non-reporting mills, supplemented since May 1923 by the statistics reported by the Census Bureau.

The statistics collected after July 1, 1918, by the Food Administration Grain Corporation and the United States Grain Corporation appear to have been extraordinarily complete. At the end of the 1918-19 crop year it was stated that "The reports finally secured by the Milling Division as to flour production covered practically all the pro-

be determined from the tables published by the Grain Corporation,² the published figures from July 1918 to May 1920 represent production as actually reported with no estimates for the few mills not reporting. In Russell's estimates as they now stand the monthly figures of the Grain Corporation for 1918 and 1919 have been raised so that the total for 1919 appears only slightly under the census figure. The figures, in thousand barrels, compare as follows:

	1918	1919
Grain Corporation	110,991	132,334
Russell	112,206	133,088
Census .....	.....	133,671

Prior to July 1918 the basis for Russell's estimates is much less satisfactory. One

¹ *Grain and Flour Statistics During the War*, U.S. Grain Corporation, 1919, p. 3.

² *Supplement to Grain and Flour Statistics During the War*, 1920, p. 22.

of the first tasks of the Milling Division was the collection of data on pre-war flour production of the mills of the country. For this purpose the Division obtained reports from a large number of mills on monthly production during the three calendar years 1914-16. The results of this survey are set forth in a table described as "A report by the Milling Division of the capacity of the mills of the country showing the number in each group of capacity and the production by months of each division during the pre-war years." The table is based, apparently, on reports from 1,178 mills. The final section of the table gives totals for all divisions for each year and adds two additional estimates for each year: a total "Production for 1914-'15-'16 raised to 100 per cent basis of final report of June 15, 1918," and an "Estimated grand total production of all mills of the country."¹ The Grain Corporation also publishes a table described as a "Report of flour production in the three pre-war years, by states and by Milling Divisions, and total production of the mills reporting," in which still different figures are shown for these three years.²

The various estimates for 1914-16 are shown in Table 4. It will be observed that Russell's present estimates are not only below the "grand total" estimate of the Grain Corporation, but in 1914 and 1916 are appreciably below the "equal 100 per cent" estimate of the Grain Corporation. Russell's estimate for 1914 agrees closely with the census enumeration for that year, which did not include custom mills, while the "equal 100 per cent" and "grand total" estimates of the Grain Corporation are far above all the other figures. The inference is that the Grain Corporation's estimates were too high, either because of an overestimate for non-reporting mills, or because the production was overstated in the reports, or both. It is worthy of note that the reports were obviously intended to furnish a basis for allocating subsequent wheat supplies. For present purposes the discrep-

ancies and the explanations which may be offered for them are chiefly significant as indicating the incompleteness and the somewhat uncertain accuracy of the figures available to Mr. Russell as a basis for his estimates.

TABLE 4.—VARIOUS ESTIMATES OF FLOUR PRODUCTION, 1914-16*
(Thousand barrels)

Estimate by	1914	1915	1916
Grain Corporation:			
"Reported".....	90,469	92,719	98,636
"Total".....	100,755	90,993	96,653
"Equal 100 per cent".....	126,932	114,633	120,947
"Grand total".....	129,522	116,972	123,415
Russell.....	116,423	114,632	119,947
Census.....	116,404	.....	.....
Dept. of Agriculture....	117,756	.....	.....

* Grain Corporation data from its publications, *Grain and Flour Statistics During the War*, 1919, pp. 8, 13. Census data from *Fourteenth Census of the United States*, 1920, X, 110 (merchant mills only). Other data from Tables 1 and 3, pp. 267 and 270, respectively.

For the crop year 1917-18 the Grain Corporation obtained weekly production reports from "agreement mills" and made monthly estimates of total United States production.³ The incomplete and variable character of the reports may be judged from the facts that the reported production for September was 75.6 per cent of the estimated total, and that for subsequent months the reported production ranged between 81.1 and 89.3 per cent of the estimated totals, except for February and April when it rose to 90.5 and 93.9 per cent, respectively.

For the period since May 1920, Russell has relied chiefly upon data collected by the *Northwestern Miller*. Since May 1923 the monthly reports of flour production collected by the Department of Commerce have also been available. In these years, Russell's estimates of flour production run much higher than those of the Census Bureau and the Department of Agriculture, as the following figures, in thousand barrels, show:

	1921	1923	1925
Census.....	110,846	114,439	.....
Dept. of Agriculture.	112,051	115,644	117,214
Russell	121,225	125,761	125,200

The data on which Russell's estimates have been based since May 1920, while

¹ Cf. *Grain and Flour Statistics During the War*, 1919, p. 13.

² *Ibid.*, Table II, p. 8.

³ The reported and estimated monthly totals are shown in *ibid.*, p. 15.

doubtless trustworthy so far as they go, are quite incomplete. The "968 identical mills" for which production is now being tabulated by the Department of Commerce are stated to have "produced approximately 87 per cent of the total wheat flour reported in 1923," and the *Northwestern Miller* data are much less comprehensive. It is a serious question whether this group of mills now produces the same proportion of the total output as it did in 1923. The large mills are more completely represented than the small mills, and with the tendency, noted above, for the larger mills to increase in relative importance, it seems probable that the percentage of the total output produced by any such group of mills is increasing year by year. Furthermore, the trend of production by any group of identical mills must fail to reflect any increase in total production arising from an increase in the total number of mills in existence or any decrease in total production arising from the elimination of mills which fail and go out of business. Since 1919 the mortality among mills has been high. All such discontinued mills are necessarily excluded from the group of identical mills.

Whatever the cause of the discrepancy between Russell's estimates of total flour production in 1921 and 1923 and the figures derived from the census enumerations, as supplemented by the Department of Agriculture estimate for mills not included in the census, there seems no reasonable ground for preferring Russell's estimates. Russell's estimates were 10,379,000 barrels above the census for 1921, and 11,322,000 barrels above the census for 1923. There seems no reason to suppose that these censuses were not complete within the classification covered, namely, merchant mills with an output valued at \$5,000 or more. This being the case, the census figures can be raised to the level of Russell's estimates only on the assumption that the production of mills deliberately excluded from the censuses of 1921 and 1923 amounted to some 10 or 11 million barrels. The mills omitted from the censuses were merchant mills with a value of product under \$5,000, and custom mills. In 1919 the census showed a production of

only about two million barrels for custom mills and all merchant mills producing less than 1,000 barrels.¹ As a matter of fact, production of a considerable proportion of the merchant mills with an output under 1,000 barrels is included in the censuses of 1921 and 1923, and it is very questionable whether the output of custom mills has increased at all since 1919.

In short, Russell's figures involve so large an element of estimate on such uncertain grounds that their divergence from the official estimates deserves to carry no weight in estimating the trend of per capita flour consumption. They are highly valuable for the purpose of showing the monthly and weekly course of production, but they cannot be accepted as casting doubt upon the calculations of the Department of Agriculture.

ADDITIONAL EVIDENCE OF THE DECLINE

The fact of the decline in per capita consumption of flour is further substantiated by figures for domestic disappearance of wheat. Chart 2 compares the per capita domestic disappearance of wheat for food, feed, and waste, since 1901-02, as derived from the revised official estimates of production,² with the Department of Agriculture figures of per capita flour disappearance since 1889 expressed in terms of wheat. The serious errors in the official production estimates prior to 1901 destroy their value for such a comparison in earlier years. The figures on domestic disappearance of wheat are taken from the supply and distribution table prepared by the Department of Agriculture,³ altered only to the extent that flour exports are converted to terms of

¹ Cf. discussion and table on pp. 267-68 above.

² While we consider our revised estimates of production, published in the June number of *WHEAT STUDIES*, to be superior to the revised official estimates, the differences are slight after 1901, and disappearance figures derived from our revised estimates could not be considered as independent evidence of the decline in per capita flour consumption, since our revision is based in large part on the flour consumption figures.

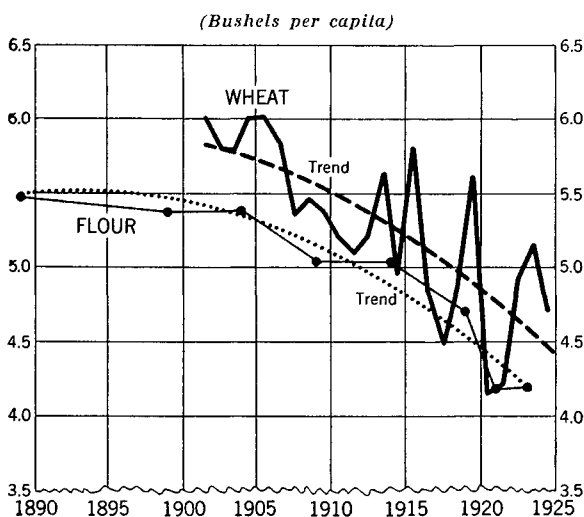
³ U.S. Department of Agriculture Statistical Bulletin No. 12, *Wheat and Rye Statistics*, January 1926, pp. 44-47.

wheat at the rate of 4.7 bushels per barrel of flour.¹ The disappearance for food, feed, and waste is calculated by computing first the total supply from the year's crop plus carryover out of the preceding year, and imports of wheat and flour in terms of wheat. This total supply, minus the exports of wheat and of flour in terms of wheat, shipments to possessions, estimated seed requirements, and the reported carryover into the following year, gives the apparent domestic disappearance for food, feed, and waste.²

The domestic disappearance of wheat is necessarily larger, on the average, than the disappearance of flour in terms of wheat, inasmuch as the former must cover feed and waste as well as wheat milled for domestic flour consumption. The wheat disappearance figures also show a much wider fluctuation, owing partly to the variation in the items of feed and waste, but chiefly to the fact that apparent disappearance of wheat may differ widely from the actual consumption. The carryover of wheat from one crop year to the next varies greatly, and available data on year-end carryovers for past years are neither complete nor accurate. The visible supply statements omit a large portion of the stocks at central points and are not entirely comparable from year to year. The estimates of stocks in country mills and elevators, prior to 1919, as used by the Department of Agriculture, are the Chicago Board of Trade statements of stocks in second hands

July 1 less the Chicago Board of Trade visible supply. These figures are less complete and probably less nearly comparable from year to year than the visible supply figures. The estimates of farm stocks are probably subject to a large error, since the crop correspondents, from whose reports the estimates have been derived, are not in a position to know the facts with any great degree of accuracy. No statistics are available for the earlier years on stocks of wheat in the hands of city mills.³

CHART 2.—PER CAPITA DISAPPEARANCE OF WHEAT, CROP YEARS 1901-02 TO 1924-25, AND OF FLOUR IN TERMS OF WHEAT, CENSUS YEARS 1889-1923*



* Flour data from Table 1 (p. 267). Wheat data from Department of Agriculture *Statistical Bulletin* 12, Table 43, with slight alterations due to conversion of flour to wheat at a rate of 4.7 bushels per barrel, and to substitution of population estimates of National Bureau of Economic Research for census estimates, for the years 1909-25.

¹The actual ratio of wheat milled to flour produced in the United States was 4.70 bushels per barrel in 1909 and in 1914, and 4.71 bushels per barrel in 1921 and in 1923. Under the influence of war-time economies it fell somewhat below this figure, and in 1919 stood at 4.63 bushels per barrel. Cf. last column in Table 1, p. 267.

²The population estimates used in obtaining per capita figures are slightly different from those used by the Department. See footnote to Chart 2.

³Additional data now being collected periodically by the Department of Commerce and the Department of Agriculture will supply much more complete and adequate information on stocks of wheat and flour than has previously been available. Incidentally, they demonstrate strikingly the inadequacy of earlier statistics. For a more detailed discussion of the limitations of past figures on stocks of wheat and of flour and an outline of the additional data which should be collected, see *The Disposition of American Wheat Supplies*, WHEAT STUDIES, August 1925, I, 293-98.

As a result of the incomplete and inaccurate character of the figures on carryover, the apparent disappearance of wheat is much larger in some years than the actual consumption, and in other years much smaller. The variation in disappearance from year to year can furnish, by itself, no basis for conclusions as to the variation in actual consumption of wheat.

Over any considerable period of years, however, the domestic disappearance of wheat for food, feed, and waste must correspond closely with the actual consumption unless there are significant errors in the production estimates. The downward

trend in per capita domestic disappearance of wheat since 1901 can be explained only on the ground of an actual decrease in per capita consumption or a progressive tendency to increasing understatement of the crops. There is no evidence whatever for the latter hypothesis; and the disappearance figures accordingly furnish strong supporting evidence of the declining per capita consumption of flour in the United States.

II. TRENDS OF CONSUMPTION OF OTHER FOODS

A variety of suggestions have been offered to account for the decline in per capita consumption of flour. Among the most complete of the published discussions is that included in a press release issued by the U.S. Department of Agriculture.¹ None of the published discussions, however, has attempted a careful statistical comparison of the changes in consumption of flour with the changes in consumption of other foods or has presented an adequate background upon which to base any confident forecast of the probable future trend of flour consumption. A statistical study of the trends in per capita consumption of other important foods and of the factors influencing food consumption brings out certain facts which are quite contrary to common impressions and gives an illuminating picture of the conditions which are causing current changes in food consumption. Most important of all, perhaps, the study of statistics for other foods gives a basis for judging the relative importance of the various factors involved. Some of the factors which have received most attention turn out to have little actual significance, while two of the most important factors have received little consideration.

¹ Released for publication May 14, 1926. The factors cited in this statement as chiefly responsible for the decline in flour consumption are the increased average purchasing power of the population, "enabling consumers to purchase large amounts of fruit, vegetables, and dairy products, at the expense of wheat flour"; the shift of the population from the country to the city, where less bread is eaten; the larger variety of foods now available; increased efficiency in the use of flour resulting from the growth of the baking industry and from the use of a higher quality of wheat; and the use of more milk, fat, and other ingredients in addition to flour in bakery products.

If further evidence of the decline in flour consumption per capita be necessary, it may be found in the fact that the study of factors affecting flour consumption, as set forth in succeeding pages, indicates that most of the important forces which might be expected to influence per capita flour consumption have been tending to cause a decrease in consumption. The decline was an inevitable result of these forces.

An excellent picture of the relative importance of the various foods as they are consumed in the United States is furnished

TABLE 5.—RELATIVE CONSUMPTION OF VARIOUS FOODS IN THE UNITED STATES IN TERMS OF ENERGY VALUE, 1911-12 TO 1916-17*

Commodity	Percentage of total	
<i>Wheat and flour</i>		25.90
<i>Meats and lard</i>		21.65
Pork and lard.....	15.74	
Beef.....	5.30	
Mutton.....	.61	
<i>Dairy products</i>		15.26
<i>Sugar</i>		13.24
<i>Cereals other than wheat</i>		8.77
Corn.....	7.03	
Rice.....	.60	
Rye.....	.45	
Others.....	.69	
<i>All other foods</i>		15.21
Oils.....	3.62	
Potatoes.....	3.36	
Poultry and eggs.....	2.02	
Vegetables unspecified....	1.13	
Apples.....	1.08	
Nuts.....	.92	
Legumes.....	.83	
Fruits unspecified.....	.62	
Oleomargarine.....	.42	
Fish.....	.41	
Bananas.....	.40	
Cocoa.....	.29	
Oranges.....	.11	
<i>Total</i>		100.03

* Adapted from Raymond Pearl, *The Nation's Food* (W. B. Saunders, Philadelphia, 1920), p. 236.

by the study of Raymond Pearl in *The Nation's Food*. Pearl's calculations are summarized in Table 5. They indicate that

during the six years, 1911-12 to 1916-17, over three-fourths of the food supply of the United States, measured in energy value, was derived from the four food groups of wheat, meats (including lard), dairy products, and sugars. Of the total, 26 per cent was derived from wheat, 22 per cent from

cane and beet sugar, and corn meal, which together with wheat flour constituted approximately 80 per cent of the total calorie-intake in the period covered by Pearl's calculations. This information leaves a good deal to be desired, in respect to periods covered, reliability of data, and es-

TABLE 6.—APPARENT CONSUMPTION OF MEATS AND LARD, CALENDAR YEARS 1907-25

Year	Total ^a (million pounds)					Per capita ^b (pounds)					Calories per capita ^c (thousands)	
	Beef	Pork	Veal	Mutton and lamb	Lard	Beef	Pork	Veal	Mutton and lamb	Lard	All meats	Lard
1907.....	6,780	6,624	644	558	1,055	77.64	75.86	7.38	6.39	12.1	206.4	51.1
1908.....	6,367	6,981	627	557	1,154	71.59	78.49	7.05	6.26	13.0	204.8	54.9
1909.....	6,835	6,100	683	601	1,042	75.52	67.40	7.55	6.64	11.5	191.1	48.5
1910.....	6,561	5,881	686	596	1,052	70.99	63.63	7.42	6.45	11.4	180.5	48.1
1911.....	6,342	6,763	656	729	1,063	67.59	72.07	6.99	7.77	11.3	192.2	47.7
1912.....	5,807	6,570	667	773	1,068	60.97	68.98	7.00	8.12	11.2	181.4	47.3
1913.....	5,852	6,797	487	725	1,100	60.26	69.99	5.01	7.47	11.3	180.5	47.7
1914.....	5,722	6,812	437	724	1,192	57.81	68.83	4.42	7.32	12.0	175.8	50.6
1915.....	5,414	6,668	428	622	1,281	53.93	66.42	4.26	6.20	12.8	167.0	54.0
1916.....	5,639	6,848	536	613	1,368	55.40	67.28	5.27	6.02	13.4	170.2	56.5
1917.....	6,083	5,704	662	473	1,195	58.92	55.25	6.41	4.58	11.6	153.1	49.0
1918.....	6,522	6,534	765	486	1,374	62.49	62.60	7.33	4.66	13.2	168.9	55.7
1919.....	6,474	6,629	808	607	1,292	61.65	63.13	7.69	5.78	12.3	170.4	51.9
1920.....	6,713	7,318	814	588	1,416	63.08	68.76	7.65	5.53	13.3	180.6	56.1
1921.....	6,171	7,792	751	639	1,223	56.94	71.90	6.93	5.90	11.3	179.9	47.7
1922.....	6,643	8,270	797	545	1,558	60.53	75.36	7.26	4.97	14.2	188.1	59.9
1923.....	6,850	9,531	872	576	1,707	61.45	85.50	7.82	5.17	15.3	206.0	64.6
1924.....	6,993	9,669	935	589	1,749	61.64	85.22	8.24	5.19	15.4	205.9	65.0
1925.....	7,166	8,749	1,004	597	1,523	62.28	76.04	8.73	5.19	13.2	191.8	55.7

^a Data from *Meat Production, Consumption and Foreign Trade in the United States*, Bureau of Animal Industry, U.S. Department of Agriculture, 1925.

^b The population figures used in calculating per capita consumption for 1907-08 are the estimates of the Bureau of the Census for population July 1; for 1909-25, estimates of National Bureau of Economic Research, from their *News-Bulletin*, March 17, 1926.

^c Based on analyses given by Bryant and Atwater, U.S. Department of Agriculture, Office of Experiment Stations, *Bulletin No. 28*, revised edition, 1906, pp. 19-34, 55. The values used, in calories per pound, are: beef 935, veal 555, mutton and lamb 1,055, lard 4,220, being for the meats the values given as averages of all analyses for "sides, as purchased," and for lard, the value for refined lard as purchased. The value used for pork is 1,622 calories per pound, obtained by finding the average of the "medium fat, all analyses" values for the different cuts, weighted according to the relative weights of the cuts in a 250-pound hog, as shown in Armour's *Monthly Letter to Animal Husbandmen*, September 1924, p. 4; Bryant and Atwater's figure for "sides" was not used because of the small number of analyses on which it is based and the uncertainty of the meaning of the term *side* as applied to pork.

meats, including lard, 15 per cent from dairy products, and 13 per cent from sugars. An additional 7 per cent was derived from corn products.

Pearl's estimates, while they give no picture of trends in consumption of different foods over more than a brief period, furnish a serviceable basis for determining which foodstuffs it is important to examine for this purpose. The remainder of this section is devoted to a study of per capita figures for consumption of the principal meats, lard, dairy products (except whole milk),

pecially deficiency in statistics of stocks. It is, however, sufficient to throw considerable light on the changes in the relative consumption of different foods, and on the trend in per capita consumption of these important foodstuffs in the aggregate.

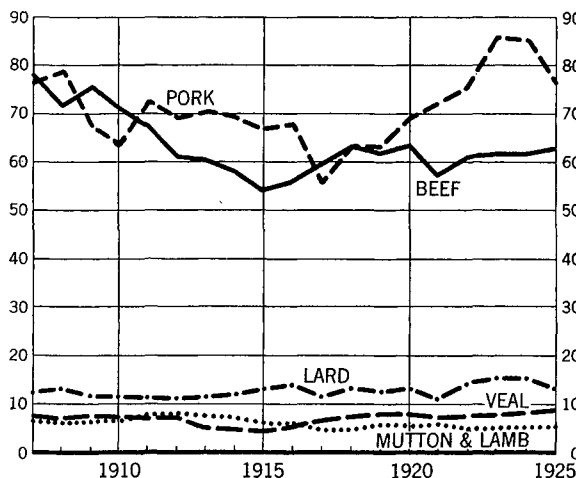
CONSUMPTION OF PRINCIPAL FOODS

Table 6 and Chart 3 (p. 276) show, on a per capita basis, the apparent consumption of each important class of *meat* and of *lard* in the United States since 1907. The primary

annual figures are conveniently available in the estimates of the Bureau of Animal

CHART 3.—APPARENT PER CAPITA CONSUMPTION OF PRINCIPAL MEATS AND LARD, 1907-25*

(Pounds per capita)



* See Table 6, p. 275.

Industry of the United States Department of Agriculture.¹

Beef consumption per capita appears to

¹ It should be noted that these estimates of meat and lard consumption are subject to a wider margin of error than any other figures used in the present study of food consumption. The latest report of the Bureau of Animal Industry (1925) states that "The estimates are based on the federally inspected slaughter. . . . The animals shown in the first table are converted into meat by use of average carcass weights and average dressing percentages derived from packers' reports to the Department, census reports, etc. Spoilage of meat is allowed for only in respect to that which is condemned under the Federal inspection.

"The slaughter each year is accurate so far as the number of animals slaughtered under United States inspection is concerned. Ratios are established for the remaining slaughter which are subject to changes due to more recent data from census and other sources. The annual ratios of cattle and calf slaughter are estimated by the method of Dr. Sewall Wright, formerly of the Animal Husbandry Division of this Bureau."

Consumption estimates are obtained by subtracting exports from the estimated production, adding imports, and (since 1916) adjusting for changes in stocks. The weakness in the estimates lies in the necessity of estimating ratios of other slaughter to federally inspected slaughter. The uninspected slaughter amounts in the case of hogs to some 40 per cent of the total, and the information on which it must be estimated is meager and unsatisfactory. The actual trend of consumption, therefore, may differ appreciably from that shown.

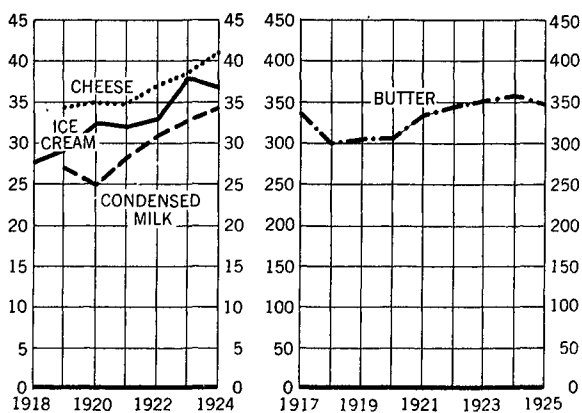
have declined materially (about 23 per cent) between 1909 and 1914, to have increased slightly during the war, and since 1918 to have remained practically constant. Pork consumption reached relatively low levels in 1909, 1910, and 1917, and apart from these dips, shows a fairly steady downward trend until 1918. In 1920 there began a sharp upward trend which carried pork consumption in 1923 and 1924 to the highest levels shown. The consumption of mutton and lamb and of veal has been too small throughout to play an important part as a substitute for other foods.

Lard consumption appears high in 1907 and 1908, perhaps partly owing to an accumulation of stocks in these years, during which production was unusually large. In preparing the estimates of consumption, no correction is made for changes in stocks until 1916. A slight upward trend of consumption began in 1914, followed by exceptionally high consumption in the three years 1922-24, with a decrease in 1925.

In estimating the total consumption of *dairy products*, Pearl obtained his figures by assuming an average annual milk pro-

CHART 4.—APPARENT PER CAPITA CONSUMPTION OF FOUR PRINCIPAL DAIRY PRODUCTS, IN TERMS OF WHOLE MILK, SINCE 1917*

(Pounds per capita)



* See Table 7, p. 277.

duction of 4,278 pounds per cow, calculating the total production by applying this figure to the official estimates of number of dairy cows in the country each year, and

making certain allowances for waste. For his purpose this method was probably the best available, since no satisfactory independent figures are available on consumption of fresh whole milk. There is a general belief, however, that milk production per cow is increasing and that many wastes are

most important of which is fresh whole milk, must be omitted.

The per capita quantities of whole milk estimated to have been consumed in cheese, condensed and evaporated milk, ice cream, and butter, respectively, and the total, are shown in Chart 4 (p. 276) and Table 7 for

TABLE 7.—APPARENT CONSUMPTION OF FOUR PRINCIPAL DAIRY PRODUCTS AND OLEOMARGARINE, CALENDAR YEARS 1917-25*

Year	Total apparent consumption					Per capita apparent consumption				
	Condensed milk (million pounds)	Cheese (million pounds)	Ice cream (million gallons)	Butter (million pounds)	Oleomargarine (million pounds)	Condensed milk (pounds)	Cheese (pounds)	Ice cream (gallons)	Butter (pounds)	Oleomargarine (pounds)
1917.....	.....	.....	.....	1,657.3	228.5	.....	.....	.....	16.05	2.21
1918.....	.....	.....	209.4	1,485.6	322.5	.....	.....	2.01	14.23	3.09
1919.....	1,130.3	360.2	222.0	1,522.1	349.0	10.76	3.43	2.11	14.50	3.32
1920.....	1,059.6	372.4	247.1	1,553.6	360.2	9.96	3.50	2.32	14.60	3.38
1921.....	1,220.3	377.3	243.9	1,725.7	210.2	11.26	3.48	2.25	15.92	1.94
1922.....	1,357.8	404.8	262.2	1,796.1	179.6	12.37	3.69	2.39	16.37	1.64
1923.....	1,454.3	425.7	305.7	1,866.8	226.5	13.05	3.82	2.74	16.75	2.03
1924.....	1,553.6	464.6	302.6	1,934.1	229.9	13.69	4.10	2.67	17.05	2.03
1925.....	.....	.....	.....	1,904.8	228.3	.....	.....	.....	16.55	1.98

Year	Whole milk equivalent (pounds per capita)				Calories per capita					
	Condensed milk	Cheese	Ice cream	Butter	Condensed milk	Cheese	Ice cream	Butter	Oleomargarine	Total
1917.....	.....	.....	.....	337.05	.....	.....	.....	57,860	7,790	.....
1918.....	.....	.....	27.64	298.83	.....	.....	8,983	51,299	10,892	.....
1919.....	26.90	34.3	29.01	304.50	8,742	6,688	9,428	52,272	11,703	88,833
1920.....	24.90	35.0	31.90	306.60	8,092	6,825	10,501	52,633	11,914	89,832
1921.....	28.15	34.8	30.94	334.32	9,149	6,786	10,368	57,392	6,838	90,221
1922.....	30.92	36.9	32.86	343.77	10,049	7,196	10,680	59,014	5,781	92,720
1923.....	32.62	38.2	37.68	351.75	10,602	7,449	12,246	60,384	7,156	97,837
1924.....	34.22	41.0	36.71	358.05	11,122	7,995	11,931	61,465	7,156	99,669
1925.....	.....	.....	.....	347.55	.....	.....	.....	59,663	6,980	.....

* Data for condensed milk and cheese computed from production, exports and imports, and stocks as reported by U.S. Department of Agriculture and Bureau of Foreign and Domestic Commerce. Data for ice cream from reports to U.S. Department of Agriculture raised to 100 per cent on basis of statement that they represent approximately 60 per cent of total production. Data for butter and oleomargarine from *Survey of Current Business*, February 1926. Per capita calculations as described in Table 6, p. 275. Conversions to whole milk on basis of milk equivalent (in pounds), for condensed milk 2.5 per pound, for cheese 10 per pound, for ice cream 13.75 per pound, and for butter 21 per pound. Cf. U.S. Department of Agriculture *Yearbook*, 1922, p. 293. Calories calculated for condensed milk and ice cream at 325 calories per pound of whole milk used, for cheese at 1,950, for butter at 3,605, and for oleomargarine at 3,525 calories per pound. (Bryant and Atwater, pp. 54, 55.)

being eliminated. If such is the case, assumption of a constant production per cow and a constant loss may yield an indication of the general level of consumption of dairy products, in terms of milk, at that time, but must fail seriously as an indication of the rate of change in consumption. For our purposes it is better to use the direct figures available for specific dairy products, despite the fact that certain products, the

years for which figures are available. A fairly steady increase is shown by each class of dairy product, except that butter shows a considerable decline from 1917 to 1918 and a sharp increase in 1923, continued into the subsequent years.

There are no satisfactory figures on total consumption of fresh whole milk in the United States. The Department of Agriculture estimates that nearly one-half of

the total production is used in this form.¹ Accepting Pearl's estimate that 15 per cent dairy products has increased markedly in recent years.

TABLE 8.—APPARENT CONSUMPTION OF CANE AND BEET SUGAR IN THE UNITED STATES, FISCAL YEARS 1888-89 TO 1924-25*

Year July-June	Total (million pounds)	Per capita (pounds)	Calories per capita (thou- sands)	Year July-June	Total (million pounds)	Per capita (pounds)	Calories per capita (thou- sands)	Year July-June	Total (million pounds)	Per capita (pounds)	Calories per capita (thou- sands)
1888-89...	3,090	50.96	88.2	1901-02..	5,044	64.32	111.3	1914-15..	8,697	87.22	150.9
1889-90...	3,191	51.37	88.9	1902-03..	6,412	80.10	138.6	1915-16..	7,973	78.90	136.5
1890-91...	3,868	61.01	105.5	1903-04..	5,728	70.15	121.4	1916-17..	8,497	82.82	143.3
1891-92...	3,920	60.81	105.2	1904-05..	6,108	73.35	126.9	1917-18..	8,167	78.64	136.0
1892-93...	4,264	64.88	112.2	1905-06..	6,554	77.20	133.6	1918-19..	8,816	84.34	145.9
1893-94...	4,939	73.73	127.6	1906-07..	7,161	82.77	143.2	1919-20..	9,830	92.99	160.9
1894-95...	4,324	63.32	109.5	1907-08..	6,657	75.54	130.7	1920-21..	10,665	99.29	171.8
1895-96...	4,499	64.65	111.8	1908-09..	7,343	82.18	142.2	1921-22..	11,242	103.01	178.2
1896-97...	5,603	79.00	136.7	1909-10..	7,346	80.26	138.8	1922-23..	11,825	106.83	184.8
1897-98...	3,475	48.07	83.2	1910-11..	7,312	78.48	135.8	1923-24..	11,341	100.64	174.1
1898-99...	4,609	62.60	108.3	1911-12..	7,950	84.16	145.6	1924-25..	12,906	112.90	195.3
1899-1900..	4,486	59.69	103.3	1912-13..	8,339	86.73	150.0				
1900-01...	5,596	72.86	126.0	1913-14..	8,903	90.65	156.8				

* Totals in terms of raw sugar, without correction for changes in stocks, from *Agriculture Yearbook, 1924*, p. 802, supplemented by trade data (including shipments to and from possessions) for 1924-25 in *Monthly Summary of Foreign Commerce*, June 1925, and altered, for the years to 1908-09 inclusive, to include beet sugar production and exports (*Agriculture Yearbook, 1924*, pp. 801-02) on raw basis throughout, at 100 pounds raw to 93 pounds refined. Per capita figures computed as in Table 6 (p. 275), but using population estimates for January 1. Conversion to calories at 1,730 calories per pound, equivalent of Bryant and Atwater (p. 65) figure of 1,860 for refined sugar.

of the energy value of the nation's food was derived from milk in the years 1911-16, it would appear that some 7 or 8 per cent was derived from fresh whole milk.

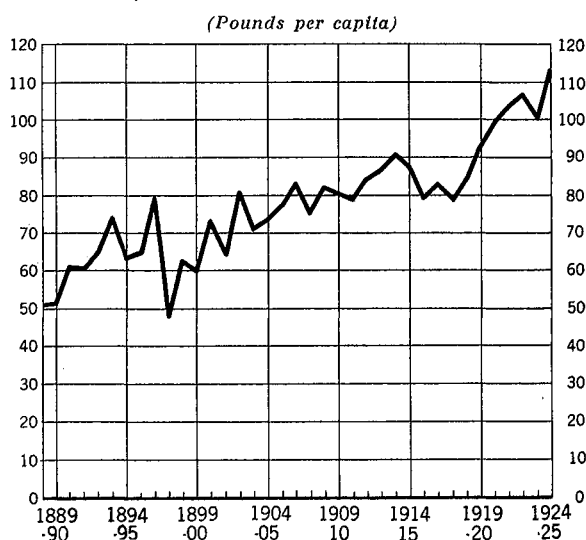
Such fragmentary data as are available point to a substantial increase in fresh milk consumption in recent years. The Department of Agriculture stated in 1922 that "During the last three or four years educational campaigns have been conducted in many cities to increase the consumption of milk. . . . Surveys showed that in many districts the amount of milk consumed was inadequate and as a result of this educational work the consumption in several large cities has been increased as much as 10 to 20 per cent, and the increases maintained."² It appears, therefore, that per capita consumption of all important

¹ Cf. tabulation in *Agriculture Yearbook, 1924*, p. 871. The estimates given are necessarily somewhat rough as regards household use and have not been considered sufficiently reliable for use in a quantitative study of trends of food consumption, but they may here be accepted without question as an indication of the approximate magnitude of the items.

² "The Dairy Industry," in U.S. Department of Agriculture *Yearbook, 1922*, pp. 288-89.

Over 85 per cent of the total consumption of all sugars in the United States is in the form of cane and beet sugar, and for pres-

CHART 5.—APPARENT PER CAPITA CONSUMPTION OF SUGAR, FISCAL YEARS 1888-89 TO 1924-25*



* See Table 8.

ent purposes these alone need be considered. The figures on consumption of cane

and beet sugar in the United States as published by the Department of Agriculture are predominantly for raw sugar but in part represent refined sugar. For the purposes of Table 8 and Chart 5 (opposite) they have been converted, so far as possible, to the basis of raw cane sugar throughout, counting 93 pounds of refined sugar equivalent to 100 pounds of raw. From this chart it

corn meal in the United States, amounting to over 75 per cent in the period 1889-1923.

CONSUMPTION OF OTHER FOODS

Consumption data on several other foods are much to be desired. Individually none of them is very important, but the foods omitted in the foregoing summary of con-

TABLE 9.—APPARENT CONSUMPTION OF CORN MEAL AND WHEAT FLOUR, CENSUS YEARS 1899-1923*

Year	Corn meal						Wheat flour		Calories per capita (thousands)	
	Production (thousand barrels)			Net exports (thousand barrels)	Apparent consumption		Apparent consumption		Corn meal	Wheat flour
	Merchant mills	Custom mills	Total		Total (thousand barrels)	Per capita (barrels)	Total (thousand barrels)	Per capita (barrels)		
1889.....	.....	.....	36,898	334	36,564	.597	70,944	1.148	193.65	369.14
1899.....	27,839	12,197	40,036	869	39,167	.527	84,857	1.134	170.94	364.67
1904.....	23,625	8,916 ^a	32,541 ^a	357	32,184	.390	93,406	1.131	126.51	363.48
1909.....	21,553	5,636	27,188	509	26,679	.295	97,327	1.073	95.69	344.97
1914.....	16,328	4,872 ^a	21,200 ^a	391	20,809	.210	104,855	1.071	68.12	344.17
1919.....	10,683	4,107	14,790	1,241	13,549	.129	106,672	1.016	41.84	326.55
1921.....	10,932	4,000 ^a	14,932 ^a	857	14,075	.130	96,362	.889	42.17	285.63
1923.....	12,155	4,000 ^a	16,155 ^a	711	15,444	.139	99,489	.891	45.08	286.31

* Corn meal production from census enumerations, supplemented by our estimates for custom mills in 1904, 1914, 1921, 1923; net exports, including shipments to possessions, from publications of Bureau of Foreign and Domestic Commerce. Wheat flour data from Table 1, p. 267. Per capita calculations as described in Table 6, p. 275. Conversion to calories at 1,655 calories per pound for corn meal, 1,640 for wheat flour (Bryant and Atwater, pp. 56, 58).

^a Custom mills output estimated by Food Research Institute.

appears that there was a steady increase in per capita sugar consumption from 1900 until about 1914, followed by a decline to a slightly lower level during the war years and a rise to new high levels beginning about 1919.

Among products of the grains other than wheat, *corn meal* is the only one of large importance in the United States. The production figures are readily available for merchant mills in each census year and for custom mills in the years of decennial censuses. The necessity of estimating the relatively large production in custom mills in years of quinquennial and biennial censuses together with the absence of figures on stocks at the beginning and end of each year, renders the final consumption estimates less reliable than the corresponding figures for apparent consumption of wheat flour. It is quite clear, however, from the figures in Table 9 that there has been a very striking decline in the consumption of

sumption, even in the years in which meats and dairy products are included, contribute in the aggregate some 20 per cent of the energy value of our total food consumption. If a considerable proportion of them show a common trend, the net influence may be considerable. The most important single omission is that of fresh whole milk, discussed above (pp. 276-78).

Next in importance among the foods are the oils, according to Pearl's estimate. In the years 1911-12 to 1916-17 they appear to have supplied 3.6 per cent of the energy in the nation's food. Potatoes follow with 3.4 per cent; and the four groups, poultry and eggs, fruits, vegetables (other than white potatoes), and other cereals, supply about 2 per cent each. Nuts reach nearly 1 per cent.

While existing data on all these foods seemed sufficient to Pearl for a useful estimate of the general level of consumption, it is only in the case of potatoes that they appear accurate and complete enough to

justify an estimate of the *trend* of consumption. Per capita production of potatoes appears to have remained constant during the last 20 years and it seems probable that consumption per capita has likewise remained substantially unchanged. There may have been a change in the percentage of the crop wasted, however, in which case the trend of consumption will differ slightly from that of production. No attempt is made to include potato consumption figures in the subsequent study because the year-to-year changes are very inaccurately represented by the production changes (the excess in years of large crops being largely absorbed by feed and waste). The available evidence indicates that there has been no change in the general level of per capita consumption, the aspect of the problem in which we are interested.

No reliable figures are yet available on the total consumption of oils for food, although the Bureau of the Census is enlarging the scope of its work in this field and the Food Research Institute has begun the assembly and interpretation of available data. There is considerable evidence that the use of salads is increasing materially and with it the consumption of salad oils.

Data on consumption of poultry and eggs are as yet quite inadequate for determining the trend, although the Department of Agriculture is rapidly improving the basis for its estimates.

Any attempt to estimate the trend of per capita consumption of vegetables (other than white potatoes) must be largely vitiated by the presence of large and quite unknown elements of production in home gardens and changing waste. A similar, though lesser, difficulty is encountered in attempting to estimate the trend of consumption of fruits. Total car loadings of fruits and vegetables have increased sharply and the impression of most observers is that per capita consumption of both fruits and vegetables has increased materially since 1900.

A fairly reliable estimate of the trend of consumption of "other cereals" and of nuts could probably be obtained, for recent years at least. The total consumption of these foods in the United States is so small, however, that even a very large percentage change would have only a slight influence on the consumption of other foods. In a preliminary study such as the present they may safely be neglected.

III. TREND OF TOTAL FOOD CONSUMPTION PER CAPITA, 1889-1919

PHYSIOLOGICAL FACTORS DETERMINING FOOD CONSUMPTION

To judge the significance of the changes in consumption of other foods as compared with the changes in consumption of flour, it is useful to have a comparison in terms of energy values. The human body requires food both as a source of energy and for the sake of three different constituents or groups of constituents necessary for proper nutrition, namely, protein, minerals, and vitamins. Although a source of certain minerals, bread serves chiefly as an energy-producing food; it is therefore the loss in energy value from the decreasing consumption of flour and the gain in energy value from increasing consumption of other foods, that should be compared. A further reason for treating food consumption in

terms of energy value is found in the fact that physiological factors exist which determine within very narrow limits, under any given conditions, the total energy value of the food which can and must be eaten.

Energy values of food are customarily measured in calories, one calorie being the amount of energy required, in the form of heat, to raise the temperature of one gram of water from 0 to 1 degree centigrade. The energy derived from food is mostly used in four different ways. First is the energy required to carry on the normal body functions when the person is at rest in a warm room; this is technically termed the "basal metabolism." Second is the energy used to maintain the body temperature when in a cool environment. Third comes the energy required for physical work. Finally, a growing child, or an adult who is increasing in

weight, stores up large quantities of energy in the form of fat or other body tissue.

A man of 160 pounds with customary clothing in a temperature in the neighborhood of 60° F. with light work and incidental activity, such as that of a professional man, a teacher, or a salesman, ordinarily requires 2,400-2,700 calories per day. The average woman engaged in the same general occupation needs 100-200 calories less. If the temperature is reduced without additional protection by added clothing, the caloric requirement increases. With added physical work also, more food is required; for practical purposes three calories of heat will be dissipated for one calorie transformed into work. Medium-hard physical work brings up the requirement to 3,500, still harder work another 1,000, and the most arduous occupations bring the figure up to 8,000. Boys from 14 to 18 years of age in schools with free opportunity for games consume in the neighborhood of 5,000 calories.

Most people not acquainted with the results of recent research in the field of food requirements seem to be of the opinion that the amount of food a person eats depends principally on taste and habit and in most cases far exceeds his actual food requirement. Much has been said and written, for example, of the habitual "overeating" of most Americans. As a matter of fact, every individual who is maintaining constant weight is unconsciously regulating his eating in accordance with his actual bodily requirements. If he eats more, he gains weight, if he eats less, he loses weight.

The natural means of accomplishing this adjustment is, for the most part, not through watching the scales or the fit of one's clothes and adjusting one's eating accordingly, but through the unconscious and automatic functioning of the appetite. The adjustment of the appetite to the needs of the body for energy-producing foods is so completely unconscious that most people, perhaps, are entirely unaware of its action. Yet excellent illustrations of this adjustment of the appetite to bodily requirements are familiar to everyone: fats and other "rich" foods, high in energy value, satisfy the appetite very quickly; candy eaten be-

fore dinner is likely to spoil one's enjoyment of the meal; and most people are content with very light meals for a day or two after Thanksgiving and Christmas.

There is a broad physiological basis for this doctrine of the saturation point of demand for foodstuffs. Herbivorous animals fatten during the summer in preparation for the high heat requirements and the shortage of vegetation in winter; hibernating animals fatten during the summer in preparation for the winter's fast. Carnivora tend to maintain a fairly constant body weight with some seasonal fluctuations. This has been frequently observed with dogs. These animals when underweight try to eat all food offered to them until they reach normal body weight; thereafter dogs eat such amounts of food as are necessary to maintain body weight within relatively narrow limits, ingesting more of low-calorie foods and less of high-calorie foods. In other words, the dog eats calories instead of pounds.

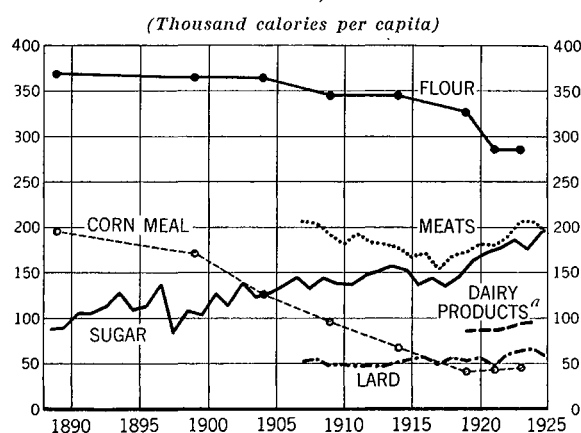
Children are like dogs underweight, and many have difficulty in eating enough to keep up to normal weight. Most adults maintain a relatively constant body weight with a certain seasonal fluctuation, unconsciously adapting their diet to this end. With some adults, the body weight tends slowly to increase with age, with others to decrease with age. There is a large group with a tendency to obesity, corresponding to selected strains of domesticated animals which tend to lay on fat instead of maintaining a constant body weight. For adults, the block of calories remains relatively constant, but there is wide variation of the components within the block—more or less cereal, more or less meat, more or less sugar, more or less bulk, but a relatively constant quantity in calories.

SUMMARY OF STATISTICS, 1889-1925

To provide a basis for studying the changes in food consumption since 1889 in the light of the physiological factors just discussed, the consumption statistics presented in Section II have been converted into terms of calories. The consumption of the various foods each year in these terms

is shown in Tables 6-9 (pp. 275-79). The same data are shown graphically in Charts 6 and 7. For convenience of comparison only the total for all meats has been shown in these charts, and the four classes of dairy products for which figures have been obtained are grouped together, with the addition of oleomargarine. Chart 6 shows most clearly the changes in consumption of individual foods or groups of foods and the relative importance of each. Chart 7, on

CHART 6.—APPARENT PER CAPITA CONSUMPTION OF IMPORTANT FOODS, SINCE 1889*



* See Tables 6-9, pp. 275-79.

^a Excluding whole milk, and including oleomargarine.

the other hand, gives the better picture of the way in which the changes are related and shows clearly the steady decline in total consumption per capita of all the foods covered prior to the war, and the considerable increase in total consumption since 1919. The previous section has shown the importance of the physiological factors controlling the total energy value of all food consumed.

Examination of the changes in per capita consumption of the various important food groups may well begin with the latest years, for which the data are more nearly complete. The marked decrease in per capita consumption of flour between 1919 and 1921 was accompanied by no significant change in consumption of corn meal, but by an almost equal increase in consumption of sugar, so that the line representing the consumption of flour, corn meal, and sugar together, in calories per capita, declines only very slightly during this period. Meanwhile

the consumption of meats increased considerably and that of lard and of dairy products very slightly, resulting in a slight upward trend in the curve of total consumption in calories per capita for the six foods and groups of foods together.

The decline in consumption of flour between 1904 and 1919, occurring mostly in the first five years of the period, was accompanied by an even greater decline in consumption of corn meal. Sugar consumption, measured in calories per capita, increased meanwhile by almost the amount of the decrease in flour consumption, but with the sharp decline in corn meal the combined consumption of the two important cereal products and of sugar, in calories per capita, showed a substantial decrease. Adding to these the consumption of meats and lard, available since 1907, the decline appears even greater.

Prior to 1904 the decline in per capita consumption of flour was insignificant, but there was a marked decline in consumption of corn meal, offset only partially by an increase in sugar consumption.

CHANGING AMOUNT OF FOOD WASTAGE

In studying statistics of food consumption it is important to bear in mind the fact that the statistics apply to quantities of food available at some point considerably removed from the actual consumer. One must distinguish among: first, food as reported in statistics and delivered into the trade; secondly, the same food carried through diverse acts of processing and conversion; thirdly, the same foodstuffs, some processed and others in their unaltered states, delivered by retailers to households; fourthly, the happenings between the state as purchased and as served upon the table; and, lastly, the remnants of table service that remain unconsumed. Between each of these stages and the next is a series of wastes. In other words, between the food as reported in statistics and the food as ingested are the wastes in wholesale distribution, the wastes in processing and converting, the wastes in retail distribution, the wastes in the kitchen, and the wastes on the table.

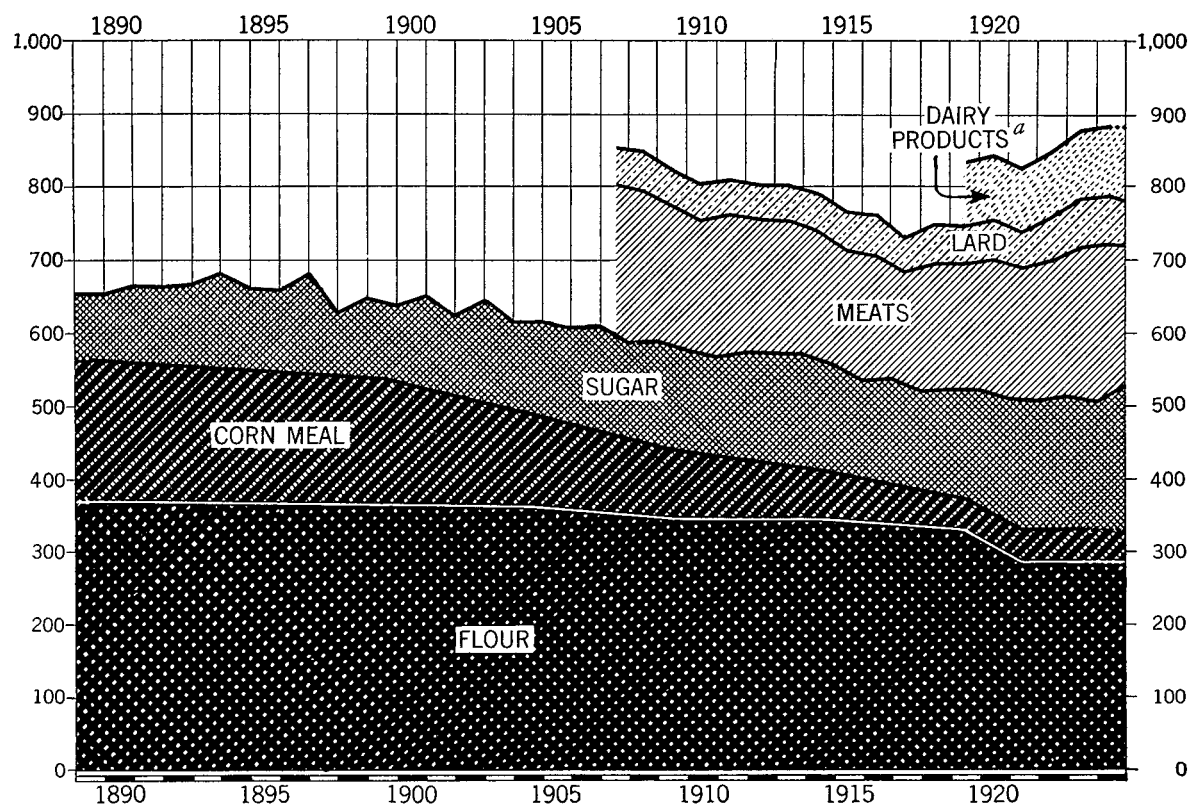
The wastes in the kitchen and on the table are indicated roughly by garbage collections and are usually measured in terms of fats. These wastes are very heavy and contribute an appreciable fraction of the raw materials for soap manufacture. The wastes in wholesale distribution like-

developments in culinary equipment. Per capita waste is probably less in public eating houses than in homes, but we have no measure of the difference.

There is no way of evaluating a trend for any of these wastes as a gross process. Cold storage and organized rail transport

CHART 7.—CUMULATIVE CHART OF APPARENT PER CAPITA CONSUMPTION OF IMPORTANT FOODS, SINCE 1889*

(Thousand calories per capita)



* See Tables 6-9, pp. 275-79. ^a Excluding whole milk, and including oleomargarine.

wise are very heavy for perishables and large even for nonperishables. The wastes in the preparation of food, whether in the home or in public eating places, are large. They vary between classes of foodstuffs, regions, years, and classes of people. It is commonly inferred that, other things being equal, waste is inverse to price; but there are many exceptions. It is commonly inferred that, other things being equal, waste is proportional to prosperity; but again there are many exceptions. Waste is modified by improvements in marketing and by

have reduced the wastes of many perishables and prolonged the seasons of consumption. Centralized slaughtering of meats is less wasteful than country slaughtering. Improvements in canning and desiccation have reduced the wastes of fruits and vegetables. When sugar prices are low, canning and preserving are encouraged and waste in fruits reduced. Whether the reduction of waste by producers counterbalances the increase of waste by consumers, cannot be determined from the available data.

INFLUENCE OF DECREASING AMOUNT OF MANUAL LABOR

With these facts in mind we may proceed to a consideration of the causes of the various changes. Prior to 1919 there appears a steady decline in the per capita consumption of the foods for which we have statistical data. The total decline in energy value derived from flour, corn meal, and sugar together, during the thirty years 1889-1919, amounts to nearly 20 per cent. Was there a corresponding decline in total per capita food consumption in terms of energy value, or did the consumption of meats, dairy products, fruits and vegetables, and poultry products increase to such an extent that the total consumption of all food, in terms of calories per capita, showed a much smaller decrease or perhaps remained constant?

During the last twelve years of the period, at least, it seems quite clear that meat consumption did not increase, but rather decreased; prior to 1907 we have no data sufficient for even a reasonably reliable guess as to the trend of meat consumption. It is generally believed that since 1900 at least, the consumption of dairy and poultry products and fruits and vegetables has been increasing. Improvements in the methods of handling both these groups of products has promoted such an increase, making them readily available in good condition to a larger portion of the population and over more months of the year. At the same time there has been developing a wider understanding of the value of fruits and vegetables and dairy products in the diet. It is difficult to believe, however, that the increase in consumption of dairy products and fruits and vegetables can have been sufficient to offset the decreases in consumption in other lines. Even in the years 1911-17, according to Pearl's estimate, dairy products, fruits, and vegetables other than potatoes supplied less than 19 per cent of the total energy value of the American diet. Altogether the evidence seems to indicate very clearly that between 1907 and 1919 there was a considerable decline in per capita consumption of all foods, in terms of energy value, and that probably this

decline began at least as early as 1890. Prior to 1919 this decrease in total food consumption affected other foods as a group more than it did the consumption of flour.

The statistical evidence of the decline in total food consumption is supported and explained by certain other facts. Most important of these, probably, is the increasing substitution of machinery for manual labor in many lines. The laborer doing heavy physical work requires much more food than the man engaged in more sedentary occupations. Steam shovels, automatic stokers for boilers, mechanical ditch-digging machines, conveyors in factories, agricultural machinery, and many other mechanical devices have been taking the place of manpower and increasing the proportion of the population engaged in tending machines, clerking, and other sedentary occupations requiring much less physical exertion. The differences in amounts of food required for different kinds of work are strikingly shown in certain tests quoted by Graham Lusk:¹

Two seamstresses, using a sewing machine, required 1,900 and 2,100 calories, respectively.

Two household servants, employed in such occupations as cleaning windows and floors, scouring knives, forks, and spoons, scouring copper and iron pots, required 2,300 to 2,900 calories.

Two washerwomen, the same servants as the last named, required 2,600 and 3,400 calories in the fulfillment of their daily work. . . .

Two tailors (men) required 2,400 to 2,500 calories. . . .

Two metal workers, filing and hammering metals, required 3,100 and 3,200 calories.

Two painters, occupied in painting furniture, required 3,200 and 3,300 calories, and two carpenters engaged in making tables required the same amount of energy. . . .

Two men sawing wood required 5,000 and 5,400 calories.

Woods and Mansfield, in a study of the food consumption of a crew of Maine lumbermen engaged in the heavy work of chopping and yarding, found an average daily consumption with a value of 8,198 calories per man.²

¹ *The Elements of the Science of Nutrition*, third ed., 1917, p. 349. The tests summarized by Lusk in this quotation were reported by Becker and Hämäläinen.

² *Studies of the Food of Maine Lumbermen*, U.S. Department of Agriculture, Office of Experiment Stations, Bulletin No. 149, 1904, pp. 16-17.

The shift of workers from the heavy manual labor requiring a large expenditure of energy and high consumption of energy-producing foods to the lighter tasks of office work and machine tending, with the introduction of labor-saving machinery, has been greatly augmented by the change in general character of the industry and commerce of the nation. Census statistics bearing on these changes appear in Table 10. The most significant change shown by these

Industries" and "Trade and Transportation" varies greatly, but with the extensive use of labor-saving machinery in these branches of industry there can be little doubt that the increasing relative importance of these branches at the expense of agriculture and forestry has brought about a substantial decrease in the proportion of workers engaged in heavy physical labor.

The census classification of occupations fails to show the change in relative im-

TABLE 10.—DISTRIBUTION OF PERSONS 10 YEARS OF AGE AND OVER ENGAGED IN GAINFUL OCCUPATIONS IN THE UNITED STATES, CENSUS YEARS 1870-1920*
(Percentages)

Occupation	1870	1880	1890	1900	1910	1920
Agriculture, forestry, and animal husbandry	47.4	44.4	39.2	35.7	33.2	26.3
Extraction of minerals.....	21.6	21.8	24.4	24.4	2.5	2.6
Manufacturing and mechanical industries..					27.8	30.8
Trade	9.5	10.8	14.3	16.4	9.5	10.2
Transportation					6.9	7.4
Clerical occupations	21.5	19.7	18.1	19.2	4.6	7.5
Professional service					4.4	5.2
Domestic and personal service.....					9.9	8.2
Public service					1.2	1.9

* Data for 1870 compiled from data in *Ninth Census of the United States*, 1870, I, 670-71; for 1880, 1890, and 1900 compiled from *Thirteenth Census of the United States*, 1910, IV, 41; for 1910 and 1920 compiled from *Abstract of the Fourteenth Census of the United States*, 1920, p. 482. Figures for 1910 and 1920 are not entirely comparable with those for earlier years on account of minor changes in census classification.

statistics, from the point of view of effect on food consumption, has been the decline in percentage of workers engaged in agriculture, forestry, and related industries. The proportion has declined from over 47 per cent of the total in 1870 to about 26 per cent in 1920. These are all occupations in which a large proportion of the workers are employed at tasks requiring severe physical exertion. Furthermore, much of the work in these occupations is out of doors, where considerable amounts of energy may be required in cold weather to maintain the body temperature. The principal increases shown by the table are in manufacturing and mechanical industries and trade and transportation. The increase in persons engaged in professional service from 3.5 per cent in 1880 to 5.2 per cent in 1920 has been large relatively, but not great in terms of the number of workers involved.

The amount of physical labor required in the various occupations included under the captions "Manufacturing and Mechanical

portance, numerically, of different types of work. The heading "Manufacturing and Mechanical Industries," for example, does not distinguish between clerical and other office workers and salesmen on the one hand, and workers engaged at the physically more arduous tasks of mill and shop. The last thirty years, perhaps especially the last ten or twenty years, have seen a notable increase in the percentage of workers employed in the lighter "white collar" jobs.

Altogether, the introduction of labor-saving machinery, the decreasing relative importance of those occupations which require large amounts of heavy manual labor, and the increasing proportion of office workers in most branches of industry, must have had a profound effect on the food requirements of the working population.

OTHER INFLUENCES

Several other developments have had a bearing on total food consumption per

capita in the United States. Most of them are of small importance by themselves, but their combined influence may have been considerable.

External temperature regarded as constant, there is probably increased heat dissipation from the body with modern clothing, as against the clothing of the closing decades of the last century. Both men and women wear less clothing and the character of the underclothing is such as to restrain heat dissipation less than was formerly the case. The lightening of garments of women has probably been no more effective in this direction than the dropping of heavy flannel undergarments for men. This represents an increase in heat dissipation with a tendency to increased food consumption.

On the other hand, the average heating of houses is probably higher than it was in earlier decades. Houses are now heated more uniformly to between 60 and 70 degrees; then a few rooms were heated to 70 or 80 degrees, but the sleeping rooms were usually unheated. Such a change tends to reduce the dissipation of body heat and hence to require less food to maintain body temperature.

There is probably a lower caloric requirement, also, due to reduction of body weight. An individual weighing 170 pounds will have a considerably smaller heat requirement than the same individual weighing 200 pounds. The vogue of the slender figure dictated by fashions for women, the

preachment against overweight after middle age by the medical profession and life insurance companies, and the prevalence of sports after middle age all tend in the direction of lower body weight and a lessened caloric requirement. The net effect of outdoor sports is probably not in the direction of increased ingestion of food. Furthermore, the development of street cars and other means of rapid transit, and in recent years the wide use of the automobile, have materially decreased the amount of walking. Much less energy is consumed today in getting to and fro, and there is less exposure to low temperatures in winter. These developments operate directly to reduce per capita food requirements.

All in all, therefore, there would seem to be a definite trend toward lessened food consumption decade by decade over the past forty years. Most of the changes have operated in that direction, and have overbalanced to a notable but indeterminate extent the few changes operating in the other direction. There is less inanition through inoccupation and poverty than was the case in the last century, which has the effect of raising the average food requirement. This, the increased feeding of adolescents, and the increased radiation from lighter clothing are the only tangible factors operating in the direction of increased average requirement, against which we have the much more important factors of decreased physical exertion, lower average weight, and less exposure to cold.

IV. SUBSTITUTION AMONG FOODS, 1889-1919

The general reduction in food consumption per capita between 1889 and 1919 very naturally had an effect on the consumption of flour. All in all, however, flour consumption held its own very well. The greatest increase among the foods for which we have statistics, occurred in the consumption of sugar, the greatest decrease in corn meal. While the general totals seem to show that sugar was being substituted for corn meal, with flour consumption changing but little, the facts seem scarcely subject to this interpretation. It seems rather that there has

been relatively little direct substitution of sugar for corn meal, but, instead, a pronounced shift from corn meal to flour, especially in the South; and, on the other hand, an equally important substitution of sugar for flour on the part of people who were previously using large quantities of flour.

This question of the exact process by which consumption of sugar has been increased and consumption of corn meal decreased, with flour consumption declining relatively little, prior to 1919, is one of great

importance. If one could suppose that sugar was being substituted for corn meal directly there would appear to have been no very strong tendency to abandon flour for other foods. The question for the future would be, now that consumption of corn meal has fallen so low, will it give place further to sugar, or has the shift come to an end? But if the actual process of the change has been one of replacement of much flour by sugar on the part of certain groups and replacement of corn meal by flour on the part of other groups, as appears to have been the case, the question as to the future must be framed very differently. In this case we have two questions: will the groups which have already replaced much flour in their diet with sugar carry the substitution further? and will the groups which have turned from corn meal to flour follow the example of the other groups and begin to abandon flour in its turn for sugar? Certain it is that there is little opportunity left for flour consumption to gain at the expense of corn meal.

Regarding the other changes in food consumption, for most of which we have no reliable statistics, it appears clear, nevertheless, that the general trend of the past forty years has been in the direction of diversification. There is a trend toward decreased consumption of wheat, coarse grains, dried legumes, and meat, and to increased consumption of poultry and eggs, milk, sugar, fruits, and fresh vegetables. These trends are not synchronous, but are irregular. This diversification of the diet is the result of prosperity, improvements in agricultural products, improved methods

of distribution and storage, prolongation of seasons, improvements in processing and packing, improvements in household culinary equipment and practices, aided by a trend of dietetic education in the direction of diversification, and supported by advertising campaigns. The diversified diet is distinctly more expensive than was the staple diet it has supplanted.

In the course of this diversification bread has become more and more an incident and a vehicle. This has had the effect, apart from other considerations, of lowering the intake of flour. When bread is eaten with butter, jam, or other spreading materials, less bread is eaten. The coarse grain breakfast cereals eaten with sugar and milk or cream replace wheat flour. Increased consumption of pastries and sweet baked goods of all kinds tends to diminish the unit consumption of flour. At the close of the last century the American consumption of wheat was comparable to that of the British; it is now distinctly lower. All of these influences tending in the direction of lower flour consumption vary from region to region, from year to year, and from class to class, and find their expression in the present low flour consumption. Against this, one can point to but one gain for wheat flour: namely, the increased use of wheat as against other cereals in the South, resulting from industrialization. Had not wheat flour replaced corn to a notable extent, the present per capita consumption of wheat flour would be considerably lower than it is. For the future one can look to but little gain for flour in this field, since the replacement is almost complete.

V. CHANGES IN FOOD CONSUMPTION SINCE 1919

SUMMARY OF CHANGES

Developments since the war present a sharp contrast to earlier shifts in food consumption. The changes may be clearly followed in Chart 7 (p. 283). Prior to the war, the notable changes in consumption of the foods for which data are available consisted of a decline in total consumption per capita and a progressive substitution

of sugar for the cereals. About 1918 there began an increase in meat consumption, chiefly in the form of pork. Between 1919 and 1921 flour consumption declined sharply, its decline offset by an equally striking increase in sugar consumption. Meanwhile meat consumption continued to increase. In 1923 consumption of meats and dairy products, per capita, rose to new high levels, maintained in subsequent years.

Study of Chart 7 suggests that the forces leading to a downward trend in per capita food consumption have worked themselves out and been replaced by other forces, for per capita consumption seems to have been approximately stationary during the war and to have started definitely upward about 1922. As will presently appear, however, the forces responsible for the declining food consumption prior to the war are probably still in operation, but have been offset in recent years by more powerful, though temporary, forces tending toward increased total food consumption.

CHANGE TO MORE EXPENSIVE FOODS

The most striking and significant characteristic of the changes in food consumption since 1919 is the tendency to increased consumption of the more expensive foods and to decreased consumption of the less expensive foods. In the explanation of this tendency will be found the principal explanation of the changes.

The increased demand in recent years for the choicer and more expensive foods has been strikingly felt in the meat trade. Since 1919 and 1920 the stronger demand for the choicer cuts of meat has kept their prices much higher, relative to other grades, than was customary in earlier years. Wholesale prices of fresh beef loins, for example, have recently averaged 80 to 100 per cent above the price of rounds, where they formerly averaged only about 30 to 40 per cent higher. Prices of ham, which formerly ran 40 to 50 per cent above the price of salt pork, rose in 1921 and 1922 to double the price of salt pork, followed, however, by a decline in the last two years to the earlier relationship. The change in the ratios of prices of these choicer meats to the cheaper cuts is shown in detail in Table 11.

The explanation of this shift to more expensive foods is to be found chiefly in the greater prosperity of the laboring classes. Throughout the war there was practically no unemployment and wages kept up very well with the increased cost of living. According to Professor Alvin H. Hansen, for example, real wages in the United States remained substantially unchanged between

1900 and 1919.¹ With the drop in prices in 1920, however, money wages fell much less than the cost of living. According to Professor Hansen, real wages, that is, wages measured in terms of purchasing power, were 9 per cent higher in 1921 than they had been in 1919. In 1922 real wages, ac-

TABLE 11.—WHOLESALE PRICES OF VARIOUS CUTS OF MEAT PER POUND, 1913-25*

Year	Beef			Pork, cured		
	Rounds, No. 2, city New York	Loins, No. 2, city New York	Ratio	Salt mess, New York	Hams, smoked, Chicago	Ratio
1913.....	\$0.121	\$0.158	1.31	\$0.112	\$0.166	1.48
1914.....	.128	.184	1.44	.114	.167	1.46
1915.....	.124	.171	1.38	.092	.153	1.66
1916.....	.130	.181	1.39	.134	.185	1.38
1917.....	.170	.217	1.28	.209	.252	1.21
1918.....	.241	.299	1.24	.241	.318	1.32
1919.....	.231	.266	1.58	.261	.343	1.31
1920.....	.224	.371	1.66	.186	.334	1.80
1921.....	.155	.285	1.84	.133	.268	2.02
1922.....	.136	.258	1.90	.136	.264	1.94
1923.....	.146	.290	1.99	.132	.212	1.61
1924.....	.144	.296	2.06	.140	.202	1.44
1925.....	.159 ^a	.309 ^a	1.94	.195	.271	1.39

* Data from publications of the Bureau of Labor Statistics.

^a Unpublished data supplied by the Bureau of Labor Statistics.

cording to the same authority, were 14 per cent higher than in 1919, and in 1923, 23 per cent higher. Professor Hansen's figures, being based on daily and weekly wages rather than hourly wages, take account of the lowering of wages by part-time work, but not of the effects of unemployment. During 1921 and part of 1922 there was much unemployment, but with the recovery of business in the latter part of 1922 labor generally reached a level of prosperity never before experienced. With this increased prosperity has come a tendency to eat more expensive foods.

¹ Alvin H. Hansen, "Factors Affecting the Trend of Real Wages," *American Economic Review*, March 1925, XV, 27-42. A more recent study of real wages by Paul H. Douglas ("The Movement of Real Wages and Its Economic Significance," *American Economic Review, Supplement*, March 1926, XVI, 17-53) shows the changes in real wages for various groups and industries as well as the average for all industries. As regards the general nature of the change in recent years, his calculations are in complete agreement with those of Professor Hansen.

INCREASING SUGAR CONSUMPTION AND DECLINING FLOUR CONSUMPTION

Special importance attaches to the explanation of the increase in sugar consumption since 1919. While consumption of meats and dairy products appears to have increased with that of sugar, the decrease in flour consumption is probably more closely related to the increase in sugar than to the increase in meats and dairy products. There is considerable waste in meats between the stage of production, to which the figures actually apply, and the stage of final human consumption. This factor is discussed in more detail below (p. 290). The percentage of waste in this form has undoubtedly increased over that of the war years and may now be larger even than in the pre-war years. Sugar, on the other hand, is subject to very little waste at any point between the refinery and the table of the consumer. The increased apparent consumption of sugar, therefore, probably explains the decline in flour consumption better than does the accompanying increase in apparent consumption of meats.

It is by no means clear that the increase in sugar consumption since 1919 can be accounted for by the tendency toward a use of more expensive foods. The substitution of sugar for alcoholic beverages since the Volstead Act is another widely noticed but incommensurable factor bearing on the increase of sugar consumption and the decline of flour consumption.

The increase in sugar consumption since 1919 probably represents little more than a continuation of the earlier trend. It is entirely possible that no new factor of great importance has been involved; that there has been little more than a continuation of the tendency toward displacement of the cereals by sugar which has been in progress for the last twenty or thirty years. Such an explanation is consistent with the fact that flour consumption has declined much more sharply in recent years. As previously noted, the substitution of flour for corn meal had probably gone, by 1919, about as far as it is likely to go for some time to come. Under these circumstances, the brunt of the decrease in cereal consumption naturally fell on flour.

Of these three possible explanations for the recent sharp decline in flour consumption, the first two (increased prosperity and the Volstead Act) involve factors which have probably exercised already most of the influence likely to be observed. The third explanation, however, involves a factor which has shown no tendency to diminishing influence: the progressive tendency toward displacement of the cereals by sugar. Any forecast of the future must depend largely on a judgment as to which of these three explanations deserves to be given the greatest weight. As yet there appears to be no basis for any certain judgment, and we must rest content with pointing out the significance of the problem and the need for watching future developments. The figures from the biennial census of manufactures for 1925 will throw much light on this point when they appear.

OTHER FACTORS

Certain other factors which may have influenced flour consumption deserve mention, though their effect has probably been very small. Some economies have undoubtedly been introduced by the expansion of the baking industry. Whether the use of flour of higher gluten-content has resulted in the eating of less flour in the form of bread, however, may well be questioned. The expansion of the baking industry has probably increased rather than diminished the stale bread loss, since most consumers refuse to buy old bread which they would eat without hesitation if it had been baked in the home.

It is frequently urged that the war-time injunction to eat less wheat has carried over into the subsequent years; in short, that the post-war decline in flour consumption proceeds from a projected war-time influence acting on both households and public eating-places. The statistics, however, and the facts of common observation, lend little support to this theory. Indeed, one may incline to the view that revulsion against the enforced use of unsatisfactory wheat substitutes during the war has had the post-war effect of increasing wheat-flour consumption at the expense of substitutes. The only influence which has clearly

persisted is the practice of charging for bread at public eating-places. This practice, instituted during the war, has been continued in some places and is probably a real, though minor, factor tending to restrain bread consumption.

INCREASED WASTE

The increase in total energy value of food consumed per capita since the war is probably more apparent than real. The energy values as computed are based on the edible portion of the food with no allowance for waste. There is usually a large amount of waste from meats, especially pork, owing to the loss of fat in cooking and the failure to eat much of the fat which may be served with the meat. This loss is much greater, measured in energy value, than would at first appear, since the energy value of the fat, per pound, is two to four times as great as that of the lean portion of the meat.

The prosperity which caused the change in relative consumption of different foods

must also have encouraged a considerable increase in waste of all foods. This increased waste in the form of fats and other food left uneaten may well account for the entire increase in total per capita consumption of foods, leaving unchanged the energy value of the quantities which are actually eaten.

There is no means of determining conclusively whether or not the increased quantities of food thrown away uneaten and the smaller proportion of the energy value available for work from a diet rich in protein, completely accounts for the increased apparent consumption of foods since the war. Certain it is, however, that these factors prevent taking the statistics as a proof of increased per capita consumption in terms of energy value actually available for work. On the contrary, it seems probable that the general factors responsible for the pre-war decrease in per capita consumption of all foods are still in operation, obscured in recent years by an increase in waste and by the effects of a change in the constitution of the diet.

VI. PROBABLE FUTURE TREND OF FLOUR CONSUMPTION

In attempting to appraise the probable future of flour consumption, it is well at the outset to concentrate attention on the really important factors. From these we shall get our best indication of the general character of any change likely to be observed. After all, the influence of minor factors must generally be so small as to be negligible beside the inevitable uncertainty regarding the probable course of the major factors.

The principal forces which have influenced flour consumption in the past seem to fall readily under four heads, with some overlapping. These may be listed as (1) prosperity, (2) diversification of the diet, (3) declining total food consumption, and (4) the inroads of sugar on the cereals.

The *influence of prosperity*, as distinguished from the diversification of the diet to which it is in some degree related, is reflected primarily in the use of more expensive foods in the place of flour. Among

some classes, however, increasing prosperity has resulted in increasing use of flour in the place of the coarser cereals. In its most striking form the influence of increasing prosperity has been a phenomenon of the years since 1919, the accompaniment of an extraordinary increase in real wages. This striking increase in prosperity of the laboring classes has probably come to an end. Some think that a slow increase will continue, while some, on the other hand, hold that wages are now at higher levels than can be maintained. In either case, the changes during the next several years must be slight and one may confidently predict that the next several years will see neither a repetition nor a reversal of the striking changes in food consumption which occurred in the period 1919-23.

Diversification of the diet, except as it accompanies a striking change in general prosperity such as that just discussed, is a result of improved facilities for handling

and supplying foods, of education in the dietary values of certain foods, and (in no small degree) of propaganda and advertising. In part, also, it is the natural accompaniment of a type of slow increase in prosperity which stands on a different footing from that discussed above. In general it takes the form of increased consumption of fruits and vegetables and of dairy and poultry products. To some degree increased consumption of these other products tends to displace flour, but their competition is probably more with meat than with flour. Such diversification of the diet may be expected to continue slowly, but its further influence on flour consumption can scarcely be great.

Declining total food consumption has been a factor in the past which would probably be found to have affected flour more than many other foods if we could actually isolate the effects of individual factors. Flour forms the basis for some of the principal staple foods of which the heavy worker must eat so abundantly. With less physical exertion and decreased food consumption there is a tendency also to shift to lighter foods.

The decline in total food consumption per capita will probably continue. There are still great opportunities for the introduction of labor-saving machinery in many lines, and the industries of agriculture and forestry will probably continue to decline in relative importance. But it is equally clear from a study of these factors that the decline in food requirements cannot continue indefinitely, and it may even now be approaching its limit. Men engaged in strictly sedentary occupations taking the amount of exercise necessary for their continued health require as much food as men doing light physical work. The proportion of the population engaged in heavy physical work is already fairly small, and further reduction must come slowly. As for the various other factors which have influenced total food consumption, the future is problematical, but their importance is relatively small and for present purposes they may be disregarded.

The possible *inroads of sugar on the cereals*, however, cannot be passed over so

lightly. If our analysis of the situation is correct, flour consumption decreased very sharply among certain classes, even before 1919, its place in the diet being taken largely by sugar. The magnitude of the decrease in flour consumption among these classes was obscured, however, by important increases among other classes where flour was taking the place of products of the coarser grains, especially corn meal. This field for expansion of flour consumption is now almost exhausted. Will the progressive decrease in flour consumption then continue among all classes with no substantial increase anywhere in the United States to offset it?

Our basis for answering this important question is unfortunately meager. We have no strictly similar experience in any country or time which might furnish a useful parallel. Certain pertinent facts affecting the situation, however, are perfectly clear. Sugar is really a fairly cheap food. Pound for pound, sugar contains about 13 per cent more energy than flour. At recent prices, sugar has been but little more expensive than flour as a source of energy and seldom in recent years has it been twice as expensive. Sugar is a highly palatable food, and moreover is entirely wholesome when adequately supplemented with vegetables, meat, and dairy products. From a dietetic viewpoint, there is no reason why sugar should not be substituted for flour in considerably larger quantities than at present.

On the other hand, we have the fact that an excessive amount of sugar is distasteful to most people. Beyond a certain point, there is no real substitute for the products of flour. A considerable portion of our population is undoubtedly using all the sugar it cares to at the present time. In this group there will probably be little further substitution of sugar for flour. The really important question for present purposes is, how large and important is the portion of the population which may be expected still further to substitute sugar for flour? For this question we do not now have the facts to give any positive answer.

Summarizing, then, it may be said that the striking decline in per capita flour consumption during the last 20 or 30 years

has been the inevitable result of certain fundamental forces which have been operating during the period. Looking to the probable future effects of these same forces, it appears that those which may be summarized under the three heads of increasing prosperity, diversification of the diet, and declining total food consumption, will probably continue to operate in the direc-

tion of decreasing flour consumption. The magnitude of their effect will probably not be great. But the influence of factors involved under the fourth head, the inroads of sugar on the cereals in the American diet, may be much greater. The probable magnitude of this influence in the future must remain conjectural until more information is obtained.

This study has been written by Holbrook Working with the assistance of the directors and the statistical staff of the Institute. The advice and aid of Alonzo E. Taylor on the nutritional problems involved have been invaluable.

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