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WHEAT STUDIES

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THE DISPOSITION OF AMERICAN WHEAT SUPPLIES

A CRITICAL APPRAISAL OF STATISTICAL PROCEDURES

I. INTRODUCTION

It is our purpose in the ensuing pages to present an appraisal of the knowledge available through statistics of the disappearance of wheat and the appearance and disposition of flour in the United States, and to suggest certain lines of possible improvement in the statistical procedures whereby this knowledge is obtained. Some phases of the problem can only be suggested; and others deserve more complete analysis than is attempted in this paper or is possible at this time.

Introduction
Statistics of Wheat Supplies
Measures of Disappearance and Consumption
Data on Flour Milling
Unreliability of Current Data on Consumption
Forecasts of Wheat Disappearance, March–June
Seasonal Variations in Flour Output and Export
Conclusions

DEVELOPMENT OF STATISTICS

Before the war the statistics of wheat, like those for most other commodities, were both deficient and defective. The United States Department of Agriculture issued (1) an estimate of planted acreage; (2) an estimate of abandonment of winter wheat acreage; (3) monthly reports on condition during the growing season; (4) preliminary crop estimates; and (5) a final crop report. These data were based largely on returns from numerous crop correspondents. Every ten years the census figures of the Department of Commerce were used to revise the crop estimates of the Department of Agriculture and to provide a new base for subsequent estimates of acreage, crops, and yields per acre.

The Department of Agriculture also issued, as of March 1 and July 1, estimates of (a) wheat on farms and (b) wheat in country mills and elevators. The former were based upon returns from crop correspondents, taken in conjunction with the estimate of the preceding crop. The latter were based upon reports from a large number of country mills and elevators, taken in conjunction with their estimated importance in the entire business. The Department of Agriculture further published (c) trade reports of monthly receipts and shipments in the leading wheat markets; and (d) trade estimates, all incomplete and not altogether comparable from time to time, of the wheat in visible positions. The three figures of wheat stocks were used to reach an estimate of the gross wheat carryover at the end of the crop year, June 30.

The figures for imports and exports of wheat and wheat products, issued by the Department of Commerce, were inconsistent and erroneous, largely as the result of confusion in the data regarding transit shipments across the Canadian border.

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Beginning with 1849, the decennial and quinquennial censuses of manufactures contained segregated but not always comparable reports on flour milling. Between the census years, milling journals published figures for estimated grindings by larger mills in important milling areas. Concerning flour stocks, conjectures were made but nothing was really known.

After the United States entered the war, the administration of the United States Grain Corporation introduced important and necessary improvements into wheat statistics. Comprehensive catalogues of country, central terminal, and port elevators, and of country and city flour mills, were prepared, with ratings of capacities. Throughout the period of the war, reports were made of threshings, of shipments from farms, of primary receipts, and of shipments from elevators to mills and terminals. Stocks of wheat and flour were followed into all positions. Losses in cleaning of wheat, wheat fed on farms, wheat used for seed, and farm reserves were studied and appraised. From the operation of the United States Grain Corporation one could draw a picture of crop, stocks, and movements of wheat such as we had never before possessed. Wheat ground to flour was reported regularly and in detail—a routine made relatively easy by the fact that mills were making a straight flour. By a process of subtraction, an estimate of wheat unaccounted for was prepared for the years 1917–18 and 1918–19. One principal point in the statistical improvements was the estimate of wheat ground by mills, appraised with a care never before exercised even in a decennial census.

Since the war most of the special statistical procedures introduced by the United States Grain Corporation have lapsed, for lack of authority and funds to continue them. Nevertheless, during the past four years the appraisals and tabulations of the Department of Agriculture in respect to wheat have been improved in quality and amplified in scope. The import and export figures have likewise been improved, under the present administration of the Department of Commerce with the coöperation of Canadian authorities. The confusion that previously existed in relation to trade across the international boundary has been largely eliminated, and we now know what proportion of wheat and flour, proceeding overseas from the ports, originates in each country. Since July 1923, the Department of Commerce has conducted a monthly census of flour milling, including estimates of wheat ground and flour and grain offal manufactured.

Wheat flour was not one of the first of manufactured agricultural commodities to receive regular statistical attention. Under authorization of special legislation, the Department of Commerce in 1914 established regular statistics of cotton. There is a record of ginning, to which a record of threshings of wheat would be comparable. The outturn of cotton, as recorded by the ginning statistics, is regarded as the crop; and after adjustment for imports, exports, and carryover, this figure represents the annual domestic supply. A special monthly report includes cotton consumed, cotton on hand in storage and in consuming establishments, and cotton spindles active, together with additional figures for consumption and storage of linters. Corresponding reports are issued for cottonseed—the crop secured after ginning, received at mills, crushed, on hand at mills and in public warehouses, together with segregation of the production of milling into hulls, linters, hull fibres, crude and refined oil, cake and meal. Somewhat comparable statistics (not yet so developed or complete) are compiled and issued for hides, skins, and leather, including raw materials, tanning, production of different classes and various semi-finished products, together with stocks in different states and positions. The Millers' National Federation is now undertaking to compile and issue at intervals comparable reports on wheat flour. The Bureau of the Census, beginning with 1925, reports wheat and flour stocks in the hands of grinding-reporting mills on June 30.

Need for Improved Statistics

Despite the fact that our information, in quality and quantity, is much superior to that of ten years ago, a fundamental defect

in the procedure persists. This is the traditional method of estimating consumption secondarily from the disappearance of the raw material, rather than primarily from the appearance of the manufactured product. The Department of Agriculture has always measured the disappearance of wheat rather than the manufacture and disposition of wheaten products. From the estimates of several items of disappearance has been derived a guess at the volume of human ingestion of wheaten breadstuffs. The data on cotton and hides give a continuous picture of crop—raw material, movement, disposition, utilization and manufacture, stocks and destination—much superior to anything we possess for wheat.

Something comparable is needed for wheat. By the use of the traditional method of calculating consumption indirectly, all the plus and minus errors in the usual estimates ultimately affect the figure for consumption and introduce there a spurious suggestion of widely fluctuating ingestion of flour. The figure for human consumption is placed at the mercy of the crop reporter; the estimates of wheat fed to animals are employed to determine the wheat fed to human beings; and a high or low dockage affects the figure for bread. When later a revision of crop or carryover is made, the figure for human consumption must again be adjusted accordingly. The correct procedure is to have a direct census of flour production, in order to eliminate errors in the flour consumption figure due to the fluctuations of estimates of crops, carryovers, and wheat fed to animals and wasted.

To a considerable extent, developments in future trading and coöperative marketing have their origins in lack of knowledge of movement, manufacture, and stocks of wheat and wheaten products. Price interests of producers and consumers alike are involved. Wheat growing may be considered primarily as a basic agricultural occupation, with flour milling as the terminal step. It may also be considered as the source of raw material for a basic national industry designed to supply the largest single item in the list of foodstuffs. In the first view, it may be compared with copper mining; in the second, with iron mining. However one conceives the industry, wheat growers and dealers need to know, through direct statistical procedure rather than through indirect inference, what becomes of the crop. It is pertinent to observe that in the sister industry of sugar, the primary concern of statistics has been the outturn of refined sugar; the secondary concern has been the crop of sugar-cane and sugar-beets.

The German War Experience

It is pertinent to conclude this introduction with an historical observation. During the war Germany suffered a tragic disillusionment in the official expectation of her bread supply. Before the war Germany possessed crop reports of wheat and rye, estimates of domestic wheat and rye used as seed and fed to domesticated animals, estimates of wheat and rye employed in the manufacture of alcohol and in other industries, and records of imports and of exports of breadstuffs. She also possessed milling statistics, which, like ours, were so submerged that the bread-grain consumption of the country was customarily inferred from the bread-grain supply. Suddenly, in the winter of 1916–17, the Food Controller of Germany awoke to the fact that the country did not possess the flour that should have been available according to the crop reports. From that time on, the statistical practice of the country was reversed, and the bread-grain crop of the country and the bread supply of the population, were in effect deduced from the flour production. Thereafter the German Food Administration had less flour, but it was real flour and not statistical flour. Since the war there has been sharp discussion as to whether the surprising exaggeration of the bread-grain supply was due to overestimate of the wheat and rye crops or underestimate of the wheat and rye fed to domesticated animals.[1] It is the present conviction of authorities in Germany, within the government and without, that the

[1] Karl Ballod, in *Schmoller's Jahrbuch*, 1915, XXXIX, 77 ff, and 1916, XL, 75 ff; A. E. Taylor, "Pre-War Crop Estimates in Germany," *Agriculture Yearbook, 1919*, p. 61; Kurt Ritter, *Deutsche Allgemeine Zeitung*, Nov. 13, 1923.

pre-war crop estimates, including those of the years 1914, 1915, and 1916, were 10–15 per cent in excess of the real crop. Upon this statistical fiction—estimating the bread supply from the wheat crop instead of from the flour production—the German Government risked the food supply of the country in the war.

II. STATISTICS OF WHEAT SUPPLIES

The statistical items on the supply side are essentially two in the United States: the estimate of crop, and the estimate of stocks, including carryover.

The Crop Estimate

The subject of estimating the wheat crop is too large to be discussed in this paper except as incidental reference must be made to the estimates. It is necessary, however, to mention certain broad considerations and to note the regional division of our wheat production, because of its bearing upon statistics of movement and position.

The estimate of crop has a double influence on the estimate of consumption. In a country like the United States the utilization of wheat, including feed use and losses as well as human consumption, to some extent increases with plenty and declines with scarcity. So long as the figure for human consumption is obtained by a series of subtractions, an overestimate of the crop exaggerates the figure for human consumption, while an underestimate of the crop has the contrary effect. A consideration of circumstances leading to over- or underestimate of the crop lies outside of the scope of the present discussion. The radical revisions of the figures for wheat crops made by the United States Department of Agriculture after the last decennial census are fresh enough in the memory of the trade.[1] The sum of the crop and the carryover constitutes the supply for the year. These are both subject to plus and minus errors, which may in different years be opposed or be in the same direction. Since the crop is so much larger than the carryover, it has been natural to suppose that error in the crop estimate is more important than error in the carryover. Nevertheless, an error in the carryover may have a larger immediate meaning to the market, in a particular season, than an error in the crop report.

[1] The wheat crops of 1919, 1920, and 1921 were revised upward by 34, 46, and 20 million bushels respectively. There is considerable conviction in the grain trade that even these revisions were insufficient.

Regional Divisions of the Wheat Crop

The country is naturally divided into four wheat regions: the eastern soft-winter-wheat region; the northwestern hard-spring-wheat region; the southwestern hard-winter-wheat region; and the Pacific region. These regions display definite characteristics in wheat production, milling, and trade.

The eastern soft-winter-wheat region includes all states east of the Mississippi, and Iowa, Missouri, Arkansas, and Louisiana. Less than 2 per cent of the average acreage of this region is planted to spring wheat, and the characteristic wheat of the division is so-called red winter wheat, ranging from soft in the East and South to semi-hard in some sections of Indiana and Illinois. This section is a net "importer" of wheat from other states to the extent of 140–160 million bushels. Raising soft wheats, it naturally ships in hard wheats and is to some extent an "exporter" of soft wheat to the other regions as well as to the outside world.

The hard-spring-wheat region includes Minnesota, the Dakotas, Montana, and Wyoming. Here spring wheat is the predominating type, and the winter-wheat acreage is less than 5 per cent of the total. This section is a net exporter of wheat. The annual consumption requirements of the five states in this region (for seed, feed, and food) are little over 60 million bushels, and the exportable surplus (including durum) often is two or three times as much. Although this region is a heavy net exporter of hard wheat and hard-wheat flour, both eastward from Minneapolis and Duluth and westward from Montana, it imports

small quantities of soft-wheat flour from the eastern soft-winter-wheat region. In the treatment of the data of the hard-spring-wheat region, it is highly desirable to have durum wheat consistently and comparably separated from the flour wheats. At present a considerable fraction of durum wheat in the trade, particularly in the case of the tabulation of exports, is lost under the heading of mixed wheat, which is known to consist largely, though indeterminately, of durum wheat.

The hard-winter-wheat belt includes Nebraska, Kansas, Oklahoma, Texas, New Mexico, and Colorado. Less than 5 per cent of the acreage is spring wheat. This region is a heavy net exporter of wheat. The consumption requirements are in the neighborhood of 90 million bushels, and the net exports may be more than double that amount. While the winter wheat is predominatingly hard, enough soft wheat is usually raised in eastern Nebraska and Kansas to supply its trade demands for soft flour.

The Pacific region includes all states west of the hard-spring-wheat and hard-winter-wheat regions. Both spring and winter wheats are raised, to the average extent of two-thirds winter and one-third spring. The predominating type outside of Idaho is soft wheat, but semi-hard wheats are being introduced in order to minimize the otherwise necessary importation of hard wheat or hard flours from the hard-wheat districts. The consumption requirements of the population in the Pacific division are roughly 60 million bushels per year. California and Arizona are ordinarily net import states, while the other states of the division are net export states. Regarded as a unit, the region is a heavy net exporter, the exports flowing out of Pacific ports often overbalancing by 40 million bushels the hard wheat and flour flowing westward across the Rocky Mountains.

The wheats of these four regions are substitutable to a considerable degree, price permitting. Nevertheless their natural qualities, the seasonal relations of the harvests, the geographical factors of transportation and distribution with respect to milling centers and the consuming populations, and the relations of trading in different futures markets make it highly advisable to have the statistics of crop disappearance, movement, and utilization segregated along regional lines. This would mean for each region separate estimates of crops by types and grades, farm reserves, stocks in country mills and elevators, stocks in city mills, visible supplies, exports in terms of variety of wheat, and consumption. The prices are already segregated, but prices cannot reflect the actual state of the commodity until segregated data of movement and stocks are made available. Data of crops, stocks, and movements should be compiled by regions, because the importing areas use more of their wheat locally than do exporting areas; and it is the mobile wheat that it is desirable to have determinable.

Wheat and Flour Stocks

In the stocks of wheat at any time, and hence in the carryover at the end of the crop year, are five items: (1) farm reserves of wheat; (2) wheat stocks in country mills and elevators; (3) wheat stocks of city mills; (4) the visible wheat supply (in specified second hands); and (5) flour stocks. The available data on these various items have been developed traditionally and unevenly. They now reflect for wheat the imperfect development of statistical procedures that are much more perfectly carried out for cotton and hides by the Department of Commerce.

Farm Reserves of Wheat

The estimate by the United States Department of Agriculture is not based upon enumeration, but upon percentages of the preceding crop as adjudged by crop reporters. When scrutinized, it is seen to contain the elements of estimates of acreage, of crop yields, and of the farm reserves of the previous year. This is an old form of estimate, extending back into the last century. It has been issued as of March 1 and July 1, and is subject to revision, either by later revision of the crop estimate or by revision of the percentage of reserves. It covers presumably all wheat, of whatever quality and grade on farms or in possession of farmers, including seed, animal feed, grain destined

for custom grindings, and unsold merchantable wheat. No estimate of the fraction of farm reserves consisting of merchantable wheat is compiled. The estimate of March 1 includes the spring-wheat seed for that season; that of July 1 includes any winter-wheat seed that may be carried over into the new season. Stocks on farms are likely to vary with the psychology of rural crop reporters.

Though it in no sense carries the conviction of an enumeration, the estimate of farm reserves might be made much more useful if two improvements could be undertaken, in addition to the standardization and improvements of technique now in process of development. The first would be the issue of such an estimate as of December 1. Comparable figures of farm reserves on December 1, March 1, and July 1 would contribute to our knowledge of the velocity of marketing of wheat, would furnish additional criteria by which figures of inspections, receipts at primary markets, and shipments might be judged, and would yield indications of seeding. Conversely, inspections, receipts at primary markets, and shipments might be used to check against farm marketing, but only as indices and not measurements. This would be the case particularly if revisions of estimates of farm reserves might be made regularly and promptly.

The second improvement to be desired consists in the segregation of farm reserves. A segregation of farm reserves by regions, and particularly as of December 1, March 1, and July 1, instead of March 1 and July 1 only, would contribute valuable information concerning the rate of disappearance of the several kinds of wheat. Closely connected with farm reserves is the estimate of wheat fed to animals. This is more fully discussed below (p. 308). There is no known method of judging the plus or minus error in the estimates of farm reserves or of wheat fed to animals.

An estimate of wheat marketed from farms, as of December 1, would be of particular advantage. This could be developed by the Department of Agriculture, utilizing inspections, receipts, and shipments as indices, provided that an estimate were made of wheat on farms as of December 1. It ought to be feasible to use data on shipments from farms to check up estimates of crop, seed, animal feed, and reserves. Proceeding further, it ought to be feasible to use mill grindings and exports to check up farm shipments.

Out of the official Canadian reports on inspections, elevator stocks, receipts, and shipments at country elevators, at interior terminal elevators, and at public and private terminal elevators, it is possible to secure a close view of the monthly marketing of wheat from the farms of the prairie provinces. The conditions in the Canadian hard-wheat belt are very much simpler than in the United States. Nevertheless, the importance of the data is such as to make it highly desirable to possess estimates of farm marketing during at least the three periods of the year ending with November, February, and June.

Wheat Stocks in Country Mills and Elevators

Wheat stocks in country mills and elevators are estimates, in part partaking of the nature of enumerations, based on reports from some 3,500 supposedly typical mills and elevators out of something like 30,000 country mills and elevators in the United States.

These estimates are supposed to exclude wheat in private commercial and in public elevators whose stocks are contained in the report of the visible supply. Estimates of wheat stocks in country mills and elevators were made first in 1910 for the March report and in 1917 for the July report, but up to 1918 were based on trade data. The estimate is subject to revision; presumably, also, revisions of the crop and of farm reserves might both find expression in revision of wheat stocks in country mills and elevators. Trade estimates of wheat in country mills and elevators sometimes vary widely from that of the United States Department of Agriculture—as, for example, on March 1, 1925.[1] These stocks are at a minimum on July 1, in the winter-wheat regions, but not in the spring-wheat areas.

[1] Broomhall used the figure of 95 million bushels; the official estimate was 69 million.

The figure for July 1, 1921, was 27 million bushels; for 1922 it was 29 million bushels; for 1923, 37 million bushels; for 1924, 37 million bushels; and for 1925, 25 million bushels. There is no way of estimating the probable error in these figures. In publishing the figure for aggregate country reserves on March 1, 1925, the Department of Agriculture made revisions of the figures for 1923 and 1924 as follows:

(Million bushels)

		1923	1924	1925
Wheat on farms	Original	155.5	133.9	113.9
	Revised	156.1	137.7	
Wheat in country mills and elevators	Original	92.6	90.4	69.1
	Revised	102.9	98.3	
Combined	Original	248.0	224.3	183.0
	Revised	259.0	236.0	

These revisions are upward, but not for reasons that are indubitably inherent in the procedures.

As in the case of farm reserves, the usefulness of the estimates of wheat reserves in country mills and elevators would be greatly increased if an additional estimate were annually compiled and issued as of December 1, and if all such estimates were segregated into the four wheat regions.

Wheat in country mills and elevators is all presumably merchantable wheat, since it would hardly have left the farm if it were tail wheat; but it includes considerable dockage. Most of the wheat reported in country mills and elevators is mobile wheat in the hands of grain merchants or farmers' coöperative associations, but some of these stocks have been purchased by city mills and are essentially mill reserves. It will be important, henceforward, that in the estimate of wheat in country mills and elevators, as of July 1, the attempt be made to state separately the holdings of city mills in country elevators, in order to avoid a duplication in the carryover, since the city mills will on June 30 also make a report of their wheat stocks to the Bureau of the Census.

Wheat Stocks of City Mills

Estimation of city-mill wheat stocks is a new practice, the figure being compiled by the Bureau of the Census this year for the first time. A comparable trade estimate was compiled by the Millers' National Federation, as of January 31 and of June 30. The estimate of the Bureau of the Census, as of June 30, ought to be relatively complete. The lack of this estimate has been a glaring defect in the figure for carryover since the war.

Mills representing 57 per cent of the total grindings, on the basis of the 1923 census, reported to the Millers' National Federation on January 31 that they were carrying some 74 million bushels of wheat. It is to be expected that ordinarily holdings of the mills on June 30 will be less than on January 31. But it is easy to picture circumstances that would induce mills to maintain heavy reserves.

According to the recent announcement of the Bureau of the Census, 956 mills, which in 1923 produced 87.4 per cent of the total flour reported in the census of that year, have made reports of their holdings on June 30.[1] These holdings, adjusted to 100 per cent from 87.4, were as follows:[2]

(Million bushels)

In country elevators	2.5
In public terminal elevators	3.9
In private elevators, in transit, and in mills	30.6
Flour converted into wheat (4.58 : 1)	17.5
Total	54.5

The holdings in country elevators are to be regarded as a duplication of wheat already reported in country elevators by the Department of Agriculture. The holdings in public terminal elevators are to be regarded as a duplication of wheat already reported in the visible supply. Wheat in transit is not reported in the visible supply. Wheat in private elevators and in mills, except in the occasional cases where a mill

[1] The figures for stocks of wheat and flour in mill hands on June 30, compiled by the Millers' National Federation, agree quite well with the figures issued by the Bureau of the Census.

[2] This adjustment is to be accepted with reserve, since it is unsafe to assume, without further experience, that the holdings of non-reporting city mills correspond to those of reporting mills, especially for flour.

elevator is run as a private elevator (cf. the Russell elevator in Minneapolis), is not included in the report of visible wheat. Accordingly, most of the 30.6 million bushels of wheat reported in private elevators, in transit, and in mills is a clear addition to the carryover otherwise reported on June 30 as 87 million bushels, to say nothing of the flour stocks. The addition, to this figure, of 48 million bushels representing stocks not hitherto reported as a matter of public information, gives to the carryover a substantially different meaning.

Mill stocks of wheat on June 30 probably depend chiefly upon three factors—quality of the crop in hand and in prospect, the volume of open flour contracts, and the relative positions of futures prices. If the quality of the old crop is such as to make it difficult for the larger mills to maintain their blends, forehanded organizations will build up stocks to some extent with only secondary reference to prices. As summer approaches the mills will maintain large stocks if the May option sells at a discount under July and July at a discount under September; when little concern is felt as to availability of desirable supplies, stocks will be allowed to run down to a low figure if the May option sells at a premium over July and July at a premium over September. Looking at the matter from the standpoint of the mills, we may easily envisage circumstances that might influence mill holdings of old-crop wheat on July 1 to vary from 10 to 50 million bushels exclusive of flour stocks.

It would obviously be of advantage if the Bureau of the Census would report mill stocks of wheat for the four principal wheat regions, and by classes. It is a particular property of mill stocks of wheat that these represent selections to some extent, and their quality is, therefore, above the average of the crop.

Visible Wheat Supply

There are several trade estimates of the visible wheat supply, of which the most prominent are issued weekly by *Bradstreet's* and the Chicago Board of Trade. The latter gives a summation of individual local records of wheat reported in an unstated and inconstant number of elevators and warehouses (including wheat afloat from lake ports) in twenty-seven places. *Bradstreet's* report includes thirty additional smaller points. The Minneapolis *Daily Market Record* and the Chicago *Daily Trade Bulletin* jointly compile another (monthly), and in some directions more comprehensive, estimate of visible wheat supplies. The reporting agencies have no check on the units, and no attempt is made to have the same number of elevators and warehouses in the various points always included in the report. Under these circumstances, the reports of visible wheat are not closely comparable from week to week or in different years. Each is an indeterminate fraction of an undefined total. In absolute amount, the error is probably lowest on June 30, when visible supplies of wheat are low and the amount rolling on rails and afloat from lake ports is also low.

A survey of the figures for visible supplies over a period of years in the light of market happenings gives one the impression that both unreliability and irregularity have been present in these trade estimates. Such faults are inherent in trade estimates, and can hardly be eliminated except in official estimates. When one compares the trade estimate of visible wheat with the estimates of stocks of cotton and leather issued by the Department of Commerce, one must give expression to the hope that the government may find it possible to compile and issue at stated intervals—for example, on December 1, March 1, and July 1—comparable estimates of visible wheat. These would possess added value if segregated into the four wheat regions and into classes. Such estimates might be compiled either by the Department of Agriculture or by the Department of Commerce through the Bureau of the Census.

Wheat in the visible supply is the most mobile of all wheat in the market. An accurate knowledge of the wheat in visible positions in different parts of the country ought to be obtainable with relative ease. There is at present no possible revision of the estimates of visible wheat. In the preparation of such a report of visible wheat, the government would have the advantage

of the use of the detailed reports on inspections, receipts, and shipments. Such an estimate would report in some detail on the number and character of the warehouses, public or private; and it would be possible to separate visible stocks at ports from mill-area visible stocks.

Flour Stocks

We possess at present no estimates of flour stocks, except those of the trade journals, since the figures in the *Survey of Current Business* of the Department of Commerce are taken from trade sources (Russell).[1] On January 31 the Millers' National Federation obtained by questionnaire an estimate of the flour stocks of members, representing about 70 million barrels' outturn per annum. These stocks amounted to about 3 million barrels. On June 30 of this year the Bureau of the Census collected data on stocks from mills reporting their monthly grindings to the Census, and on the basis of these data flour stocks in the hands of mills may be estimated at 3.8 million barrels. These items should be made a regular item of report, in order that the figure for carryover may be made more complete, the figure for flour stocks to be translated into terms of wheat in accordance with the reported ratio of bushels of wheat per barrel of flour.

Flour stocks in the hands of mills are usually kept as low as possible consistent with contracts and current trade demands; any further storage would be at least semi-speculative. East of the Rocky Mountains unsold mill flour stocks are usually hedged.

Flour stocks not in mill hands lie chiefly in the hands of exporters, jobbers, wholesalers, retailers, and bakers, with an uncertain small quantity in households. Stocks on July 1 are ordinarily relatively low, other things being equal, except that bakers' stocks are likely to be considerable in July–September; but modern flour stores so well that one would expect such stocks to vary widely in accordance with quality of flour out of the old crops, apprehension concerning the quality of flour out of the new crop, and relations of prices. Flour stocks in distributive channels are largely unhedged. When one views the experiences of the Milling Division of the United States Food Administration during the war, one reaches the conviction that as much as 10 million barrels of flour may easily be held in the form of stocks in the distributive trades outside of mill hands; on the other hand, if reasons for hand-to-mouth trading are clearly in evidence, stocks may be reduced to a small fraction of this figure. The United States Department of Agriculture annually reports an estimate (cf. Appendix Table I) of flour stocks, as of July 1, this being drawn apparently from the compilations of the Chicago *Daily Trade Bulletin*. It is interesting to note that this estimate for July 1, 1925, was 1,815,000 barrels, whereas the returns reported for mills alone by the Bureau of the Census for June 30 was 3,829,420 barrels.

Practices in the retail trade are apparently changing. Milling capacity being in excess of grindings, with prompt and dependable transportation by rail and truck, retailers see little reason for carrying stocks. Fearful of the future price movement (which is partly discounted by the willingness of mills to sell at current prices for distant delivery) and confident of immediate delivery of flour on order, retailers naturally buy from hand to mouth. The remaining motive for carrying stocks, where it exists, is largely financial, and unless flour purveyors make unusual terms to retailers, even this works out in the direction of hand-to-mouth buying. When a chain store is able to gauge its flour trade so that an order of flour is sold before the bill is due, for example, within thirty days, this means that so long as flour is purchased on this basis the seller is supplying the capital, since the flour is not paid for until after it is sold. All in all, the tendency in the retail trade is not to carry heavy flour stocks; and this means that our inability to measure stocks in retailers' hands is of relatively less importance. Under these circumstances, an estimate of flour carryover becomes

[1] Reports of flour stocks from sources of information in the trade are regularly assembled by A. L. Russell, the *Northwestern Miller*, and the Chicago *Daily Trade Bulletin* and the Minneapolis *Daily Market Record*. These do not possess identical bases and are not strictly comparable.

more feasible, since the stocks in the hands of mills, wholesalers, and factors are more visible than those in the hands of retailers.

So far as bakeries are concerned, we are also in a stage of transition. The emphasis on high-protein flour works in favor of flour reserves by large bakeries. Price fluctuations react in the direction of low stocks held by small bakeries. The effect on flour stocks to be anticipated as the result of consolidations of bakeries into large country-wide organizations cannot yet be foreseen.

In any event, there is at present no method of estimating flour stocks in distributive channels, and the only adjustment possible is to regard them as high or low, on the basis of trade considerations, and to regard the carryover in as balancing the carryover out. The economies in use of flour that attend high prices are accomplished to a large extent on the flour stocks in the hands of retailers; and hand-to-mouth buying by retailers reacts profoundly back to the mills.

The considerations presented in the preceding paragraphs make clear the certainty of the omission of several variable items from the published estimates of carryover and the probability of duplications in the several items that ought to be considered in the carryover. It should be possible to do much toward completing and perfecting the estimate of this basic figure, though flour stocks in distributive channels will probably remain an unknown item.

III. METHODS OF MEASURING WHEAT DISAPPEARANCE AND CONSUMPTION

The amount of flour produced has no direct relation to the amount of wheat produced; but since by the traditional procedure practically all items in disappearance, outside of the visible, depend on the crop estimate and in effect are derived directly or indirectly through the crop estimate, this traditional method purports to make the volume of flour a function of the volume of wheat.

There are three ways of measuring the volume of a manufacture. One is to measure the raw material utilized. The second is to make an enumeration of the outturn of the product. The third is to ascertain the consumption of the manufactured article, with adjustment for stocks and foreign trade. Each of these is theoretically available in the case of flour, but no one of them has been carried through with precision for any length of time.

The third method is the most difficult. Except for the period of the United States Food Administration, we have little data on the subject from the side of the consumer. The historical method of estimating flour production has been to subtract from the crop of wheat every other conceivable item and then regard the remainder as wheat passing into the manufacture of flour. We have had censuses of flour milling every five years since 1899, and biennially since 1919. Since July 1923 we have had a monthly census of flour milling. It is possible, despite the paucity of the statistical data, to discuss the advantages and disadvantages of the several avenues of approach. It is important to do this in order that the future development of our statistical information may be guided by a realization of the defects of the present position.

Five pieces of information are theoretically requisite:

(1) The amount of wheat milled into flour and by-products. This is in 60-pound bushels, and the wheat reported as going into milling is thus comparable, presumably, with the wheat reported in the crop estimate.

(2) The weight of flour secured from the stated weight of wheat. This is in barrels.

From (1) and (2) we secure the average ratio of bushels of wheat per barrel of flour.

(3) The seasonal rate of flour outturn throughout the year. This is measured in the mills by the day's output, and daily figures are added to form figures for weeks and months.

(4) Stocks of flour carried into and out of the milling year. This is now to be obtain-

able as an approximate census enumeration, as of June 30, of stocks in mill hands. It does not take into account flour stocks in the wholesale and retail trade; nor stocks of householders which under normal circumstances may be assumed to be relatively constant and rather low in midsummer, but under circumstances of abnormal prices might be notably above or below a normal figure.

(5) Segregation of consumption into three groups:[1]

(a) Flour consumption by manufacturers of bread, cakes, pastry, biscuits, crackers, etc., for ready-to-eat sale to households.

(b) Flour consumption in hotels, restaurants, dining cars, public eating-places, and institutions.

(c) Flour consumption by households, being purchases of raw flour.

Current Statistical Procedures

Now what are the procedures currently employed? It has been customary to formulate the situations of wheat and flour combined. A brief summary of the older practice of the Department of Agriculture is as follows:

Supplies		
Crop	a_1	
Carryover into crop year	a_2	
Imports, wheat and flour (as wheat)	a_3	
Total		A
Disposition		
Exports, wheat and flour (as wheat)	b_1	
Carryover out of crop year	b_2	
Total		B
Balance for domestic utilization		X
Population		Y
Utilization per capita		x

For commercial purposes more detail is desirable both as to volumes and movement, and such statements are prepared to indicate the current position as well as the position at the close of the crop year. A good illustration of such a current statement is that of Russell, as follows:

Supplies		
Crop and farm reserves	a_1	
Stocks at elevators, mills, and terminals, July 1	a_2	
Receipts from farms since July 1, estimate	a_3	
Imports, domestic account	a_4	
Total		A
Disposition (except carryover out)		
Exports, U. S. grain from July 1	b_1	
Ground by mills, same time	b_2	
Total		B
Balance		
Stocks on hand and in transit		X
Of which at terminals		x

Another commercial formulation is that of the *Northwestern Miller*, as follows:

Supplies		
Carryover, wheat	a_1	
Carryover, flour as wheat	a_2	
Crop	a_3	
Imports, wheat	a_4	
Imports, flour as wheat	a_5	
Total		A
Disposition (except human consumption)		
Wheat exports	b_1	
Exports of flour as wheat	b_2	
Carryover, wheat	b_3	
Carryover, flour as wheat	b_4	
Reserved for seeding	b_5	
Waste, feed, and loss	b_6	
Total		B
Balance for domestic utilization		
As wheat		X
As flour *(barrels)*		x

The Division of Historical and Statistical Research of the federal Bureau of Agricultural Economics uses a different formulation, with more detail, as follows:

Supplies		
Carryover in:		
Stocks on farms, July 1	a_1	
Stocks in country mills and elevators, July 1	a_2	
Commercial visible (Bradstreet's), July 1	a_3	
Stocks of flour (in terms of wheat), July 1	a_4	
New crop	a_5	
Imports (flour included), July 1 to June 30	a_6	
Total		A

[1] This phase is not discussed in this paper.

Disposition (except for food and feed)		
Exports, July 1 to June 30 (flour included)	b_1	
Estimated seed requirements	b_2	
Carryover out:		
On farms, June 30	b_3	
In country mills and elevators, June 30	b_4	
Commercial visible (Bradstreet's), June 30	b_5	
Flour (in terms of wheat)	b_6	
Total		B
Disappearance for food and feed		X
Population		Y
Per capita disappearance, food and feed *(bushels)*		x

The tabulation of the Department of Agriculture brings into clear relief the factors of this segregation that are at once illogical and inchoate from the standpoint of consumption. There is no item for dockage, wastage, or losses; these and the disappearance for food and feed are all lumped into one figure. It would be almost as illogical to estimate coal production not by the tons carried over railroads from pit-heads, but by the yardage of coal seams excavated in the mining operations, including in the figure for coal disappearance the volume of culm that annually accumulates outside the pit-heads.

Proposed Formulations

From the standpoint of wheat as raw material for manufacture, the following represents a correct form of statement:

Supplies		
Crop	a_1	
Carryover in, wheat	a_2	
Imports, wheat	a_3	
Total		A
Disposition		
Milled	b_1	
Exports, wheat	b_2	
Carryover out, wheat	b_3	
Total		B
Remainder		C
Seed	d_1	
Feed	d_2	
Waste, losses, dockage, unaccounted for		X

Two alternative methods of accounting for the disposition of wheat are shown below. In the table of disappearance, the burden of cumulative error falls on flour milling; in the table of manufacture it falls on a fraction unaccounted for.

Table of Disappearance

Supplies		
Carryover in, July 1:		
(a) Farm reserves	a_1	
(b) In country mills and elevators	a_2	
(c) Stocks of city mills	a_3	
(d) Commercial visible	a_4	
New crop	a_5	
Imports	a_6	
Total		A
Disposition		
Exports	b_1	
Used for seed	b_2	
Industrial use	b_3	
Waste, spoilage, losses	b_4	
Fed to animals	b_5	
Carryover out, June 30:		
(a) Farm reserves	b_6	
(b) In country mills and elevators	b_7	
(c) Stocks of city mills	b_8	
(d) Commercial visible	b_9	
Total		B
Available for flour milling		X

Table of Manufacture

Supplies		
Carryover in, July 1:		
(a) Farm reserves	a_1	
(b) In country mills and elevators	a_2	
(c) Stocks of city mills	a_3	
(d) Commercial visible	a_4	
New crop	a_5	
Imports	a_6	
Total		A
Disposition		
Exports	b_1	
Used for seed	b_2	
Industrial use	b_3	
Ground into flour	b_4	
Carryover out, June 30:		
(a) Farm reserves	b_5	
(b) In country mills and elevators	b_6	
(c) Stocks of city mills	b_7	
(d) Commercial visible	b_8	
Total		B
Unaccounted for as waste, spoilage, losses, and animal feed		X

It is further expedient and practicable to separate flour and wheat. A serviceable method of separation is shown below:

DISTRIBUTION, UTILIZATION, OR DISAPPEARANCE OF WHEAT, JULY 1–JUNE 30

Supplies	
Carryover in, July 1:	
(a) Farm reserves	a_1
(b) In country mills and elevators	a_2
(c) Stocks of city mills	a_3
(d) Commercial visible	a_4
New crop	a_5
Imports	a_6
Total	A
Disposition	
Exports	b_1
Used for seed	b_2
Industrial use	b_3
Ground into flour	b_4
Carryover out, June 30:	
(a) Farm reserves	b_5
(b) In country mills and elevators	b_6
(c) Stocks of city mills	b_7
(d) Commercial visible	b_8
Total	B
Waste, spoilage, losses, fed to animals on farms	X

FLOUR PRODUCTION

Supplies	
(Wheat ground)	(a_1)
Flour outturn	a_2
Flour imports	a_3
Flour stocks, July 1	a_4
Total	A
Disposition	
Flour exports	b_1
Flour absorbed by trade	b_2
Flour stocks, June 30	b_3
Total	B

It will be advantageous to conclude this discussion with tabular presentations of the data for the year 1924–25, though some of the estimates are still provisional and subject to revision. The supply and disposition of wheat, provisionally issued in a press release, according to the United States Department of Agriculture was as follows:

(Million bushels)

Supplies			
Crop			873
Carryover	farm reserves	31	107
	country mills and elevators	37	
	visible	39	
Imports	wheat for consumption		6
	wheat for grinding for export		
	flour as wheat		
Total			986
Disposition			
Seed			88
Exports, wheat			195
Wheat milled			540
Fed to animals			75
Carryover	farm reserves	30	87
	country mills and elevators	25	
	visible	32	
Total			985

This deviates from previous practice by the inclusion of a figure for wheat milled obtained from the Bureau of the Census. It includes, however, no estimate of city-mill stocks. If the item of wheat fed to animals was a primary estimate, the agreement between the totals is of course fictitious. Otherwise this indicates that all of the losses have been included in the item "fed to animals."

The supply and disposition of wheat, according to the data of the United States Department of Agriculture and the Bureau of the Census, employed in accordance with the views herein expressed, are as follows:

(Million bushels)

Supplies			
Crop			873
Carryover	farm reserves	31	107
	country mills and elevators	37	
	visible	39	
	city-mill stocks unreported		
Imports	wheat for consumption		6
	wheat for grinding for export		
	flour as wheat		
Total			986
Disposition			
Seed			88
Exports, wheat			195
Wheat milled			540
Carryover	farm reserves	30	135
	country mills and elevators	25	
	visible	32	
	city-mill stocks (excluding clear duplications)	48	
Total			958
Farm uses and losses			28

The presence of an item of city-mill stocks in the outgoing carryover, without a corresponding item in the incoming carryover, is a glaring inconsistency. Since city-mill stocks were not reported in the carryover in July 1924, the residual figure of 28 million bushels for farm uses and losses is too low by at least that unknown amount. This formulation has the obvious advantage of presenting the four most verifiable items in the disposition (seed, exports as wheat, mill consumption, and carryover), leaving the least verifiable items (fed to animals, losses, and wheat unaccounted for) under one heading, the size of which, if incongruous, will reflect back to the figure for the crop, rather than to the principal items in disposition. A year hence it will be possible to present a perfected statement of the position of that date, because city-mill stocks will be available for both carryovers.

Contrast Between Wheat Production and Flour Production

It is important clearly to realize that production and disappearance of wheat and production and consumption of flour are not comparable processes, when contrasted from the standpoint of the market procedures by which supply and demand are equated in price. Commodities may be divided into two groups according to whether production is confined to a limited season or is continuous. With a season's production unforeseeable and uncontrolled, it is assumed that the product is placed on sale during the year; it is this fixed supply, set against the effective demand, that is equated in the current price. With continuous production both controllable and to some extent foreseeable, the product set out for sale during the year may be adjusted to the effective demand; the price may be raised or lowered to some extent by contracting or expanding the production. Wheat belongs to the first type of commodity, flour to the second. The grower must harvest the yield nature has provided; the miller needs to grind only what he can sell.

The wheat crop becomes available during a harvest season of four months. Wheat is relatively non-perishable, may be stored and shipped at all seasons, and is a highly mobile commodity. The practice of future trading on grain exchanges enhances this mobility. Therefore, under normal circumstances, despite the fact that wheat is shipped from the farm more heavily in the fall than throughout the remainder of the year, it is broadly correct to say that the bulk of the crop of wheat is offered for sale at one time. The effects of physical mobility, hedging, and speculation normally reduce the monthly variations in prices to little more than the carrying charges; in effect, the merchandised crop is thus placed on sale at once. This statement must be qualified by the facts that the farmer may withhold a variable amount of wheat from the market and dispose of it on the farm; and that a variable amount may pass from one crop year to another in the form of carryover. With these qualifications, it may be said that the annual outturn of wheat is normally placed on the market for sale at one time, to meet the purchasers of wheat, who are continuously in the market, supplying a somewhat variable but continuous demand for the manufactured product.

The buyers of wheat may be classed under four heads: (1) flour mills; (2) grain merchants who act as factors, brokers, or jobbers, usually hedging their transactions, and selling to exporters, millers, and other users; (3) fobbers and exporters making purchases for immediate loading or prospective cargoes; and (4) speculators purchasing wheat to hold for a rise. The last-named group is only an occasional buyer of wheat in notable amounts, as in 1924–25. The other three groups are continuously in the market for amounts of wheat that are variable from month to month. Buying of wheat and flour, when hedged, does not influence price in the sense of equating the supply and demand, since a purchase of cash wheat is approximately offset by the sale of a wheat future in corresponding amount.

The manufacture of flour is a continuous operation, with only moderate variation from season to season and even from year to year. In a wheat-surplus-producing country like the United States, the physical supply of raw material may be regarded

almost as a constant, in quantity if not in quality. Most mills try to maintain a certain volume of operation. But they are also compelled to adapt operations to fluctuating trade demand for flour. The monthly operations of large mills are compromises between these two positions. Technically considered, the volume of operations is determined by the advantageous use of the capacity of the mill and by the demand for flour, and has practically nothing to do with the quantitative supply of wheat. A comparison of actual grindings with capacities of flour mills[1] and with flour sales, week after week throughout the year, would make this clearly evident, since current grindings frequently exceed current and contract sales. The annual production of flour is thus not to be regarded as a total supply placed on sale at one time. The normal demands are fairly well known for each region. Beyond that, mills grind for export when it is of advantage to their particular organizations so to do. Only the largest mills, and these not at all times, are in a position to maintain a relative continuity of operations; most of them slacken or speed up in accordance with demand for flour.

Broadly considered, therefore, in the marketing of wheat, the supply of the year may be regarded as set up for sale at one time. In the marketing of flour, the outturn of the year is determined by the demand for the product, and this is not to be regarded as set up for sale at one time. Beyond a certain point, expansion of milling operations does not necessarily make for economy. A mill not desirous of restricting operations to the scope of demand may undertake to increase demand by grinding to capacity with sale of flour at reduced price. The experiences of recent years, however, have indicated that for the most part this practice proves illusory in terms of monetary return.

IV. DATA ON FLOUR MILLING

The chief source of our information concerning the volume of flour milling is the reports of the Census Bureau, supplemented by reports and estimates prepared by milling journals and special statistical service.

The Census of Flour Milling

A census of flour milling should report three essential facts: (1) the volume of wheat ground; (2) the weight of flour produced; (3) the monthly rate of grindings.

The amount of wheat ground is influenced by the quantities of wheat of different qualities in the crop, by home demand, and by export demand. The weight of flour produced out of the wheat ground represents the average extraction, largely the expression of the quality of the crop and the flour specifications of consumers. The seasonal rate of grinding is the expression of several influences including administrative stocks at the opening of the season, the rate and volume of wheat marketing, relations of transportation and power, and the trend of flour sales. The grindings of July–December inclusive always exceed those of January–June inclusive, though the amount varies from year to year.

The weighted flour value of a wheat crop is relatively computable for Canada, but much less computable for the United States. The crop report is in bushels of 60 pounds, and represents therefore an adjustment corresponding to the varying amounts of the several grades of wheat with weights lower than 60 pounds to the legal volumetric bushel. This adjustment is based on appraisal of crop reporters at the source, not on official inspections at the terminals, as is the case in Canada.

The degree to which wheat is cleaned before it is milled depends upon many circumstances. We have five inspection grades of wheat, for which the minimum test weight per volume bushel is allowed to run from 50–51 pounds for No. 5 to 58–60 pounds for No. 1. Total foreign material other than dockage is allowed to run from

[1] On account of persistence of old-type mills, there is a difference between gross capacity and what may be termed economic capacity.

7 per cent for No. 5 to 1 per cent for No. 1; and matter other than cereal grains from 5 per cent for No. 5 to 0.5 per cent for No. 1. Heat-damaged grain is allowed to run from 3 per cent for No. 5 to 0.1 per cent for No. 1. Total damaged kernels are allowed to run from 15 per cent for No. 5 to 2 per cent for No. 1. The five grades represent a varying gradation in quality, always more or less unsatisfactory, and one that by no means always corresponds to similar gradation in flour yield. Each variety is allowed to contain wheats of other varieties from 10 per cent for No. 5 to 2 per cent for No. 1, and sometimes these admixtures have an unusual effect on the flour yield as well as on the quality of flour. In different years and in different regions, these admixtures fluctuate rather widely, sometimes in the upward direction, at other times downward, and the mills must adapt their practices accordingly. One of the results of these adaptations is to be found in the yield of flour per bushel of wheat. The miller naturally endeavors to keep his flours uniform, but may be induced to shade the extraction upward or downward according to the prices of flour and mill-feeds.

The decennial census is an actual enumeration of flour grindings, including merchant mills and customs mills, reported separately, having an annual outturn of a value exceeding $500. The biennial census of milling is now confined to reports from merchant mills, excluding all establishments the value of whose products is below $5,000 per annum. This gives a lower figure than would be obtained by the method of the decennial census, depending upon increases or decreases in establishments and shifts of establishments above or below the $5,000 reporting line. When it becomes possible to check the results of several successive biennial censuses against two decennial censuses, the varying relations of the partial censuses to the more complete census will become evident. Most likely these variations are negligible, since the wheat flour produced in customs mills and in merchant mills having an outturn of a value of less than $5,000 per annum is small and probably relatively constant.

The monthly census of milling has a scope more limited than the decennial or biennial census, since it includes only merchant mills manufacturing at the rate of 5,000 or more barrels of flour annually. A careful comparison of the unpublished individual reports of the monthly and the decennial census would indicate the number of mills whose operations lie between the value of $5,000 per annum and the volume of 5,000 barrels per annum, the amount of flour included in this zone, and the proportion it bears to the total outturn.

The monthly census of flour milling includes two running tabulations: (a) the number of mills reporting with an outturn for the month at the rate of 5,000 or more barrels of flour annually, and (b) a comparative statement for the identical mills reporting each month, with a figure for the relation of the outturn of these mills to the total wheat flour reported in the last decennial census. (See Appendix Table VI.) The number of mills reporting monthly has thus far varied roughly from 1,000 to 1,100. The number of mills included in the comparative statement is around 950, and these produced in 1923 approximately 87 per cent of the total wheat flour reported for that year. Assuming that the relations between reporting and non-reporting mills and between the groupings of mills remain relatively constant and comparable, one should be able at the end of the year to secure from the data of the monthly census of flour milling a computed figure for total flour production for the year that may be compared with figures from the quinquennial and biennial censuses, as shown below:

	1909 [a]	1914	1919 [a]	1921	1923	1924	1923–24	1924–25
Wheat ground (*million bushels*)	503.5	545.8	618.7	521.2	558.1	557.4	573.7	539.1
Flour outturn (*million barrels*)	107.1	116.4	133.7	110.8	113.5	120.8	123.9	117.7

[a] These figures include customs mills not reported in the other years. The 1909 figures, excluding customs mills, are 496.5 for wheat and 105.8 for flour. The 1919 figures, excluding customs mills, are 612.6 for wheat and 132.5 for flour.

Since these various censuses have not identical bases of enumeration, is it possible to make them comparable?

It is possible to secure an approximate estimation of the volume of unreported

milling in customs mills and in small merchant mills. In the census of 1919 customs mills were reported as having ground 6,105,047 bushels of wheat and as having produced 1,205,068 barrels of flour. These figures were slightly smaller than the corresponding figures in 1909. The merchant mills with an outturn of less than 1,000 barrels turned out 869,831 barrels, from 5,495,584 bushels of wheat. Since the mills turning out over 1,000 barrels per year correspond fairly closely with the mills turning out a product valued at over $5,000 per year, this would mean, other things being equal, that the reports of the biennial censuses have missed about 11.6 million bushels of wheat ground and 2.1 million barrels of flour included in the decennial census. This would indicate that the biennial census of 1921, and presumably of 1923, missed about 2 per cent of the flour reported in 1919. Strictly speaking, to this must be added the outturn of mills with an annual value of under $500, unreported in all; but this may probably be regarded as negligible.

There is no definite way of knowing just how conditions have changed since 1919. One hears the suggestion that higher freight rates may have stimulated milling in small country mills. On the other hand, competition in flour selling has never been more intense than during the past few years, and this is not favorable to country milling.

Russell and the *Northwestern Miller* have attempted to adjust the census figures in such a way as to represent what they believe to be the total production. The *Northwestern Miller*,[1] on the basis of census comparisons, suggests that the average monthly census estimate of flour production is 81 per cent of the probable total for all wheat flour mills in the country. A. L. Russell[2] believes that the adjusted estimate of the Bureau of the Census, if raised by 5 per cent, would approximate the probable total production. Adjustment for an increase of 2 per cent has been demonstrated to be necessary, but how much more is not demonstrable. The various figures for the last two fiscal years may be contrasted as follows:

(Million barrels)

	1923–24	1924–25
Bureau of Census, raised to 100 per cent	123.9	117.7
The above, plus 2 per cent	126.4	120.1
Northwestern Miller	129.5	129.7
A. L. Russell	130.1	123.6

The discrepancy is slight in 1923–24, but noteworthy in 1924–25.

An increase of somewhere between 2 and 5 per cent represents the adjustment apparently necessary to bring the figure for annual flour production based upon the monthly reports of the census up to the probable total. There is little profit in discussing this adjustment, which will probably be clarified by an additional year's experience with the monthly census and the forthcoming results of the biennial census of 1925.

Once the figure for flour supply is secured (meaning by this outturn of flour minus net exports, adjusted for carryover in and carryover out), the next step would be to segregate consumption into the three main fractions indicated above (p. 299).

Other Data on Flour Milling

Additional data on the course of flour milling would be highly desirable, though differences of opinion may be expected as to whether these ought to be secured through the Census Bureau or through the trade association. It may be taken for granted that the statistics of flour milling, like those of other major industries composed of a large number of operative units, will be expanded either by the Millers' National Federation operating under governmental supervision, or by governmental agencies directly. Desirable additional data would include the following:

(1) monthly outturn of mills, by regions;
(2) stocks in milling hands, by regions;
(3) relation of monthly milling to capacity, by regions;
(4) relation of sales to outturn;
(5) relation of sales to capacity;
(6) stocks covered by hedges.

Concerned with wheat are growers, grain merchants, millers, exporters, bakers, flour dealers. The possession of such current

[1] *Millers' Almanack*, 1925, p. 166.
[2] Personal communication.

data would engender in the minds of each of these groups an objective attitude toward the others, and would tend to reduce waste, increase efficiency, and narrow the spread between the farm price of wheat and the family price of flour and bread.

Bushels of Grain per Barrel of Flour

The outturn of flour per bushel of grain varies considerably from year to year, within the year in different regions, and within a region in different mills. The weight of the wheat per bushel, the variety and quality (whether single or mixed varieties), the percentage of foreign materials (including dockage of all kinds), and the degree of inclusion of frosted, shrivelled, immature, smutted, bin-burnt, or other damaged grains, the water-content of the grain and of the milled products—all affect the outturn. The milling census is based on bushels of 60 pounds as bought. These are weighed by the mill, then cleaned, and the clean wheat weighed. The cleaned wheat is then tempered and in many mills weighed again before being ground. Some of the screenings and cleanings go into the mill feed; others go into feed mixtures. Finally, the relations of prices of flour and mill feed may exert influence on the extraction. In theory, the price of flour is fixed after the returns from sales of mill feed are subtracted from total costs; but in practice, mills may extract higher if mill feed is cheap and may extract lower if mill feed is dear.

The variations in outturn of flour per unit of wheat are not only annual but also monthly. There is a seasonal trend in the quality of grindings due to the obvious fact that most mills purchase month by month and do not secure the grain for a year's program at one time. We have census records of variations in the annual ratio, extending from 4.61 to 4.91 bushels to the barrel of flour. A scrutiny of the details of the monthly milling reports issued by the Department of Commerce (to be found in the Appendix) indicates that during the past two crop years the amount of wheat to the barrel of flour has fluctuated from 273.6 to 279.6 pounds. These are the fluctuations in seasons of large available supplies.

These variations in the utilization of wheat in milling cannot be disregarded, since they run into substantial figures. The error thus introduced is not the same for the consideration of flour milling and wheat crop. We observe variations, according to census returns, of .3 of a bushel of wheat per barrel of flour. A hundred million barrels of flour required 463 million bushels of wheat in 1919 and 491 million bushels in 1923. If one were to subtract from the crop in any year a figure for wheat ground based on an average, one might obviously reduce or increase the resultant figure for carryover by 10–20 millions of bushels. If, on the other hand, one were to apply to the remainder of the wheat crop, after subtraction of all other items from the total supply (the wheat thus statistically consigned to milling), an arbitrary or average factor of flour outturn per bushel of wheat, one would secure a figure for flour production notably above or below the actual outturn. The error in the one case raises or lowers the wheat item to be accounted for with other items of the disappearance; the error in the other instance makes a fictitiously high or low figure for flour consumption.

Since the war the number of bushels of wheat necessary to produce the unit of flour has apparently been rising. Before the war it was common to convert wheat into flour or flour into wheat on the assumption that 4.5 bushels of average wheat equalled the 196-pound barrel of flour. Since it is now possible to obtain the reported relation from the reports of the census, the use of the figure 4.5 for conversion is to be regarded as obsolete. The reported ratio was 4.63:1 in 1923–24 and 4.58:1 in 1924–25.

V. UNRELIABILITY OF CURRENT DATA ON CONSUMPTION

In the study of the disappearance of wheat, the immediate purpose lies in the elucidation of trade relations; the ultimate purpose lies in the appraisal of the human consumption of wheat and the relations of the wheat supply to this demand. While

the manufacture of flour is the chief item in the disappearance of wheat, the disappearance of wheat and the manufacture of flour are two fundamentally different phenomena. They are of considerable importance, and they can be understood only with the aid of adequate statistical material. The present section deals with the inadequacy of these data on consumption.

Wheat Disappearance

The available data on the disappearance of wheat cannot now be used to suggest an approximate estimate of the amount of wheat passing into human consumption, for the simple reason that our information on the several items is so indefinite that every year an amazingly large fraction of the reported supply remains unaccounted for.

The best illustration of this uncomfortable fact is to be found in the records of the United States Grain Corporation. The Food Administration, operating under war powers, was in possession of an extraordinary volume of information concerning wheat and flour. Flour mills, elevators, dealers, and bakers were under license. There was supervision of threshing and an accounting of screenings. Weekly reports were received from some 21,000 country elevators and 10,000 flour mills. Movements of wheat from farms to elevators and from elevators to mills, by states and regions, were reported continuously and minutely. Wheat was allocated to mills, competitive buying was suspended, and all operations were directly measured. The control of the Grain Corporation and of the Milling Division of the Food Administration covered approximately 97 per cent of the wheat supplies. The comparable information on wheat and flour thus secured was better than has been obtained in any decennial census. What under these circumstances could not be accomplished toward elucidating the disappearance of wheat, would appear to lie outside the range of present peace-time statistics. Outstanding, therefore, is the fact that in the three years covering the control of wheat by the Government (extending, however, one month beyond the date of operation of the Grain Corporation, but statistically included) a large volume of wheat remained unaccounted for in each year.

Table 1 indicates this clearly.

Table 1.—Disposition of Wheat, Crop Years 1917–18 to 1919–20, According to U. S. Grain Corporation*

(Million bushels)

	1917–18	1918–19	1919–20
Supplies			
Carryover in all elevators, mills, etc., beginning of year	40.3	14.3	37.9
Carryover on farms, beginning of year	15.6	8.1	19.3
Crop—government estimate	636.7	921.4	968.0
Imports of wheat	28.2	11.1	4.8
Total	720.8	954.9	1,030.0
Disposition			
Ground by mills	523.1	539.1	599.6
1 per cent loss in mill screenings	5.2	5.4	6.0
Exported as wheat	34.1	181.4	122.4
Used for seed	89.3	98.7	80.4
Fed on farms[a]	13.0	26.6	26.6
Farm reserves end of year	8.1	19.6	47.8
Stocks in all elevators and mills, end of year	14.3	37.9	76.0
Total	687.1	908.7	958.8
Unaccounted for	33.7	46.2	71.2

* Abbreviated from Table No. 21 of the supplement to "Grain and Flour Statistics During the War," published by the United States Grain Corporation in 1920. Corrected for the wheat crop of 1919.

[a] Department of Agriculture estimate based on average.

It is astonishing to note that during these three years we exported 338 million bushels of wheat as grain and lost account of 151 million bushels!

Table 2 represents, so far as the disposition of the stated supplies is concerned, Table 1 rewritten to correspond to the formulation now being used by the Division of Historical and Statistical Research of the Bureau of Agricultural Economics.

Obviously, the presence of definite figures for wheat ground as the largest item of known size in the one tabulation, and in the other the stating of wheat ground as the principal unknown, makes all the difference in the meaning and purposes of the two tabulations.

The unaccounted-for wheat in 1917–18 was 33.7 million bushels, or 4.6 per cent of the supply; in 1918–19 it was 46.2 million bushels, or 4.8 per cent of the supply; and in 1919–20 it was 75.2 million bushels, or 6.9 per cent of the supply. Noteworthy, first, is the large volume of wheat involved; secondly, the regular increase in the figure, suggesting possibly the cumulation of a statistical error. When such a volume of wheat remained unaccounted for during years in which the wheat ground was specifically reported and wheat flour was almost as precious as munitions, it would appear fatuous in normal times to make estimates of carryover in and out and wheat used for seed and fed to animals, to subtract the sum of these from the wheat crop, and to regard the remainder as wheat passing into human consumption.

TABLE 2.—DISPOSITION OF WHEAT, CROP YEARS 1917–18 TO 1919–20 (U. S. GRAIN CORPORATION), ACCORDING TO THE CLASSIFICATION OF THE U. S. DEPARTMENT OF AGRICULTURE

(Million bushels)

	1917–18	1918–19	1919–20
Supplies	720.7	954.9	1,030.0
Disposition			
Exports (including flour)	132.6	290.2	219.9
Seed requirements	89.3	98.7	80.4
Farm reserves	8.1	19.6	47.8
Other stocks, including flour	14.3	37.9	76.0
Total disposition	244.3	446.4	424.1
Disappearance for food and feed	476.4	508.5	605.9

The detailed figures of the Grain Corporation give no trustworthy clue to the explanation for these noteworthy discrepancies. Whether the crops were overestimated or the items of stocks and wheat fed to animals underestimated, or both, remains conjectural. Pearl estimated the wheat fed to animals and wasted as 7 per cent of the crop, far below the figure of the Department of Agriculture for feed alone, but larger than the figure stated in the table for the war years. An inherently probable explanation of a part of the unaccounted-for disappearance may lie in the suggestion that farmers, disregarding the urgent appeals of the Department of Agriculture and the Food Administration to send to market all millable wheat, actually used more wheat as animal feed during those years than they were supposed to do.

The average for the three years of wheat lost in mill screenings, fed on farms, and unaccounted for was 78 million bushels, which was a little over 14 per cent of the average amount ground in mills. If one takes the flour production figures of Russell, minus net exports of flour, and the figures of the United States Department of Agriculture for wheat disappearance (as including food, animal feed, and waste) and by subtraction secures figures for animal feed and waste, the average of these figures over the ten-year period is 13 per cent of the average flour production of that period. This concordance looks too good to be more than accidental; but it does indicate that a fraction of unaccounted-for wheat must be regularly present in the estimates of the disposition of the wheat supply.

WHEAT FED TO LIVESTOCK

Wheat fed to livestock and wheat fed on farms are commonly used as synonymous expressions. This is an error that in different years may run into several million bushels.

The late Secretary of Agriculture, in his report of November 1923 on "The Wheat Situation" (Table 19), used certain figures for wheat "fed to livestock." Since this table was based on "reports from farmers," "fed to livestock" obviously meant "fed to livestock on farms," and presumably on farms in counties where the wheat was grown.

Wheat fed to animals is not identical with wheat fed on farms, the former being larger. Wheat fed on farms in the locality where it is grown consists of three kinds of wheat:

(1) Tail wheat; and frosted, shrunken, bin-burnt, sprouted, smutty, or other forms of deteriorated wheat, salable only at heavy discount and unfit for seed.

(2) Low grades or undesirable varieties of millable wheat, selling at a discount so heavy as to make the feed value on the farm higher than the cash value converted

into other available feeding stuffs at local prices.

(3) Sound representative wheat, in some years and in some regions, under conditions of unusual scarcity of other feeding stuffs.[1]

Wheat of the first two kinds is included in the crop report but is not marketed; to the extent that it is not included in the estimate of wheat fed on farms, it is lost in the item of wheat unaccounted for.

When wheat is shipped to elevators and mills, it contains a variable percentage of dockage. This wheat ought to be cleaned on the farm, or at least in the country elevators; but for the most part it is not cleaned until it reaches the mills. The screenings are for the most part later used as animal feed, either unground or ground in the form of mixed feeds. To a considerable extent these feeds are shipped back to the regions from which they were originally derived. The process constitutes a wastage of transportation that has been made prominent in the prairie provinces of Canada, where records are kept of the losses in cleaning and of rail shipments of screenings. The loss in cleaning of Canadian hard spring wheat in four of the past five years has been estimated at 3 per cent of the crop.[2] The Minnesota State Grain Inspection Department has kept records of dockage assessed on wheat at Minnesota markets since 1899. In recent years the dockage has amounted to from 2.3 to 4.8 per cent.[3] We have no comparable estimates for the wheats of other regions, but it is known that the conditions in the spring wheat belt are the worst, though in some years much of the hard winter wheat is quite foul. Assuming for the sake of argument that the dockage removed from wheat by mills grinding soft red winter, hard winter, and the various Pacific Coast wheats was half as much as is the case with Canadian hard spring wheat, we may calculate that the total materials removed before grinding might correspond to some 15 million bushels. Since this is practically all fed back to animals, some such figure must be added to the government estimate of wheat fed on farms in order to secure a more comprehensive estimate of "wheat" (included in the crop estimate but by no means all true wheat) fed to livestock.

The official data on wheat fed to livestock are substantially limited to those obtained in November 1923 from estimates of crop reporters of the "usual disposition" and the intended disposition of the 1923 crop. The "usual" figure averaged 8.1 per cent of the crop, and ranged in different states from 1 per cent in North Dakota to 24 per cent in New York. The corresponding figure for intended disposition of the 1923 crop was much higher,—11.6 per cent. In presenting these figures the Department of Agriculture added:[4]

> Because of unsatisfactory wheat price situation at time of inquiry the estimates of "fed to livestock" may be slightly excessive. The ratio of 1923 to usual, however, is felt to reflect the changed situation as it existed in November. The degree to which these expressed intentions materialized was probably affected by subsequent price changes.

Pearl,[5] statistician of the Food Administration, estimated that 5 per cent of the wheat crop was wasted and lost and only 2 per cent fed to animals directly on the farm. His figure for wastage and losses does not seem too high, in view of the wheat remaining unaccounted for under the operations of the Grain Corporation during the war, if one accepts the crop estimate; but his figure for wheat fed to animals is certainly too low. Wheat fed to livestock and wheat losses between the harvest and the arrival of the grain at the mills were the subject of debate in every European country during the war; the estimates ranged from as low as 2 per cent in countries like Italy to as high as 10 per cent in countries like Germany.

Using the Department of Agriculture average of 8.1 per cent of the crop, we reach the quantities fed to livestock in the past 11 years as shown below. To these figures one ought to add a more or less constant fraction representing screenings

[1] In the years 1921–24, efforts were made by the federal and state departments of agriculture to instruct farmers in the relative feed value of wheat in terms of calories and price.

[2] Canada, *Monthly Bulletin of Agricultural Statistics*, April 1925, p. 101.

[3] *Agriculture Yearbook, 1923*, p. 619.

[4] *Ibid.*, p. 660.

[5] *The Nation's Food*, 1920, pp. 212–218.

included in the crop that are not milled into flour, but are returned to animal feed for urban and country use; this has not here been done.

An indirect way of checking these figures is to take the government figure for disappearance for food and feed and subtract from this a figure for wheat used in milling domestic flour supplies, and regard the remainder as wheat fed to livestock and wasted. The two sets of figures compare as follows:[1]

(Million bushels)

	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20	1920–21	1921–22	1922–23	1923–24	1924–25
Calculated with official average (8.1 per cent):	72	83	52	52	75	78	68	66	70	65	71
Calculated by indirect method:	67	110	33	47	77	112	36	–19	28	76	40

The figures do not agree well nor could they be expected to do so, since in both calculations a number of plus and minus errors find expression. The wheat concerned is not in itself important, and the variation has little consequence so long as there is a notable amount of the reported crop otherwise unaccounted for. But it becomes important for its influence on the carryover at the end of the crop year and on the disposition of wheat during the final months of the crop year. If the figure for wheat fed to animals, including all fractions, may vary as much as to be expressed in a plus or minus error of 15 million bushels, this figure subtracted from or added to farm reserves as reported on July 1, would in many years make a substantial difference that would find reflection in the expected final distribution of the crop, on which the prices of the May and July options are to some extent based. Early improvement in this estimate is hardly to be expected, except for the eventual inclusion of the screenings of wheat flour mills.

Per Capita Flour Consumption

We have no intention of entering here into an exhaustive survey of the per capita flour consumption. It is, however, advantageous in a brief manner tentatively to appraise the apparent consumption of flour in the light of the methods that are available for measuring flour production.

According to Pearl, the average per capita consumption of wheat flour and wheaten products in the seven fiscal years 1911–18 was about 205 pounds, corresponding to 1.04+ barrels of flour.[2] There were necessarily a number of hurried guesses of the United States Department of Agriculture included in the computations, and the period included two abnormal years.

It is sometimes inferred that consumption of wheat is notably elastic and directly related to prosperity and the condition of the family income. In good times some classes cut down consumption of wheat and turn to other foods, especially meats; poorer classes increase the use of wheat and reduce the consumption of cheaper cereals. In periods of unemployment or lower wages, these practices are reversed. Obviously, it might be possible for these to be compensatory, although the lower-wage class contains a larger number of consumers than the higher-wage class. This might mean that increased use of wheat flour by certain classes in times of prosperity would outweigh decreased use of flour in other classes. This, however, is contrary to the usual trade notion existing in milling circles, which runs to the effect that hard times increase the consumption of flour.

It seems to be believed in some quarters that consumption of wheat follows the trend of the business cycle. This is obviously a contradiction of the view that hard times increase the consumption of wheat. It might, however, still be true that the consumption of wheat follows the business cycle, if there were large waste in the periods of boom and small waste in the periods of depression.

Lastly, there is evidence for the view[3] that in a country like ours, consumption (or at least disappearance) of wheat rises with large crops and declines with smaller crops. These more or less conflicting views are appraisable only with possession of accurate data on flour production.

[1] See Appendix Tables I, III.
[2] *The Nation's Food*, 1920, pp. 212–218.
[3] See Wheat Studies, July 1925, I, No. 7.

In order to form a tentative idea of the per capita flour production of the mills of the United States, we may contrast estimates drawn from trade data with those based on reports of the government. Excluding the calendar years 1917 and 1918, Russell's figures for flour production for the years 1914–24, inclusive, are adjusted for exports, averaged, and divided by the population to secure per capita figures. We have census reports for the years 1914, 1919, 1921, 1923, and 1924, the latter being the monthly grindings adjusted to the census of 1923. These various census figures are not strictly comparable, as we have already shown above (p. 305), and each is more or less below the truth. There is little purpose in attempting a highly elaborate adjustment to include the outturn of mills not reporting to the Census Bureau, so long as we have no good figures for carryover of flour, since variations in the flour carryover may easily be larger than flour production missed in the census reports. With a year's further experience with the monthly census of flour milling and the possession of the forthcoming biennial census of 1925, we should be in a position to make a more accurate adjustment than is possible today.

Table 3 shows the figures for per capita consumption obtained by using Russell's figures and the census figures for flour production, less net exports of flour. These are contrasted with those obtainable by taking the United States Department of Agriculture figures for disappearance, subtracting each year the figure for the average for wheat fed on farms (8.1 per cent), and converting the figure for wheat into flour by the factor 4.5. These give hypothetical figures (only to be used with the reservations expressed below Table V in the Appendix).

It is clear from the variations in these figures, taken in the light of the several plus and minus errors that find expression therein, that such figures cannot be employed by students of nutrition, or by the trade, to judge flour consumption in the country, in a region, in a year, or through a business cycle. Moreover, the figure for per capita production cannot be accepted as the figure for per capita consumption, since carryovers of flour are by no means constant. Nor are any of the current theories of the elasticity of the demand for flour, and the reactions of variations in family income on the use of flour, appraisable with the use of the figures currently available.

TABLE 3.—CALCULATIONS OF PER CAPITA FLOUR SUPPLY, DISREGARDING CARRYOVERS*

(Barrels)

Calendar year	Russell	Census[a]	Fiscal year	Russell	U.S.D.A.
1914	1.06	1.12	1914–15	0.97	0.96
1915	1.00		1915–16	1.07	1.13
1916	1.05		1916–17	1.02	0.98
1917	1.02		1917–18	0.91	0.90
1918	0.89		1918–19	0.93	0.94
1919	1.02	1.02	1919–20	1.02	1.09
1920	0.95		1920–21	0.86	0.79
1921	0.98	0.88	1921–22	0.99	0.82
1922	1.09		1922–23	1.05	0.96
1923	0.99	0.88	1923–24[b]	1.01	1.04
1924	1.04	0.94	1924–25[c]	1.01	0.95

* Basic data given in Appendix Tables.

[a] As reported on various bases, most inclusively by the 1919 census, least inclusively by the monthly census for 1924, 1923–24, and 1924–25. See above, p. 305.

[b] Census figure, 0.96; *Northwestern Miller* figure, 1.01.

[c] Census figure, 0.92; *Northwestern Miller* figure, 1.03.

In the *Agriculture Yearbook* for 1923, page 110, a discussion on "The Decreased Consumption of Wheat" is introduced with the following words:

> Decrease in consumption of wheat flour in this country has contributed to the large exports of the war and post-war period. The war appeal to save bread, aided by high prices, formed food habits which have remained with us.

This is followed by a reference to the prewar custom of serving bread free in public eating-places contrasted with the post-war custom of making a charge for bread.

It is difficult to find in the statistical material of the Department of Agriculture an adequate basis for the inference that consumption of wheat flour in this country has decreased materially. On page 614 of the same *Yearbook* is a tabulation of per capita disappearance of wheat in the United States. It is an arbitrary inference to assume that the stated decline in per capita disappearance of wheat means a corresponding or substantial decline in per capita consumption of flour. Not only are the plus and minus errors of the several items of supply and demand finally cumulated in

the figure for per capita disappearance of wheat, but no consideration is given to variations in wheat fed to animals, wasted, and unaccounted for, and to changes in the level of extraction. The only sound statistical method of proving a decrease in consumption of wheat flour must rest upon milling statistics, and these were not used in the formulation of the sentence quoted above for the simple reason that they were not available.

It is more or less widely believed that as the result of the war (entirely apart from the question of free bread service in public eating-places) people are ingesting less wheaten products—that having learned to get along with less bread and cake, we have continued to do so. To us this sounds naive. More bread eaten free with one meal taken in a public eating-place might mean less bread eaten with the two meals in the home; a breadless meal in a public eating-place might mean more bread eaten with the two meals at home. We do not contend, and could not prove, that the per capita ingestion of wheaten products is not less than it was before the war; we merely insist that the proponents of lower consumption are not in statistical position to prove it, or, if proved, to measure it. But if such an under-consumption exists, explanation should be sought in the price relations of wheaten foods and other foodstuffs, in the expansion in use of fresh fruits and vegetables, and in the purchasing power of the family income.

How little the trade knows about flour disappearance may be illustrated by two examples.

According to the biennial census of 1923, the total sales of wheat flour to commercial bakeries were a little under 35 million barrels. This figure created veritable consternation in milling and baking circles, because it was so much lower, probably 10 million barrels lower, than the figure commonly accepted for such flour sales.

The second example is drawn from the milling records of the past season. In January it was apparently the consensus of opinion in milling and baking circles that flour stocks in distributive channels were at low ebb and that buying was strictly from hand to mouth. On these two positions, with a further assumption as to prospective exports, it was inferred that flour milling during the remainder of the fiscal year would not exhibit the usual seasonal decline, but instead would continue on a relatively high level. The census figures for grindings during the last five months of the fiscal year exhibit, however, a seasonal decline that could only be described as a heavy decline from the level of milling operations during the first seven months of the fiscal year, a reduction that could not be explained by decline in exports.[1] Either the term "hand-to-mouth buying" is in itself relative and varies from season to season; or flour stocks were in existence of which the trade had no knowledge or took no cognizance.

VI. FORECASTS OF WHEAT DISAPPEARANCE, MARCH–JUNE

A prominent use, and the principal abuse, of the current data on disappearance of wheat and production of flour lie in their employment in March in trade forecasts of probable developments up to the new crop. The lack of estimates of farm reserves, stocks in country mills and elevators, stocks in city-mill hands, and flour stocks in the distributive trades on December 1 accentuates the difficulties of the trade as March approaches, since up to the establishment of the monthly milling census there was nothing to guide the trade outside of inspections, receipts, and the visible wheat. By March 1, therefore, except where the market was clearly a buyer's market, considerable uncertainty naturally developed. The issue of the March 1 estimates for wheat on farms and in country mills and elevators, with the visible wheat, thereupon made possible a speculative prevision extending to July 1. To a considerable extent, during this period, the relations of the May and July options have rested on the figures

[1] See below, p. 316.

issued on March 1 and the forecasts based upon them.

The Principal Questions

The American millers, the exporters, and the European importers ask four questions in March:

(1) What is the available American wheat supply for the remaining four months of the year?

(2) What are the requirements of American mills during this period?

(3) What is the exportable American surplus?

(4) What is to be the American carryover on July 1?

The amount of wheat which will be used for spring seed can be forecast in March with reasonable accuracy. Wheat fed to animals during the months March–June has been generally disregarded, on the theory that feed use of wheat would have been completed earlier in the winter. Given the disposition of the supply on the basis of the revised crop report of December, and the remnants reported on March 1 in farm reserves, in country mills and elevators, and in the commercial visible, the trade attempts each year to answer the four questions above stated. In the absence of milling statistics, the practical result has been, in effect, to load the uncertainties upon the item of domestic consumption.

In a year of easy adjustment between world supply and world demand, the situation is of no great practical importance. But in a year of presumably close adjustment between world demand and world supply, as during the past season, this statistical situation in the wheat supply and disposition of the crop during March–June becomes acute. The situation in respect to supply and disposition of wheat in the United States during the period under review was this year esteemed so important as to be reflected in the grain exchanges of the world and in the domestic markets of most European countries.

This method of loading on mill consumption the uncertainties of the other items is bad enough when applied to a crop year, but leads to worse results when used to estimate the consumption in the last four months of the crop year—namely, from March 1 to July 1. The census data on mill grindings and mill stocks put us in a position to place a check on the other items in disposition of wheat supply.

Broomhall's Formulation

Table 4 represents Broomhall's forecast, early in March 1925, of possible wheat happenings in the United States up to the first of July, as based on the available trade estimates of stocks as of March 1.

Table 4.—Broomhall's Summary and Forecast of United States Wheat Supplies and Their Disposition, March 5, 1925*

(Million bushels)

	1920	1921	1922	1923	1924	1925
Farm reserves, March 1st	166	208	131	153	134	115
"Bradstreet's," American only	59	32	47	55	73	75
Country mills and elevators	118	82	75	93	90	95
Total available March 1st	343	322	253	301	297	285
Farm reserves, June 30th	49	57	32	36	31	
"Bradstreet's," American only	28	12	20	29	39	
Country mills and elevators	36	26	28	36	36	
Total available June 30th	113	95	80	101	106	60
Indicated quantity consumed, seeded and exported, March–June	230	227	173	200	191	225
Of which exported	78	109	54	48	36	63
Of which seeded	30	30	30	30	30	30
Of which consumed	122	88	89	122	125	132
Add imports of Canadian wheat	2	11	7	17	8	
Total consumed	124	99	96	139	133	132

* Broomhall's *Corn Trade News* (daily edition), March 5, 1925, p. 639.

Under "total consumed" of course is understood something more than mill consumption. But even if we possessed no figures for milling, one could hardly believe that mill consumption in the period March–

June during the past six seasons could have been portrayed by these figures.

Broomhall's table, even for earlier years, does not check at all points with the best reported figures. With suitable corrections, his table would appear as in Table 5.

TABLE 5.—UNITED STATES WHEAT SUPPLIES AND THEIR DISPOSITION, TABULATED IN THE SAME FORM AS BROOMHALL'S TABLE, BUT BASED ON OFFICIAL UNITED STATES FIGURES

(Million bushels)

	1920	1921	1922	1923	1924	1925
Farm reserves, March 1st	169.9	217.0	134.3	156.1	137.7	113.9
"Bradstreet's" U. S. visible	58.6	31.9	48.0	54.6	72.9	76.4
Country mills and elevators	123.2	87.1	75.1	102.9	98.3	69.1
Total available March 1st	351.7	336.0	257.4	313.6	308.9	259.4
Farm reserves, July 1st	49.5	56.7	32.4	35.9	30.7	30.0
"Bradstreet's" U. S. visible	23.4	10.0	20.3	29.4	38.6	32.0
Country mills and elevators	37.3	27.2	28.8	37.1	37.0	25.0
Total available June 30th	110.2	93.9	81.5	102.4	106.3	87.0
Indicated quantity consumed, seeded, and exported, March–June	241.5	242.1	175.9	211.2	202.6	172.0
Of which exported	78.2	109.4	57.3	48.2	35.3	52.0
Of which seeded	29.1	28.0	27.6	27.7	24.6	30.0
Of which consumed	134.2	104.7	91.0	135.3	142.7	90.0
Add imports of Canadian wheat	1.5	10.8	7.1	4.6	7.2	1.0
Total consumed	135.7	115.5	98.1	139.9	149.9	91.0

COMPARISONS WITH MILL GRINDINGS

Let us now contrast the best available figures for wheat ground with the figures for consumption secured by the current method employed by Broomhall. Russell's figures for flour produced have been converted into wheat by multiplication with 4.5. The figures of the Bureau of the Census for the last two years are adjusted for the proportion of mills reporting to the total reported in the previous biennial census.

Table 6 shows clearly that the discrepancies are heavy and erratic. But this is exactly what is to be expected when we recall that this figure for consumption is affected by cumulative net errors of the previous crop report and carryover and the March 1 estimates of farm reserves, stocks in country mills and elevators, the visible wheat, and invisible stocks of various kinds. Broomhall's method of computation appears to assume either that all the wheat in the country, and no more, is included in the item for "total available, 1st March," or that missing items may safely be left out of account. As a matter of fact, one positive item has always been missing—namely, wheat reserves in mill hands (not reported under farm reserves, stocks in country mills and elevators, and the visible supply), reserves that are variable and are likely to be large on March 1. Lacking also in the item, "total available, 30th June," are the corresponding mill reserves of that date. Beyond this, any overestimate of the previous crop year or the previous carryover would find expression in the item "total

TABLE 6.—COMPARATIVE APPROXIMATIONS OF WHEAT CONSUMED IN THE UNITED STATES, MARCH–JUNE, 1920–25*

(Million bushels)

	1920	1921	1922	1923	1924	1925
Broomhall						
Total consumed	124	99	96	139	133	132[a]
Corrected						
Total consumed	136	116	98	140	150	91[b]
Russell						
Wheat milled	143	157	152	166	176	155[b]
Census						
Wheat milled, unadjusted					142[b]	128[b]
" " adjusted					174	148

* Based on Tables 4 and 5, *Russell's Commercial Review*, and Monthly Census of Wheat Milling.

[a] Forecast.

[b] Reported.

available, 1st March." The mill grindings for the period March–June are obviously the direct method of applying a check, and when applied, the result is disastrous to our confidence in the method employed by Broomhall, even conceding that the flour production estimates of Russell are trade figures and that we have the figures of the Bureau of the Census covering only two years.

The Element of Mill Stocks

On January 31 the mills making replies to a questionnaire of the Millers' National Federation reported stocks of some 74 million bushels of wheat and 3 million barrels of flour. These reporting mills manufactured in 1923 about 70 million barrels of flour, being about 57 per cent of the total. If we assume, which is probably in excess of the truth, that the unreporting mills carried the same relative stocks, this would have meant that total mill stocks on February 1 were in the neighborhood of 150 million bushels, including flour as wheat. The unreporting mills probably carried relatively lower stocks than the reporting mills, but how much less is not determinable; therefore, no one is in a position to suggest how much the figures for stocks would have been above 74 million bushels of wheat and 3 million barrels of flour if all the merchant mills whose annual outturn is in excess of $5,000 could be included in the report. The mill stocks a month later were probably somewhat smaller than on February 1, but again how much is indeterminable. For purposes of argument, let us assume that the mill stocks on March 1 were the same as on February 1. On March 1 the Department of Agriculture issued estimates of wheat on farms and in country mills and elevators. Table 7 shows an approximation to the wheat supplies on March 1, 1925, including country stocks, Bradstreet's figure for the American visible supply, and the unadjusted minimum estimate of mill stocks.

Part of the mill stocks was in country mills and elevators, part of it in the visible supply,[1] but how much in each case is indeterminate. Clearly, however, there was in the country more than the 259 million bushels comprising the sum of the first three items; but how much more than that, how much less than 346 or possibly more than that, no one can guess. The figure of 346 million bushels for supply on March 1 would have given a very different complexion to the Broomhall table from the 285 in the original table or the 259 in the corrected table.

Table 7.—Wheat Supply on March 1, 1925

(Million bushels)

Farm reserves	114
Country mills and elevators	69
Bradstreet's American visible	76
Millers' National Federation report of mill stocks	87
Total	346

This is illustrated in Table 8, which contains the figures for supply available on March 1, contrasted with the figure for the amount of wheat that must have been in the country according to the reported exports of wheat, wheat ground, and carryover on July 1.

Table 8.—Comparative Estimates of Wheat Stocks, March 1, 1925

(Million bushels)

Sum of farm reserves, in country mills and elevators, and commercial visible, March 1		259
The above, plus city-mill stocks according to Table 7, March 1		346
Sum of:		
Farm reserves, July 1	30	
Country mills and elevators, July 1	25	
Commercial visible, July 1	32	
Mill stocks, Bureau of the Census, July 1	48	
Exports as wheat, March–June	34	
Wheat milled, Bureau of the Census, March–June	148	
		317

This table shows that it is unwarranted on March 1 to make a forecast for the last four months of the fiscal year on the basis of estimates of wheat on farms, in country mills and elevators, and the commercial visible, without estimates of wheat grindings and city-mill stocks.

[1] Of the 76 million bushels only 18 were reported as hedged. Practically all visible wheat east of the Rocky Mountains is hedged, while large mills carry stocks that are mostly hedged, but are not in the visible.

VII. SEASONAL VARIATIONS IN FLOUR OUTPUT AND EXPORT

Seasonal Influences

The monthly curve of flour milling is affected by at least four influences. (1) Midsummer stocks of flour in the channels of distribution are usually low for climatic reasons and because of the disinclination of the trade to hold heavy stocks in the face of a new crop. (2) In the autumn, flour holders stock up and the mills speed up to meet their demands as well as to make the best use of new crop supplies. (3) The export demand varies greatly, and reacts upon milling activity. There is a certain degree of normal seasonal variation of exports, dependent also on climate and on the relations of our flour supplies to the flour supplies of other competing countries. (4) Finally, the actual and prospective course of wheat prices constitutes a modifying factor.

These influences vary from year to year. In some years mill operations and stocks decline in midsummer more than in others. In different years, fall milling is restrained or exaggerated; dealers stock up heavily and stay so or do not stock up and buy from hand to mouth through the season. In some years, export demand is early, sustained, and used to maintain stocks abroad; in other years it is low or may be reversed as to seasons. The peaks of milling may be high and narrow or low and broad. We have no long-term figures from which to construct an average or norm with which to contrast the variations in a single year. Nevertheless, it is of interest to examine the available data on flour milling and exports from the standpoint of seasonal variation.

Available Milling Statistics

Until recently the best figures available for milling outturn by months were those based on the experiences of the Grain Corporation and the Milling Division of the United States Food Administration. This series was extended backward to January 1914, in a somewhat arbitrary manner, with the Food Administration data for the years 1917–19. A. L. Russell, formerly statistician of the U. S. Grain Corporation, has carried the series forward from July 1, 1920, using the data of the *Northwestern Miller*, and again with the aid of somewhat arbitrary assumptions. The whole series, referred to as Russell's, is given in Appendix Table VII, from July 1914 to June 1925; and Appendix Table VIII shows the monthly and quarterly figures for the past five years expressed as percentages of the annual totals.

These data show that the flour trade year coincides with the wheat crop year and the fiscal year, all running from July 1 to June 30. June is always a low month in flour production, and the outturn for July, with the advent of new crop wheat, usually registers a sharp increase over that of June. Dividing the year into quarters, beginning with July, one observes that throughout the period covered by the tables the outturn for the second quarter was always larger than for the first quarter, except in 1921–22, in which year the mills endeavored by producing heavily in the first quarter to take advantage of current price relations. Only twice during the period was the outturn of the third quarter equal to that of the first or second quarter—namely, in 1915–16 and 1917–18, both times due to exigencies of war. The last quarter is ordinarily the one of lowest production. Only four times during the period (in 1916–17, 1917–18, 1918–19, and 1920–21) did the outturn for the last quarter exceed that of one of the other quarters of the year; in all instances this was due to exigencies of war demand and post-war trade.

Quarterly averages for various periods, expressed as percentages of the year's total, run as follows:

	July–Sept.	Oct.–Dec.	Jan.–Mar.	Apr.–June
10-year average, 1920–24	25.36	30.13	23.77	20.74
The same, excluding 1917–18	26.29	28.96	23.66	21.09
3-year average, 1914–17	25.71	30.03	23.49	20.77
4-year average, 1920–24	27.38	27.52	23.64	21.46

None of these averages is really representative, but the last is probably least unrepre-

sentative, since it excludes the war period and the immediate post-war period. All the averages agree in showing the production of the first half of the trade year about 55 per cent of the year's total.

Since July 1923, as we have already noted, the monthly milling census has yielded data which, though incomplete, afford the basis for estimating flour production with a serviceable approach to accuracy. Each month the Census Bureau reports thirteen months' data for wheat ground and flour produced by all reporting mills (usually 1,000 to 1,100), and also similar data for a smaller number of identical mills (usually about 950) which have reported for the entire thirteen months. A figure is also given showing the ratio of the production of these identical mills to the total flour production reported according to the available data from the most recent biennial census. These figures are summarized in Appendix Table VI.

It is necessary to point out that in the census estimate of flour production in 1923–24 the 955 regularly reporting mills produced approximately 82 per cent of the flour reported in the biennial census of 1921, while in the estimate for the year 1924–25 the 949 regularly reporting mills produced approximately 87 per cent of the flour reported in the biennial census of 1923. But the bases of the two biennial censuses were not identical; and the results, therefore, are not closely comparable. The number of establishments reporting in 1923 was lower than in 1921, due particularly to the fact that only strictly merchant mills were included in the census of 1923, while in 1921 mills doing customs grindings as well as merchant business were included if the value of the outturn exceeded the minimal limit of $5,000 per annum. This has the effect of making the figure for 1924–25 appear low by comparison with the figure for 1923–24, and the adjustment secured by the use of the factor 87 per cent in the latter year yields clearly too low an absolute figure, compared with that secured for the earlier year through adjustment with the factor 82 per cent. According to the *Northwestern Miller*[1] the estimate of approximately 113.5 million bushels in the 1923 biennial census ought to be raised to 120 millions to correspond with total production. This is a temporary difficulty in the monthly census of flour milling that will be rectified with another year's experience with the procedure.

[1] February 18, 1925.

Monthly Indexes of Seasonal Variation

The Federal Reserve Board computed a seasonal index for flour production in making their index of production in basic industries (see *Federal Reserve Bulletin*, December 1922, pp. 1414–21). This seasonal was computed from Russell's figures for monthly production of flour for the years 1914 to 1921 inclusive, by obtaining the ratios of the original data to a 12-month moving average, then taking the median of these ratios for each month and adjusting these medians to total 1,200 for the year.

The Harvard Economic Service also computed a seasonal index of flour production in making their index of the volume of manufacture (see *Review of Economic Statistics*, January 1923, pp. 49–50). Russell's figures for the period January 1914 to October 1922 were used and the seasonal index was computed by the regular "link relative" method as described in the *Review of Economic Statistics*, Preliminary Volume I.

These two seasonal indexes are compared below:

Month	Federal Reserve Board	Harvard Economic Service
January	112	110
February	89	90
March	89	91
April	82	86
May	84	82
June	79	80
July	77	86
August	106	105
September	113	117
October	124	125
November	124	121
December	121	108

The two indexes agree in showing distinctly heavier millings in the months of August–January than in the months of February–July, but the two methods give quite different curves, and notably different results for July and December.

A more serious criticism applies to both indexes. The length of the series employed is spurious. Since the basic data for the period 1914–17 were arbitrarily computed backward from the data of the United States Food Administration for the years 1917–19, it is technically improper to use the results of these earlier years in combination with those of the later years to form an index covering the entire period. The figures prior to July 1, 1920, are not adapted to the preparation of a seasonal index of flour milling, for the simple reason that the variations between 1914 and 1920 did not express reactions to normal trade influences but were largely the results of arbitrary factors. Prior to our entrance into the war, more or less concerted European buying introduced abnormal influences into our grain and flour trade. After the entrance of the United States into the war, wheat supplies were allocated to mills, and flour milling was forced, since it was the policy of the Food Administration to ship flour instead of wheat to the largest extent possible. Early in 1919 milling operations were released from government control, but the operations remained abnormal because the United States government was shipping abroad large amounts of flour as food relief; European countries continued to control imports through government agencies; the Director of the United States Grain Corporation bought wheat and flour in maintenance of the fixed price; and large amounts of clear flours were literally dumped on the Corporation by the mills. Beginning with July 1, 1920, wheat grindings again became private operations; and from that time on the volume of grindings has represented reactions to trade influences, still more or less abnormal in importing European markets. From this date alone determinations of volume and seasonal variations should be undertaken. Nor is it safe to construct such an index from the five years' post-war observations at our disposal, for the period is much too short to yield a reliable index of normal seasonal variation.

The Federal Reserve Board and the Harvard Economic Service are of course fully aware of the tentative character of their indexes, and they have never employed them in forecasts. To use either index, or another constructed from the data of the past five years, as an aid in forecasting flour production for a few months ahead, might lead to quite erroneous results. Probably such a seasonal index can be computed with safety only after the lapse of several years.

Application to Forecast February–June Millings

There remains a question whether it may be possible to use the available data in forecasting the probable flour output, not of a single month or series of months, but of a period of months toward the end of the crop year. In particular can one employ the data for flour output in the first seven months to predict the output in the five months February–June? If it were possible in March, when the census figures for the first seven months are available, to indicate the normal totals for the year, and by deduction the flour output for the last five months, it might be possible to derive a forecast by modifying the resulting figures up or down in the light of the best available information concerning the outlook.

The annual totals, according to Russell, are shown in Appendix Table IX, divided into 7-month and 5-month portions. For the four years 1920–21 to 1923–24, the flour output of the first seven months averaged 63 per cent of the output for the trade year. If now we take the census figures for production July–January in the past two years, adjust them to allow for non-reporting mills, and raise the resulting figures to 100 per cent by the use of the average ratio derived as above, we have the results shown in Table 9. These are compared with the actual outturn as derived from the final reports of the census (adjusted for non-reporting mills) and as reported by Russell and the *Northwestern Miller.* It appears that the crude forecast was about 4 million barrels too low in 1923–24 and about 4 million barrels too high in 1924–25.

In comparing the differences between the forecast and the census reported total, on the one hand, with the reported totals of Russell and the *Northwestern Miller,* on the

other hand, it must be recalled that Russell and the *Northwestern Miller* attempt to include unreported flour milling, while the census figures here included are not adjusted to include any custom milling or milling in merchant mills with an outturn of less than $5,000 per annum. If the flour trade of the country had really been on a hand-to-mouth basis on the first of February, as was believed by most traders, and production had continued through the year on an even level, the census production would have recorded an outturn of 132 million barrels instead of the 121.7 actually reported.

TABLE 9.—FORECAST OF YEAR'S PRODUCTION OF FLOUR, 1923–24 AND 1924–25, FROM DATA FOR FIRST SEVEN MONTHS, COMPARED WITH REPORTED PRODUCTION

(Million barrels)

	1923–24	1924–25
Census grindings, July–January for identical mills, as reported in March	63.5	66.7
Adjusted for non-reporting mills	75.6	76.7
Raised from 63[a] to 100 per cent	120.0	121.7
Final census report, adjusted for non-reporting mills	123.9	117.7
Russell's reported total	129.8	128.5
Northwestern Miller estimate	129.4	129.6

[a] Average percentage of annual production milled in first seven months of years 1920–21 to 1923–24, according to Russell.

The crude results shown are not without significance. Some variations from year to year are to be expected, and it is part of the forecasting operation not merely to make such a calculation as the above, but to take account of influences which promise to cause actual production to be higher or lower than the average. Better results can be expected when census figures for grindings are available for a longer period, and when the average percentage of the year's output produced in the first seven months can be based on a longer period.

IRREGULARITY OF FLOUR EXPORTS

One special reason for the difficulty in forecasting the flour production of the last four or five months of the fiscal year—or indeed of any period—lies in the irregularity of exports. This is suggested by Appendix Table X, which gives the monthly flour exports of the United States in the last six fiscal years. A flour exporter would probably rate each of these years as abnormal, for one reason or another. The high months in each of the different years were respectively July, August, October, November, December, and May; the low months were respectively July, September, January, June, and May. It is difficult to picture the variations in these figures as corresponding to seasonal influences in the importing countries. When one scrutinizes the individual items in this short series, a curve of flour exports based on the relations of percentage of export each month to the total would not seem to afford a convincing basis for a forecast of exports. The exports of a certain month were milled, for the most part, one to three months previously; some exports represent fulfillment of contracts undertaken much earlier and milled in accordance with the otherwise varying business of the mill; part of the export represents a dumping trade of low-grade flours that may have accumulated over a considerable period of time.

A comparison of the rate of flour export from the United States with that of the corresponding export from Canada is suggestive. The individual items in the table of Canadian flour export (see Appendix Table XI) exhibit less fluctuation than is to be observed in the figures of exports from the United States. Taking the course of the monthly averages over the past six years for what it is worth, in the case of the United States there are two high points in exports—namely, October–November and in March. These same two high points are visible in the Canadian exports, except that the first high point is deferred a month—namely, November–December, but the second high point is the same month, March. The exports in January and February are, for the United States, lower than in July and August and almost as low as May and June. For Canada, however, the exports for January and February do not fall to as low a relative level. The tables are not strictly comparable, since the Canadian crop year is really September–August, while our crop year is July–June, and we are exporting new-crop

flour in August and September at a time when the Canadians are still exporting old-crop flour. Since the export of flour from Canada is practically 60 per cent of the production, while that from the United States is less than 15 per cent of the production, the relationship between flour export and wheat grindings is naturally much closer in Canada than in the United States, and the difficulty of forecasting flour production for months ahead is correspondingly greater in Canada.

VIII. CONCLUSIONS

The outcome of such an appraisal as the foregoing is necessarily unsatisfactory in the direction of positive interpretations of existing data because many data are incomplete in extent, defective in amount, not comparable in character, and have been set up on inconstant and inconsistent bases. Our statistics of crops are more or less imperfect; our statistics of wheat and flour stocks are seriously deficient. We possess no really dependable series of measures of domestic flour consumption or of wheat fed to animals. Important advances, however, have recently been made through the census reports of city-mill stocks and monthly millings. Appreciable errors are introduced into calculations through statistical conversions of wheat into flour, or flour into wheat, at the round figure of 4½ bushels to the barrel, and also by disregarding dockage and waste in computing wheat fed to animals.

The principal conclusions to be drawn from the analysis may be summarized.

(1) The statistical procedures now employed to measure the disappearance of wheat and the appearance and disappearance of wheat flour are technically inadequate in scope and incomplete in execution.

(2) The traditional method of reaching a figure for flour consumption specifically or human consumption generally (by subtracting from the sum of crop and carryover a series of items, several of which are inherently indeterminate) is unsound.

(3) To allow the sum total of the plus and minus errors of estimates of all the items in the appearance and disappearance of wheat to fall upon the item of flour production has the result of magnifying existing uncertainties and introducing new uncertainties into the appraisal of the situation of the wheat supply.

(4) Since a census of manufacturing production is in practice more accurate than a census of agricultural production, the method of estimating flour production directly represents the correct procedure to be followed.

(5) The monthly reports on wheat milling now being compiled by the Bureau of the Census are an indispensable contribution to our fund of information. Interpretation of the results of this census will be facilitated and improved when we are in possession of the results of the biennial census of 1925 and the quinquennial agricultural census. Until after the decennial census of 1930, it will not be possible to reach a close adjustment of the flour output reported in the monthly milling census to take account of non-reporting mills.

(6) The reports on stocks of wheat and flour in mill-hands now being compiled by the Bureau of the Census and the Millers' National Federation are important contributions to our knowledge of the carryover. It would be of advantage if the Millers' National Federation, acting as a trade association, would compile for flour regular statistics of operations and movements comparable to those compiled by the Department of Commerce for cotton and hides and their products.

(7) The inference seems warranted that correct data on flour milling will prove more helpful in estimating the wheat supply than improvement in wheat statistics will contribute to our knowledge of flour production. Data on disappearance of wheat can be used to check up on flour milling, and data on flour milling can be used to check up on the wheat supply; but the latter procedure seems the more promising.

(8) There are important variations in flour milling within the season, but com-

parable data cover too brief a period to yield a dependable index of typical seasonal variation. It is possible, however, to make some approach toward forecasting, from milling data for July–January, the milling output of the last five months of the trade year. Erratic movements of flour exports render difficult the forecast of both milling output and exports.

(9) On the assumption that the use of wheat in the diet of the country has been under the normal, millers and bakers have been urging the people to "eat more wheat." But since it is not possible to determine how much was ingested before the war, we lack the basis for comparison; and since accurate means of measuring flour production have but recently been developed, we lack a basis for judging the trend of consumption.

From a survey of existing practices we venture to advance recommendations for the amplification and perfection of statistical procedures designed to elucidate the disappearance of wheat and the appearance of wheat flour. These include the following:

(a) The addition of estimates as of December 1 and March 1 to the estimation of wheat stocks in city-mill hands, now for the first time being estimated for June 30 by the Bureau of the Census.

(b) The extension of current official estimates to include an additional earlier estimate as of December 1 for

(I) wheat on farms, and
(II) wheat in country mills and elevators.

(c) The establishment of official estimates as of December 1, March 1, and June 30 for visible wheat in commercial hands (outside of country stocks), independent of the present trade estimate bearing the same name.

(d) The reporting of official estimates, by wheat regions as well as for the country as a unit, for

(I) farm reserves,
(II) wheat in country mills and elevators,
(III) visible supply, and
(IV) city-mill stocks.

(e) The reporting by wheat regions of

(I) wheat inspections, and
(II) primary receipts and primary shipments.

(f) The segregation of durum wheat from flour wheats.

(g) The development of a system of reporting farm marketing.

In conclusion, study of the employment and usefulness of statistics of wheat (including crop, carryover, marketing, movement, stocks, milling, and exports) lends support to the view that business dealings in wheat (including those of farmers, elevators, coöperatives, grain merchants, millers, and exporters) would be improved and clarified if trading in wheat futures on established grain exchanges (indispensable in wheat commerce) could be extended to six calendar months, instead of four as at present. This would mean the following six evenly-spaced months designated as trading months in wheat futures: namely, July, September, November, January, March, and May. The reasons to be adduced in favor of amplification of the months of trading in wheat contracts, however, must be reserved for subsequent consideration.

TABLE I.—WHEAT SUPPLY AND DISTRIBUTION IN THE UNITED STATES, CROP YEARS BEGINNING JULY 1, 1914–15 TO 1924–25*

(Figures in thousands, except per capita)

Item	Unit	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20	1920–21	1921–22	1922–23	1923–24 [a]	1924–25 [a]
Area sown for harvest of year stated	Acre	54,781	61,592	56,852	56,191	65,177	76,251	65,988	65,907	69,746	66,241	57,520
Area harvested	Acre	53,541	60,469	52,316	45,089	59,181	75,694	61,143	63,696	62,317	59,659	54,209
Supply:												
Production	Bu.	891,017	1,025,801	636,318	636,655	921,438	967,979	833,027	814,905	867,598	797,381	872,673
Stocks, beginning of crop year:												
On farms	Bu.	32,236	28,972	74,731	15,611	8,063	19,261	49,546	56,707	32,359	35,894	30,980
In country mills and elevators [b]	Bu.	31,000	18,000	46,000	18,000	19,000	19,672	37,304	27,167	28,756	37,117	37,000
Visible supply (Bradstreet's)	Bu.	18,558	10,734	50,515	19,901	2,465	10,873	23,404	9,966	20,342	29,403	38,597
Flour, in terms of wheat	Bu.	8,766	7,371	11,259	8,586	4,023	7,402	10,274	6,651	7,461	10,049	9,207
Imports:												
Wheat	Bu.	426	5,703	24,139	28,177	11,122	4,780	51,004	14,465	18,013	27,283	6,179
Flour, in terms of wheat	Bu.	289	1,485	786	3,038	167	716	6,394	2,786	1,932	761	31
Total supply	Bu.	982,292	1,098,066	843,748	729,968	966,278	1,030,683	1,010,953	932,647	976,461	937,888	994,667
Distribution (except domestic disappearance):												
Exports, domestic:												
Wheat	Bu.	259,643	173,274	149,831	34,119	178,583	122,431	293,267	208,321	154,951	78,793	195,476
Flour, in terms of wheat	Bu.	72,822	69,843	53,743	98,460	108,819	97,433	72,810	71,086	66,972	77,637	62,638
Exports, foreign:												
Wheat	Bu.	181	575	54	1,053	499	94	778	4	148	28	
Flour, in terms of wheat	Bu.	7	46	10	358	4	58	207	379	60	60	
Shipments to possessions:												
Wheat	Bu.	119	104	77	23	21	55	70	67	81	102	125
Flour, in terms of wheat	Bu.	2,267	2,474	2,365	1,988	2,393	2,858	2,515	2,509	2,705	2,748	2,782
Stocks, end of crop year:												
On farms	Bu.	28,972	74,731	15,611	8,063	19,261	49,546	56,707	32,359	35,894	30,980	29,705
In country mills and elevators [b]	Bu.	18,000	46,000	18,000	19,000	19,672	37,304	27,167	28,756	37,117	37,000	25,000
Visible supply (Bradstreet's)	Bu.	10,734	50,515	19,901	2,465	10,873	23,404	9,966	20,342	29,403	38,597	31,803
Flour, in terms of wheat	Bu.	7,371	11,259	8,586	4,023	7,402	10,274	6,651	7,461	10,049	9,207	8,168
Seed requirements [c]	Bu.	84,997	78,456	77,544	89,944	105,226	91,063	90,952	96,249	91,413	79,378	88,000
Total distribution (except domestic)	Bu.	485,113	507,277	345,722	259,496	452,753	434,520	561,090	467,533	428,793	354,530	443,697
Total domestic disappearance [d]	Bu.	497,179	590,789	498,026	470,472	513,525	596,163	449,863	465,114	547,668	583,358	550,970
Disappearance per capita [e]	Bu.	5.041	5.905	4.908	4.573	4.924	5.640	4.199	4.285	4.981	5.238	4.885
Population, Jan. 1 (following year)	No.	98,635	100,050	101,465	102,880	104,296	105,711	107,126	108,541	109,956	111,371	112,786

* Data furnished by Division of Statistical and Historical Research, Bureau of Agricultural Economics, U. S. Department of Agriculture. Certain figures in final column, from official sources, inserted by Food Research Institute.

[a] Subject to revision.

[b] Stocks in country mills and elevators, from 1914 to 1918, are stocks in second hands less visible supply on July 1, as given by Chicago *Daily Trade Bulletin*.

[c] Seed requirements for acreage of following year, at 1.38 bu. per acre, for winter wheat acreage sown plus spring wheat acreage harvested.

[d] Food, feed, and loss.

[e] Food, feed, and loss, in bushels, not thousands.

NOTE. Users of this table should keep in mind (1) that a constant factor, 4.5 bu., is used in converting flour to terms of wheat while the quantity of wheat required to make a barrel of flour varies from year to year, due to variation in the milling quality of wheat; (2) that the quantity of wheat used as feed varies materially from year to year; (3) that stocks of flour are more nearly comparable with "visible supply" as used in wheat, and should not be understood or used as flour stocks in full; and (4) that the data in earlier years do not approximate accuracy as nearly as in the more recent years.

TABLE II.—CALENDAR OF WHEAT STATISTICS IN THE UNITED STATES

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Winter wheat												
Acreage planted						x						
" abandoned											x	
Condition estimates	x					x				x	x	x
Forecasts and estimates of output	x	x				x				x	x	x
Spring wheat												
Acreage planted											x	
Condition estimates	x	x	x									x
Forecasts and estimates of output	x	x	x	x		x						x
Total wheat												
Revised estimate of output						x						
Wheat stocks												
On farms	x								x			
In country mills and elevators	x								x			
Of city mills [b]	x											
Visible supplies[a]	x	x	x	x	x	x	x	x	x	x	x	x
Carryover	x											
Flour stocks [b]	x											
Wheat movements												
Inspections[a]	x	x	x	x	x	x	x	x	x	x	x	x
Receipts at primary markets[a]	x	x	x	x	x	x	x	x	x	x	x	x
Shipments from primary markets[a]	x	x	x	x	x	x	x	x	x	x	x	x
Mill grindings	x	x	x	x	x	x	x	x	x	x	x	x
Imports for consumption [a]	x	x	x	x	x	x	x	x	x	x	x	x
Imports for grinding for export [a]	x	x	x	x	x	x	x	x	x	x	x	x
Exports of wheat	x	x	x	x	x	x	x	x	x	x	x	x
Exports of U. S. ground flour	x	x	x	x	x	x	x	x	x	x	x	x
Futures contract months												
United States	x		x			x					x	
Winnipeg	x			x		x					x	
Liverpool	x			x		x			x		x	

[a] Also weekly.
[b] Also compiled by Millers' National Federation for January 31 and June 30, 1925. Whether this will be regularly compiled year after year, on these dates or on others, is not known.

TABLE III.—PER CAPITA WHEAT FLOUR SUPPLIES FOR DOMESTIC USE, 1914–15 TO 1924–25, BASED ON RUSSELL'S ESTIMATES OF FLOUR PRODUCTION

Crop year July–June	Flour production [a] *(thousand barrels)*	Net exports [b] *(thousand barrels)*	Net supply *(thousand barrels)*	Population [c] *(thousands)*	Per capita supply	
					As flour *(barrels)*	As wheat *(bushels)*
1914–15	111,969	16,120	95,849	98,635	.97	4.37
1915–16	122,064	15,201	106,863	100,050	1.07	4.82
1916–17	115,584	11,771	103,813	101,465	1.02	4.59
1917–18	115,390	21,284	94,106	102,880	.91	4.10
1918–19	121,425	24,146	97,279	104,296	.93	4.19
1919–20	129,395	21,505	107,890	105,711	1.02	4.59
1920–21	106,427	14,805	91,622	107,126	.86	3.87
1921–22	122,692	15,246	107,446	108,541	.99	4.46
1922–23	129,662	14,451	115,211	109,956	1.05	4.73
1923–24	129,767	17,090	112,677	111,371	1.01	4.55
1924–25	127,889	13,894	113,995	112,786	1.01	4.55

[a] *Russell's Commercial Review.*
[b] Official data.
[c] Approximation for January 1 by averaging two official estimates for July 1 preceding and following.

TABLE IV.—PER CAPITA ANIMAL FEED AND WASTE, 1914–15 TO 1924–25, COMPUTED FROM PER CAPITA WHEAT DISAPPEARANCE AND FLOUR PRODUCTION*

(Bushels)

	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20	1920–21	1921–22	1922–23	1923–24	1924–25
Total domestic wheat disappearance (U.S.D.A.)	5.04	5.91	4.91	4.57	4.92	5.64	4.20	4.29	4.98	5.24	4.88
Flour production (Russell) less net exports	4.37	4.82	4.59	4.10	4.19	4.59	3.87	4.46	4.73	4.55	4.55
Animal feed and waste	0.67	1.09	0.32	0.47	0.73	1.05	0.33	-0.17	0.25	0.69	0.33

* See Tables I and III.

NOTE. Since there are considerable errors in each of the first two items, the differences shown as "animal feed and waste" may be wide of the truth. While considerable variations in this item certainly occur, the variations shown appear impossibly large, and a negative item, such as that shown for 1921–22, is inconceivable.

TABLE V.—PER CAPITA DOMESTIC FLOUR SUPPLY COMPUTED FROM WHEAT DISAPPEARANCE, 1914–15 TO 1924–25

	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20	1920–21	1921–22	1922–23	1923–24	1924–25
Total domestic disappearance *(million bu.)*[a]	497.2	590.8	498.0	470.5	513.5	596.2	449.9	465.1	547.7	583.4	551.7
Average wheat fed on farms *(million bu.)*[b]	72.2	83.1	51.5	51.6	74.6	78.4	67.5	66.0	70.3	64.6	70.7
Used for food *(million bu.)*	425.0	507.7	446.5	418.9	438.9	517.8	382.4	399.1	477.4	518.8	481.0
Flour equivalent *(million bbl.)*[c]	94.5	112.8	99.2	93.1	97.5	115.1	85.0	88.7	106.1	115.3	106.9
Flour per capita *(bbl.)*	0.958	1.127	0.978	0.905	0.935	1.089	0.793	0.817	0.965	1.035	0.948

[a] From Table I.

[b] Calculated by applying to each estimated crop the figure of 8.1 per cent, which the Department of Agriculture derived from estimates of crop reporters, November 1923, as the "usual" disposition—fed to livestock. The Department noted that, "because of unsatisfactory wheat-price situation at time of inquiry estimates of 'fed to livestock' may be slightly excessive." *Agriculture Yearbook, 1923*, p. 660.

[c] Figure for food use divided by 4.5.

NOTE. The per capita figures shown in this table are not to be taken seriously. There are no grounds for believing that the flour consumption actually varies from year to year to any such degree. The table is prepared merely to show what results follow from using the data available for this period. The item of total disappearance and the conversion of wheat to flour both involve a considerable margin of error. But the least satisfactory figure of all is that for "average wheat fed on farms." The percentage employed (8.1) is itself not highly reliable even as an average, and there are certainly considerable variations in this percentage from year to year. Finally, the computation leaves out of account other wheat fed to livestock and other loss and waste. See text, pp. 308–310.

TABLE VI.—CENSUS DATA ON WHEAT GROUND AND FLOUR PRODUCTION, JULY 1923 TO JUNE 1925*

Year and month	All mills reporting				Identical mills [a]	
	Number reporting	Wheat ground *(thousand bushels)*	Wheat flour *(thousand barrels)*	Bushels of wheat per barrel of flour	Wheat ground *(thousand bushels)*	Wheat flour *(thousand barrels)*
1923 July	1,054	35,871	7,805	4.60	35,249 [a]	7,672 [a]
Aug.	1,068	44,179	9,642	4.58	43,246	9,428
Sept.	1,069	44,969	9,760	4.61	43,775	9,504
Oct.	1,069	50,810	10,983	4.63	49,354	10,673
Nov.	1,081	43,606	9,403	4.64	42,053	9,075
Dec.	1,094	37,799	8,137	4.65	36,680	7,898
1924 Jan.	1,100	41,834	8,970	4.66	40,103	8,605
Feb.	1,115	39,180	8,433	4.65	37,574	8,090
Mar.	1,094	38,809	8,355	4.65	37,399	8,053
Apr.	1,082	35,680	7,682	4.64	34,474	7,428
May	1,075	36,688	7,896	4.65	35,376	7,615
June	1,060	36,293	7,797	4.65	36,180	7,559
July	1,066	39,272	8,465	4.64	38,611 [a]	8,323 [a]
Aug.	1,069	45,434	9,842	4.62	44,248	9,595
Sept.	1,060	47,857	10,459	4.58	46,649	10,198
Oct.	1,069	51,863	11,371	4.56	50,476	11,070
Nov.	1,050	41,982	9,187	4.57	41,248	9,017
Dec.	1,052	40,428	8,855	4.57	39,611	8,680
1925 Jan.	1,050	45,010	9,853	4.57	43,764	9,576
Feb.	1,056	37,720	8,248	4.57	36,447	7,971
Mar.	1,067	33,548	7,347	4.57	32,530	7,125
Apr.	1,058	31,066	6,781	4.58	30,308	6,617
May	1,048	31,874	6,942	4.59	30,791	6,704
June	1,001	35,211	7,678	4.59	34,362	7,491

* Source: Press releases, U. S. Department of Commerce.

[a] For the crop year 1923–24, the figures are for 955 identical mills, which produced approximately 82 per cent of the estimated total wheat flour production reported in 1921. For the crop year 1924–25 the figures are for 949 identical mills which produced approximately 87 per cent of the estimated total wheat flour production reported in 1923.

TABLE VII.—OUTPUT OF WHEAT FLOUR, MONTHLY AND QUARTERLY, 1914–15 TO 1924–25*

(Thousand barrels)

Month or quarter	1914–15	1915–16	1916–17	1917–18	1918–19	1919–20	1920–21	1921–22	1922–23	1923–24	1924–25
July	8,975	7,321	9,447	2,875	6,515	7,596	8,152	10,720	10,321	10,408	10,395
Aug.	10,965	8,645	11,231	5,714	10,238	12,042	9,059	13,266	12,271	12,019	11,812
Sept.	11,429	11,215	10,674	10,528	12,161	14,087	9,650	13,349	12,540	11,995	13,798
Oct.	12,254	12,723	11,456	13,856	11,544	15,008	9,981	13,917	13,581	12,561	13,404
Nov.	10,660	14,213	12,669	16,601	10,987	13,519	9,889	10,166	13,424	11,524	11,665
Dec.	9,608	12,437	8,960	17,064	12,009	12,865	8,745	8,856	11,049	10,778	11,007
Jan.	10,542	11,686	9,118	10,382	10,593	13,005	8,924	9,496	10,137	11,000	11,705
Feb.	9,012	9,768	7,402	9,185	7,736	9,557	7,066	9,232	9,425	10,286	10,189
Mar.	7,059	9,338	8,207	9,049	10,498	8,632	9,100	9,658	10,607	10,578	9,307
Apr.	6,933	8,531	9,608	6,893	11,276	7,374	9,368	7,823	8,969	9,521	8,183
May	7,171	7,722	9,521	6,459	10,738	8,249	8,406	8,073	9,007	9,765	8,151
June	7,361	8,465	7,291	6,784	7,130	7,461	8,087	8,136	8,331	9,332	8,917
Total	111,969	122,064	115,584	115,390	121,425	129,395	106,427	122,692	129,662	129,767	128,533 [a]
July–Sept.	31,369	27,181	31,352	19,117	28,914	33,725	26,861	37,335	35,132	34,422	36,005
Oct.–Dec.	32,522	39,373	33,085	47,521	34,540	41,392	28,615	32,939	38,054	34,863	36,076
Jan.–Mar.	26,613	30,792	24,727	28,616	28,827	31,194	25,090	28,386	30.169	31,864	31,201
Apr.–June	21,465	24,718	26,420	20,136	29,144	23,084	25,861	24,032	26,307	28,618	25,251

* Data from *Russell's Commercial Review.*

[a] Revised figure, 127,889.

TABLE VIII.—PERCENTAGES OF ANNUAL OUTPUT OF WHEAT FLOUR PRODUCED MONTHLY AND QUARTERLY, 1920–21 TO 1924–25*

Month or quarter	1920–21	1921–22	1922–23	1923–24	1924–25
July	7.66	8.74	7.96	8.02	8.09
Aug.	8.51	10.81	9.46	9.26	9.19
Sept.	9.07	10.88	9.67	9.24	10.73
Oct.	9.38	11.34	10.47	9.68	10.43
Nov.	9.29	8.29	10.35	8.88	9.07
Dec.	8.22	7.22	8.52	8.31	8.56
Jan.	8.38	7.74	7.82	8.48	9.11
Feb.	6.64	7.52	7.27	7.92	7.93
Mar.	8.55	7.87	8.18	8.15	7.24
Apr.	8.80	6.38	6.92	7.34	6.37
May	7.90	6.58	6.95	7.53	6.34
June	7.60	6.63	6.43	7.19	6.94
Total	100.00	100.00	100.00	100.00	100.00
July–Sept.	25.24	30.43	27.09	26.52	28.01
Oct.–Dec.	26.89	26.85	29.35	26.87	28.07
Jan.–Mar.	23.57	23.13	23.27	24.56	24.27
Apr.–June	24.30	19.59	20.29	22.05	19.65

* Based on Table VII.

TABLE IX.—RUSSELL'S ESTIMATES OF WHEAT FLOUR OUTPUT BY SEVEN-MONTH AND FIVE-MONTH PERIODS*

Year ending June 30	Output (thousand barrels)		Percentage of total for year	
	July–Jan.	Feb.–June	July–Jan.	Feb.–June
1914–15	74,433	37,536	66.48	33.52
1915–16	78,240	43,824	64.10	35.90
1916–17	73,555	42,029	63.64	36.36
1917–18	77,020	38,370	66.75	33.25
1918–19	74,047	47,378	60.98	39.02
1919–20	88,122	41,273	68.10	31.90
1920–21	64,400	42,027	60.51	39.49
1921–22	79,770	42,922	65.02	34.98
1922–23	83,323	46,339	64.26	35.74
1923–24	80,285	49,482	61.87	38.13
1924–25	83,786	44,747	65.19	34.81
Averages				
Eleven years	77,907	43,266	64.29	35.71
Omitting 1917–18	77,996	43,756	64.06	35.94
1920–21 to 1923–24	76,944	45,192	63.00	37.00

* Data from *Russell's Commercial Review.*

TABLE X.—MONTHLY EXPORTS OF WHEAT FLOUR FROM THE UNITED STATES, 1919–20 TO 1924–25*

Month	Actual exports (thousand barrels)						Percentage of total exports for the year					
	1919–20	1920–21	1921–22	1922–23	1923–24	1924–25	1919–20	1920–21	1921–22	1922–23	1923–24	1924–25
July	1,731	2,404	1,238	921	884	789	7.99	14.86	7.84	6.19	5.12	5.61
Aug.	1,638	1,107	1,873	1,169	1,273	949	7.57	6.84	11.86	7.85	7.38	6.82
Sept.	1,764	938	1,802	1,301	1,568	1,463	8.15	5.80	11.41	8.74	9.09	10.52
Oct.	1,621	1,607	1,557	1,510	2,092	1,872	7.49	9.93	9.85	10.15	12.12	13.45
Nov.	1,840	1,101	1,246	1,556	1,778	1,616	8.50	6.81	7.89	10.45	10.30	11.62
Dec.	1,313	952	1,014	1,500	1,789	1,452	6.06	5.88	6.42	10.08	10.37	10.44
Jan.	843	1,280	1,105	1,161	1,716	988	3.89	7.91	6.99	7.80	9.95	7.10
Feb.	1,254	1,023	1,203	1,379	1,539	939	5.79	6.32	7.62	9.27	8.92	6.75
Mar.	2,209	1,369	1,495	1,430	1,426	1,387	10.20	8.46	9.46	9.61	8.26	9.97
Apr.	2,121	1,591	1,243	1,167	1,038	955	9.80	9.83	7.87	7.84	6.02	6.87
May	3,339	1,265	1,089	983	977	690	15.42	7.82	6.89	6.60	5.66	4.96
June	1,979	1,543	932	806	1,174	820	9.14	9.54	5.90	5.42	6.81	5.89
Total	21,652	16,180	15,797	14,883	17,254	13,920	100.00	100.00	100.00	100.00	100.00	100.00

* Source: *Monthly Summary of Foreign Commerce of the U. S.*

TABLE XI.—MONTHLY EXPORTS OF WHEAT FLOUR FROM CANADA, 1919–20 TO 1924–25*

Month	Actual exports (thousand barrels)						Percentage of total exports for the year					
	1919–20	1920–21	1921–22	1922–23	1923–24	1924–25	1919–20	1920–21	1921–22	1922–23	1923–24	1924–25
July	1,195	433	465	486	775	613	16.56	6.47	6.02	4.54	6.36	6.15
Aug.	1,171	288	454	591	657	626	16.22	4.31	5.88	5.52	5.39	6.28
Sept.	463	310	361	697	456	967	6.41	4.64	4.68	6.50	3.74	9.70
Oct.	591	570	659	855	1,155	1,145	8.19	8.52	8.54	7.98	9.48	11.49
Nov.	785	744	856	1,214	1,357	905	10.88	11.12	11.09	11.33	11.14	9.08
Dec.	1,237	608	748	1,463	1,390	828	17.14	9.09	9.69	13.66	11.41	8.31
Jan.	388	704	632	1,025	1,052	875	5.37	10.53	8.19	9.57	8.64	8.78
Feb.	236	623	665	779	1,092	834	3.27	9.31	8.61	7.27	8.96	8.37
Mar.	236	821	986	1,221	1,398	1,385	3.27	12.27	12.77	11.40	11.48	13.90
Apr.	148	535	512	832	890	710	2.05	8.00	6.63	7.76	7.31	7.12
May	102	518	617	645	1,057	482	1.41	7.74	7.99	6.02	8.68	4.84
June	666	535	765	905	903	596	9.23	8.00	9.91	8.45	7.41	5.98
Total	7,218	6,689	7,720	10,713	12,182	9,966	100.00	100.00	100.00	100.00	100.00	100.00

* Source: *Canadian Grain Statistics.*

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