WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

ESTIMATION OF END-YEAR WORLD WHEAT STOCKS FROM 1922

S TUDENTS of the world wheat situation urgently require trustworthy estimates of end-year world wheat stocks that are more comprehensive than data currently available. Familiar statements of the "world visible supply" probably cover no more than a fourth of the old-crop wheat actually existing at the end of the Northern Hemisphere crop year in the world excluding Russia, China, and southwestern Asia. Total end-year stocks as reported and directly estimated in North America, Australia, and afloat to Europe cover the situation in those important positions rather satisfactorily. Yet other important countries and positions where stocks are neither reported nor directly estimated are also significant in explaining past events or in appraising the outlook for wheat trade and prices during an oncoming crop year. This was demonstrated in 1929–30, when early-season misjudgments of probable trade and prices rested heavily on faulty appraisal of the old-crop stocks available in Argentina, the Danube basin, and importing Europe.

Within the limits imposed by the range of available statistics, this study is designed to fill the gap in available data on end-year stocks. It presents estimates of total stocks of old-crop wheat grain in the world (excluding Russia, China, and southwestern Asia) about as of August 1, from 1922. Indirect estimates are given to supplement reported stocks and direct estimates, and the methods of indirect estimation are described. The results are subject to limitations with respect to scope, degree of accuracy, and date. Nevertheless, the estimates contribute not only to explanation of past events in the world wheat situation and to appraisal of the outlook, but also to such specific important problems as measurement of the existing world wheat surplus.

WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

ESTIMATION OF END-YEAR WORLD WHEAT STOCKS FROM 1922

The purposes of this study are to present estimates of "world" wheat stocks ex-Russia at the end of each of the eleven crop years beginning with 1921–22, including estimates for as many positions and countries as the data justify; and to describe the methods of estimation.

The need for trustworthy comprehensive estimates of world wheat stocks was strongly emphasized in the crop year 1929–30. The crop of 1929 was short, strikingly smaller than the bumper crop of 1928. Europe, which had imported heavily in 1928–29, was expected to need and take large quantities also in 1929–30. The situation was interpreted, at least in North America, to justify sharply higher prices. This interpretation led to resistance to wheat-price declines in Canada and the United States in the autumn of 1929. Yet prices failed to maintain their early advance, and in the second half of the crop year they declined to the lowest level since pre-war days. For the year as a whole the average price of wheat imported into Great Britain was slightly below the corresponding average for 1928–29, whereas early in the crop year it had been confidently expected that it would be at least 30 to 40 cents higher.

Upward revisions in estimates of 1928 and 1929 wheat crops contributed to prevent the realization of hopes and expectations. Abundant harvests of all crops in Europe, and factors associated with notable recessions in business activity and in commodity prices, were still more important. But a major additional factor in the misjudgments was a serious underestimate of the stocks of wheat carried over from the abundant supplies of 1928–29.

In July–September 1929, the trader or stu-

dent had ready access to trade statistics loosely termed "world wheat stocks" or "world visible supplies"; these were and are part of the regular flow of market information. One widely circulated statement (*Bradstreet's*) showed, early in August 1929, a total of about 300 million bushels; another (Broomhall's) showed a total of 370 million. The one recorded an increase of stocks in the course of the year by about 110 million bushels; the other an increase by about 140 million. Anticipating a decline in the world wheat crop ex-Russia of perhaps from 400 to 500 million bushels, traders saw little reason to ascribe great weight to the excess of "world" wheat stocks or visibles above their normal level.

As a matter of fact, however, the increase in stocks during 1928–29 was more like 260 million bushels, if one now takes account of old-crop supplies lying in other positions and countries than those covered by the familiar trade statements. In Argentina, the exporting countries of the Danube basin, and European importing countries, wheat stocks are reported only fragmentarily if at all. In all these positions stocks were very heavy, much heavier than was realized at the time. Unseasonably large autumn exports from Argentina and the Danube basin, and drastic curtailment of imports into many Continental European countries, gradually brought to light the true facts of the initial stocks position. Export pressure from Argentina and curtailed European import demand, both arising largely from abundance of old-crop stocks, were important among the factors that caused wheat prices to weaken after the steep rise of June–July 1929. Misjudgment of the initial stocks position and subsequent correction of early mis-

judgments were significant factors in the course of wheat prices throughout the crop year. These misjudgments had far-reaching consequences. They contributed heavily to the adoption of policies by the Canadian Wheat Pool and the Federal Farm Board which eventually brought the Pool to disaster and involved provincial governments and eventually the Dominion government as well, and which led the Farm Board to operate in wheat through the Grain Stabilization Corporation.

No one can say how far the course of prices would have been different if adequate data on initial stocks had been at hand. It is reasonable to infer, however, that the movement from peak to trough would have been substantially less precipitous; probably the peak would have been lower and the subsequent trough not so deep. At least one of the many uncertainties in the world wheat situation— an uncertainty more or less important in any year—would have been much less if traders had had access to well-founded and comprehensive estimates of world wheat stocks. The estimates presented and described in the following pages are designed to minimize this uncertainty.

The estimates and methods of estimation here presented are the result of inquiries which have extended over several years. Earlier issues of WHEAT STUDIES[1] have contained tabulations designed to show approximate end-year wheat stocks in important areas. In the light of experience and events, we have revised the earlier estimates and enlarged their scope. Further revision will almost certainly be necessary as more information comes to hand. The estimates, however, have now proved sufficiently serviceable to warrant fuller explanation than has heretofore been given.

The broad subject of commodity-stocks estimates is one of recognized importance. J. M.

Keynes has written: "Accurate information as to the volume from time to time of surplus stocks of staple commodities is of the utmost interest both to business men and to economists. . . . . But stocks, failing special explanations in particular cases, are the best index to impending instability of the price level, and there is nothing which it is more necessary for the merchant to gauge accurately than whether consumption is proceeding in excess of production or *vice versa*. . . . . I have long believed that a certain amount of information (not hitherto available) as to the correlation between changes in the volume of stocks and the successive phases of the trade cycle is necessary to a full understanding of the latter."[2] With special reference to wheat, Mr. Keynes has further stated that it "is a very baffling commodity to the compiler of comparative totals. . . . ."[3]

We therefore deal here with a subject at once important and baffling. The importance of wheat-stocks estimates seems to justify resort to indirect methods of estimation. These we describe in some detail as an illustration of methodology which may need to be employed for many commodities, if moderately trustworthy indications of their general position are to supplant misleading indications now currently available in the form of fragmentary statistical data.

PUBLISHED STATEMENTS ON STOCKS

A review of available statistics on wheat stocks is pertinent.

Statistics published weekly relate mainly to "visible supplies." The term is of variant meaning. Visible supplies in the United States are usually regarded as wheat stocks resting in non-mill elevators in the principal urban markets — mainly so-called public terminal elevators. In Canada visible supplies include also wheat stored in country elevators of the Prairie Provinces, in western flour mills, and (recently) in transit on the Great Lakes. In Australia, where country elevators are rare, visibles include wheat stored in bags on platforms along railroads. Argentine visibles include only wheat in elevators at export ports. Wheat and flour afloat to Europe is called a part of the visible supply, but similar data are

---

[1] See especially December issues, 1930–32: VII, 178; VIII, 128–29, 146–47, 190; IX, 128.

[2] J. M. Keynes and R. B. Lewis, *Stocks of Staple Commodities* (London and Cambridge Economic Service, Special Memorandum No. 1, April 1923), p. 2. This service has published similar memoranda annually since 1923.

[3] *Ibid.*, p. 18.

not available for wheat and flour afloat to ex-European destinations. British visible supplies comprise wheat and flour stored in the principal ports.

Three weekly statements are published on United States visibles: one by the Chicago Board of Trade;[1] one by *Bradstreet's;* one by the United States Department of Agriculture, beginning with January 1927.[2] The two last, which cover more points than the first, yield figures of much the same magnitude. Practically all of the important points of accumulation are covered by each, though the list of points covered is not identical. The Winnipeg Grain Exchange publishes a statement on Canadian visibles,[3] and a much more inclusive one is issued by the Dominion Bureau of Statistics.[4] Each of the official statements from these two countries covers separately (with trifling differences) Canadian wheat stored in the United States and United States wheat stored in Canada. All other statistics of weekly visible supplies are unofficial, and are compiled mainly by Broomhall's *Corn Trade News* of Liverpool.

Statistics published monthly also pertain mainly to "visible supplies." A joint compilation, usually appearing between the 15th and the 25th of each month, is issued by the

[1] Readily available in the *Daily Trade Bulletin* or the *Chicago Journal of Commerce.*

[2] See weekly mimeographed releases, *Commercial Grain Stocks in Store at Principal United States Markets.* Statements are given of "Domestic Grain in Store and Afloat at United States Markets"; of "Canadian Grain in Bond at United States Markets"; and of "United States Grain in Store in Bond at Canadian Markets."

[3] Available in the Chicago *Daily Trade Bulletin,* daily. A daily statement of stocks at Fort William and Port Arthur is published by the Winnipeg *Grain Trade News.*

[4] See the weekly mimeographed *Canadian Grain Statistics,* which gives detailed statements of Canadian grain in store both in Canada and in the United States, and of United States grain in Canada.

[5] German data are conveniently available in the U.S. Department of Agriculture, *World Wheat Prospects* or *Foreign Crops and Markets;* and in the *Deutsche Getreide-Zeitung* and *Statistische Meldungen der Preisberichtstelle beim Deutschen Landwirtschaftsrat.*

[6] See *Foreign Crops and Markets* and *World Wheat Prospects.* Some of the data are collected by the *Corn Trade News.*

[7] See *Canadian Milling Statistics.*

Corn Trade News, the *Daily Market Record* (Minneapolis), and the *Daily Trade Bulletin* (Chicago). It is designated "world visible supply" in the *Corn Trade News,* and "world available supply" in the *Daily Trade Bulletin.* The August 1 totals given in this compilation have run in the past ten years anywhere from 20 to 54 million bushels above summations of eight of the weekly series listed above (Broomhall's statement of visible supplies in Argentina, Australia, afloat to Europe, and in United Kingdom ports; the official statement of the United States visible supply, using *Bradstreet's* prior to 1927; and three Canadian official series on United States grain in Canada, Canadian grain in the United States, and the visible supply in Canada). The excess is due partly to the fact that the joint compilation of the United States visible covers more "country" points (where mill stocks are included) than the official statement of *Bradstreet's;* and partly to inclusion of some North American flour stocks, which are not included in the weekly North American visibles.

In addition to this joint monthly compilation mainly of visible supplies, semiofficial data on farm stocks in Germany have been published for several years, monthly except in July and August; and for about a year official German statistics have covered wheat and flour stocks monthly "in second hands" (principally mills and warehouses).[5] Monthly data on stocks in store at several important Continental European ports, and also at Berlin, have been made available for a few recent years by the United States Department of Agriculture; these data often appear twice a month, but somewhat irregularly.[6] Flour stocks in Canadian mills are officially reported each month.[7] Partly because of the brief periods covered by these several series, they are not ordinarily included in tabulations designed to show the monthly movement of "world visibles"; the German farm stocks, of course, would not be regarded as visible wheat, as the term is commonly used.

Statistics published quarterly refer solely to "mill stocks" in the United States, as reported to the Bureau of the Census. The data cover the stocks of reporting mills which produce some 90 per cent (more or less at differ-

cnt times) of the United States flour output. The statement gives separate figures for wheat actually in the elevators of these mills, and for wheat owned by them but stored in country elevators or in public and private terminal elevators, and in transit; flour stocks are also reported, and (since June 1930) wheat stored by mills for "others."[1]

Statistics published at irregular intervals are more numerous, and cover diverse positions. In the United States, the Department of Agriculture publishes official estimates of stocks in interior (country) mills and elevators as of March 1 and July 1, and of stocks on farms at the same dates; and similar estimates of farm stocks as of April 1 have also been published for 1930 and subsequent years.[2] Private statisticians issue March 1 and July 1 estimates of stocks on farms and in country mills and elevators.[3]

For Canada, the Dominion Bureau of Statistics publishes estimates of farm stocks as of March 31 and July 31.[4] Farm stocks in England and Wales are officially estimated as of January 1 and April 1. Rough unofficial evaluations of Argentine stocks in ports, along railways, and on farms are prepared by the *Times of Argentina*, and apply usually to dates in June, September, and December.

Less important are statistics of stocks in warehouses in Hungary; French official data on stocks of import wheat and flour in customs warehouses; and Russian official estimates of end-year stocks in the country at least from 1925 to 1930, and in the cities at least from 1925 to 1929.[5]

This enumeration does not completely exhaust the list of available stocks statistics. Broomhall regularly publishes appraisals of exportable surpluses in the principal exporting countries. An official statement of the Argentine exportable surplus is issued regularly; but this appears to be a figure derived from estimates of crop and domestic utilization in relation to reported exports. There was a direct official evaluation of Argentine stocks on August 21, 1926. The United States Department of Agriculture appraises export surpluses in Australia and Argentina as of at least two dates in a year, December or January 1 and July 1. There were several widely divergent unofficial estimates of stocks in France at the end of the crop year 1929–30.[6] In the main, however, these data have little or no bearing on the problem in hand, and need not be considered further.

SERVICEABLE SERIES

For the purposes here in hand, several of the series listed above are of moderate value at best. Some, e.g., the Chicago Board of Trade visible and the Winnipeg Grain Exchange visible, cover stocks in positions that are also reported in other somewhat more comprehensive series. Some are unofficial series that closely approximate official series, e.g., the unofficial estimates of United States stocks on farms and in country mills and elevators, and the joint trade compilation of United States and Canadian visibles. Some do not yield stocks statistics as of the end of the crop year, e.g., farm stocks in the British Isles and in Germany. Some, e.g., German stocks "in second hands," and Continental European port stocks of import wheat, have been collected (in post-war years)[7] only for a brief period of time. Some, e.g., Russian stocks, do not become available promptly enough to throw light on the current position. Others, e.g., Canadian flour stocks, Argentine port stocks, Hungarian warehouse stocks, and French customs warehouse stocks, are unimportant because of the relatively small magnitudes involved.

Many of these series can be utilized as indi-

---

[1] For a convenient summary of these statistics as of June 30, 1925–32, see WHEAT STUDIES, December 1932, IX, 129.

[2] See especially press releases and *Crops and Markets.*

[3] Familiar private estimates are those of Nat C. Murray, published in circulars issued by Clement, Curtis and Company, Chicago; and of R. O. Cromwell, published in circulars issued by Lamson Brothers and Company, Chicago.

[4] See especially press releases and *Monthly Bulletin of Agricultural Statistics.*

[5] See V. P. Timoshenko, *Agricultural Russia and the Wheat Problem* (Grain Economics Series of the Food Research Institute, Stanford University, 1932), p. 396.

[6] See *La Cote Bodenheimer,* July 16, 1930.

[7] Before the war, Broomhall published monthly estimates of European port stocks.

cators of the end-year stocks position in one country or another; but none is adequate to be included directly in a summation designed to show the size of end-year "world" wheat stocks over a period of years.

The basic series useful for this purpose, all official except as noted, are the following:

United States (as of July 1)
1. Farm stocks
2. Country mill and elevator stocks
3. Commercial stocks (*Bradstreet's* visible prior to 1927)
4. Mill stocks (not reported prior to 1925)
5. Stocks of United States wheat in Canada

Canada (as of August 1 from 1925; as of September 1 for earlier years)
6. Farm stocks
7. In western country, private, and mill elevators
8. In terminal elevators
9. In transit
10. In flour mills
11. Stocks of Canadian grain in bond for export in the United States (as of August 1 throughout)

Other positions (as of August 1)
12. Australian visibles (Broomhall)
13. Argentine stocks on farms, on railway sidings, and in ports (*Times of Argentina*, available only from 1928)
14. Stocks afloat to Europe (Broomhall)

In addition, Broomhall's statement of stocks in ports of the United Kingdom is a series which would be appropriate as part of a summation. We have chosen, however, to utilize this series not directly, but as a check upon total British stocks as estimated by a method discussed below. The series is an extremely important one for certain other purposes, particularly the appraisal of immediate and prospective ease or tightness in the international statistical position of wheat.

We have available, therefore, fourteen series which can be regarded as serviceable for estimating end-year wheat stocks in the world at large. All except three of these, however, refer to stocks in the United States and Canada.[1] If we ignore the British port stocks, the

only other countries covered even in part by the available series are Australia and Argentina, though one series refers to stocks afloat to Europe. It is particularly important to have knowledge of end-year stocks in these four countries, where the variability of stocks tends to be relatively large. Yet it is also important to have knowledge of stocks in other areas, where fully half of the wheat produced in the world ex-Russia, China, and southwestern Asia is grown. Usable stocks statistics are not available for such important wheat-producing countries as India, France, Italy, Spain, and the exporting countries of the Danube basin. End-year stocks in these and many minor wheat-producing countries can be estimated only indirectly, without appreciable reference to fragmentary published data on wheat stocks.

Furthermore, several of the fourteen serviceable series are not available throughout the whole period 1922–32, and several others require adjustment. Only five of the fourteen series (1, 2, 3, 5, and 11) provide figures which as they stand are available and appropriate for use in a summation of end-year world wheat stocks. Five of the Canadian series (6, 7, 8, 9, and 10), however, require only minor adjustment, so as to derive data for August 1 from those for September 1, 1922–24; this is easily compassed for the aggregate of the five series by adding to the September 1 figures the Canadian net exports made in August and one-twelfth of Canadian domestic consumption. So far as concerns United States commercial stocks (series 3), no significant error arises from splicing together an official and an unofficial series, for

---

[1] The several official series on United States stocks as of July 1 and on Canadian as of August 1 have been carefully designed so as to yield a statement of total carryover at once as complete as possible and involving a minimum of duplication between the several series that make up the totals. In respect to wheat-stocks statistics, these two countries lead the world.

Holbrook Working has prepared estimates of total end-year stocks in the United States, closely comparable with the official data of recent years, for the period 1896–1927. See "Disposition of American Wheat since 1896, with Special Reference to Changes in Year-End Stocks," WHEAT STUDIES, February 1928, Vol. IV, No. 4.

the two cover approximately the same wheat in store. The official statistics of United States mill stocks (series 4) from 1925 have been raised by the Bureau of Agricultural Economics to account for stocks held by mills not reporting, and data for 1922–24 have been estimated.[1] The duplication between these estimates and other official estimates of country mill and elevator stocks (series 2) is probably not large.

With the indicated adjustments, the first eleven and the last of the fourteen series may be regarded as satisfactory for inclusion in a statement of end-year world wheat stocks. They provide a sufficiently accurate measure of stocks in the United States and Canada, and afloat to Europe.

The series numbered 12 and 13, however, do not cover the stocks position in Australia and Argentina with similar completeness. Farmers and millers in Australia hold wheat not reported in the Australian visible; and mills in Argentina hold wheat not covered even in the most complete of the reports by the *Times of Argentina*. The available statistical series on wheat stocks in these countries therefore require substantial adjustment in order to assure reasonably complete coverage of total end-year stocks.

If we regard as unimportant the adjustment of several published series on United States and Canadian end-year stocks, the processes of estimation which require further discussion are (1) estimation of total stocks in Australia and Argentina, for which useful partial statements are available; and (2) estimation of total stocks in the British Isles and a long list of countries for which no state-

---

[1] Even after these adjustments, the figures on city mills stocks may not be precisely comparable from year to year. Only in and after 1931 was wheat "stored for others" reported, in addition to wheat owned. The probability that some wheat was "stored for others" in earlier years does not seem seriously to affect the comparability of the data.

[2] Theoretically, however, estimates could be prepared for countries whose domestic crops were a very small proportion of their total consumption. Current analysis of the world stocks position, moreover, would be facilitated by direct estimates of port stocks in China, which could be prepared by the Chinese authorities.

[3] Timoshenko, *op. cit.*, p. 399.

ments, or none of comparable usefulness, are available.

SCOPE AND DATE OF ESTIMATES

It is necessary first to point out that estimation of end-year stocks in some countries is impossible, or at least unlikely to result in figures reasonably acceptable or moderately significant; that all estimates cannot be made to apply to the same date; and that the estimates finally reached cannot be said to apply strictly to old-crop wheat, or strictly to wheat grain.

Obviously no estimates can be prepared of end-year total wheat stocks in countries where the size of the wheat crops is not known.[2] Such are China, Afghanistan, Persia, Arabia, and Abyssinia, to mention only countries which unquestionably produce wheat crops of significant size. For Turkey, crop estimates are now available, but only for six of the past eleven years. Obviously, also, end-year wheat stocks cannot be estimated for countries where the size of the crop is known but the volume of wheat exports or imports is not; several ex-European countries, relatively unimportant producers of wheat, fall within this category. There is further little purpose in attempting to estimate end-year stocks in various ex-European countries where very little wheat is produced, imported, or exported.

Russia presents a special case. Comparable wheat-production statistics are now available only from 1925 to 1930, and these have been frequently and drastically revised. The governmental controls of consumption tend to invalidate application of general economic reasoning to the problem of the distribution of crops between exports, consumption, and storage. And the few estimates of stocks not only appear tardily but in some respects seem unreliable.[3]

With these necessary omissions, the areas and positions covered by the estimates of end-year stocks subsequently to be presented and in part discussed are as follows: United States, Canada, Argentina, Australia, India, northern Africa (Algeria, Morocco, Tunis, Egypt), the Danube basin (Hungary, Jugo-Slavia, Roumania, Bulgaria), importing Eu-

rope (all of Europe except the Danube basin, Russia, and Albania), afloat to Europe, afloat to ex-Europe, and Japan.

For convenience, aggregate stocks in these areas and positions may be termed "world stocks ex-Russia." The omissions, while doubtless considerable in the aggregate, are of small importance for the world wheat trade, and ordinarily of negligible significance in the world wheat market.

In general, the estimates of stocks in these areas and positions have been prepared to apply to old-crop wheat in the form of grain, and as nearly as seems feasible to the end of the Northern Hemisphere wheat - crop year, which is commonly taken as August 1 (or July 31).

But measurement cannot be made precisely as of August 1, nor can the estimates be made to include only old-crop wheat grain. Even for a single country the concept of a crop year is not clear-cut. The beginning of a crop year is defined in common usage as the time when the flow of new-crop wheat from farm to market has assumed sizable proportions. Clearly, however, there would be differences of opinion about the day when "sizable proportions" were reached; and, with varying weather, the date could not remain the same from year to year. Thus, designation of July 1 as the beginning of the crop year in the United States, and August 1 in Canada, is somewhat arbitrary, though these are the commonly accepted dates. In the same way it is not strictly in accord with the facts to designate August 1 as the beginning of the Northern Hemisphere crop year. At the extremes, among important countries, the Indian crop year probably begins about April 1, and the British and German in early September. Yet August 1 is the date widely used as marking the beginning of the Northern Hemisphere crop year, and it is a date as useful as any other single day for marking the transition. The point requiring emphasis here is that the term "end-year stocks" is not the precise equivalent of an inventory of goods as of a given date. It means in the first place world wheat stocks *about* or *not far from* August 1; and in the second place mainly stocks of old-crop wheat grain, not stocks of old and new wheat combined, or stocks of flour and wheat.

Among the several series of stocks statistics which have been designated above as serviceable, some give data only as of July 1, others only as of August 1, and others as of both July 1 and August 1. The alternatives in statistical procedure in estimating total stocks are to seek to bring all figures to the basis of one date or the other, or to disregard the differences in date and add together data applying to both dates. Largely as a matter of convenience, statistics of United States stocks as of July 1 are combined with data on stocks in other countries and positions as of August 1. It seems unnecessary to offer further justification of this procedure than to say that the alternative does not promise better results; that the August 1 basis is most commonly used in Europe; and that essential basic data (international trade statistics by crop years) are more complete and accessible for estimating stocks on August 1 than they are for estimation as of July 1.

The procedure employed, however, necessarily involves a certain artificiality, with respect to the date to which the estimates of stocks apply. This is most forcibly brought out with regard to India. The basic data are annual crop statistics, estimates of seed use, and statistics of net exports or net imports. The Indian crop is harvested in March–May. The trade statistics here used are for August–July. Summation of a crop harvested in March–May and net imports in the following August–July obviously does not yield a figure showing how much wheat was available in an August–July year for consumption and for carryover at the end; and relating estimated August–July consumption to the summation cannot show with precision by how much stocks were reduced or increased during August–July. The stocks on August 1, moreover, must be very largely of new-crop wheat rather than of old-crop wheat. The estimates of Indian stocks on August 1, therefore, are in a sense hypothetical, representing roughly what old-crop stocks would be if the Indian crop year began on August 1 rather than about on April 1. But they may also be taken to represent roughly the excess on Au-

gust 1 of new-crop wheat stocks over requirements for domestic consumption until the next harvest becomes available. In substantially lesser degree—for the Indian crop is considerably the earliest in the Northern Hemisphere—the estimates of stocks in other Northern Hemisphere areas where the crop year begins before August 1 are in the same sense hypothetical.

The several "serviceable" series may in any year include some new-crop wheat, and some flour. By July 1, commercial stocks in the United States may consist in small part of new-crop winter wheat, more or less depending on the size of the crop, when the harvest begins, and the rate of movement from farms, in the Southwest.[1] Stocks afloat to Europe on August 1 may include in one year or another some new-crop wheat from northern Africa, the Danube basin, or Russia; these stocks consist in small part of flour. But exclusion of flour is complete in the stocks statistics of Canada and the United States, and little new-crop wheat can ever be covered by the various "serviceable" series.

It is impossible to be precise about the exclusion or inclusion of new-crop wheat or of flour in the estimates of end-year stocks in Europe, northern Africa, India, and Japan. On the assumption that end-year flour stocks in these areas tend to be very stable, it is fair to say that the estimates refer only to wheat grain. The accuracy of this assumption cannot be tested, however; and in any event the available methods of estimation preclude an attempt to distinguish between wheat grain and wheat flour stocks.

On the whole, therefore, it seems appropriate to designate the estimates of end-year stocks as applying to old-crop wheat grain as of about August 1 each year. But this designation is not a precise one, especially as regards the estimates for India.

The first step in the process of estimating end-year wheat stocks in the world ex-Russia

is, as we have seen, to adjust certain published series on United States and Canadian stocks. The second step is to estimate, in the light of published statements covering the stocks position partially, the total stocks in Argentina and Australia. The third step is to attempt to estimate total stocks in a long list of countries for which few or no statements of stocks are available.

In the following description of procedures it is assumed that the time when August 1 stocks are being estimated is September or October following. Certain of the requisite data are never available as early as August; some, indeed, do not become available before December or January. Estimation is possible in August, or even in July; but the results obtained will inevitably require substantial revision later, when more accurate and complete data become available.

Australian and Argentine Stocks

Total stocks in Australia on August 1 must represent the sum of (a) the wheat and flour which passes into export between August 1 and the time when the next crop is harvested; (b) the wheat and flour consumed for food and feed domestically between these dates; and (c) the wheat and flour neither exported nor consumed, but remaining as old-crop stocks at the beginning of the Australian new-crop year. For all years prior to the current one, official statistics of net exports of wheat and flour are available by months. The amount of wheat milled and retained domestically is reported by July–June years,[2] and has been subject to only minor variations. From weekly reports of the Australian visible supply it is clear that the Australian stocks of old-crop wheat tend to be at their lowest level about on December 1. If, therefore, one adds to the reported December 1 visible, adjusted in some years to exclude new-crop wheat, (a) the net exports of wheat and flour in the preceding August–November and (b) four-twelfths of the reported or estimated domestic use of flour as wheat, the resulting summation can be taken to represent fairly closely the total stocks that were available on August 1.

---

[1] As wheat acreage expands in Oklahoma and Texas, more new-crop wheat will appear in July 1 figures on commercial stocks.

[2] Prior to 1926–27, statistics of wheat milled and flour produced in western Australia, Queensland, and Tasmania were not reported for July–June years.

Such a figure will be below the facts in any year to the extent that December 1 total stocks include wheat stored on farms, and hence not reported in the visible supply; and to the extent that wheat was used for feed, or was wasted, in the months of August–November. But such evidence as exists suggests that neither farm storage on December 1 nor use of wheat for feed in August–November (or throughout the year) tends to be considerable in Australia.

Argentine stocks on August 1 may be estimated on similar principles. The date when old-crop wheat stocks are lowest, however, is somewhat later than in Australia; January 1 is the most appropriate date to use. If to stocks on January 1 are added the net exports of wheat and flour in August–December preceding, and five-twelfths of a year's domestic retention of wheat milled, the result must represent closely the total Argentine stocks on August 1. Since the net exports and the wheat milled are reported (the latter, however, only by calendar years), the principal problem is to estimate the stocks on January 1.

It is not difficult to ascertain from trade journals *what* earlier years (up to 1929) were characterized by exceptionally large stocks on January 1; in general, large stocks are held on that date only when the preceding crop was of notably poor quality, and the prospect is that a good deal of poor old-crop wheat can be exported later mixed with good new-crop wheat. It is difficult, even impossible, to ascertain *how large* the exceptionally heavy stocks may have been. For years prior to 1929, there seems to be no dependable basis for appraising the size of January 1 stocks; the estimates must rest heavily upon qualitative reasoning, though available data on crops, exports, seed use, and mill grindings provide a rough check upon the accuracy of the outcome. From January 1, 1929, direct estimates of total old-crop stocks in Argentina (excluding mill stocks)[1] are published by the *Times of Argentina* as of dates from two to six weeks prior to January 1. With adjust-

ment of these estimates to allow for exports and domestic consumption between the date of estimate and January 1, figures can be reached which seem at least to approximate total January 1 stocks. Addition of August–December net exports and consumption to these figures yields estimates of August 1 stocks. The method seems adequate to indicate significant changes in the August 1 level from year to year, though smaller changes indicated by the resulting figures may be more apparent than real.

"Final" estimates of both Australian and Argentine stocks on August 1 for a current year cannot be prepared until the following January. But even as early as August, rough approximations are feasible, based upon the Australian visible supply as of August 1, upon stocks data in the *Times of Argentina* applying to some date in June–August, and upon the course and level of export shipments. The basis for estimation improves from week to week in September–December.

FRENCH STOCKS: AN ILLUSTRATION

The problem of estimating end-year stocks in all other countries, including the British Isles, is to derive estimates from statistics of crop production, net imports or net exports, and seed use of wheat.

Statistics of wheat acreage and production, and of net imports or exports, are available in publications of the United States Department of Agriculture and the International Institute of Agriculture, as well as in official publications of particular countries. Data on average seed use per acre cannot be obtained for all countries; but rough estimates, based upon accredited data of neighboring areas, can be made to fill the gaps.

The use of these statistical series in estimating end-year stocks in France is illustrated in Table 1 (p. 176).

The first step is to measure the gross quantities of wheat available in France for use and carryover. If stocks carried over never varied in size, the wheat crop in a given year (column 1) added to the August–July net imports of that year (column 2) would represent approximately the amount available

[1] Argentine mills are said to cease purchasing old-crop wheat as early as mid-November.

for seed use and consumption (column 3).[1] If end-year stocks did not vary, they could be ignored. Since they do vary, it is not safe to ignore them; but we may accept the summations of column 3 as representing gross supplies of wheat in France year by year exclusive of initial stocks.

a fairly satisfactory quantitative basis. To measure the quantity of seed used in a given year, we can multiply the acreage harvested in the following year by the average or "normal" quantity of seed sown per acre, with results as given in column 4. The desiderata, it is true, are acreages sown rather than har-

TABLE 1.—ESTIMATION OF AUGUST 1 WHEAT STOCKS IN FRANCE, 1922–32

(Million bushels)

Year	Crop[a]	Net Imports[b]	Gross utilization[c]	Total seed sown[d]	Net utilization[e]	Assumed consumption[f]	Change in stocks[g]	Stocks at end[h]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1921–22	323.5	21.8	345.2	28.7	316.4	294	+22.4	22.4
1922–23	243.3	55.0	298.3	30.1	268.2	290	−21.8	0.6
1923–24	275.6	68.1	343.7	30.0	313.7	303	+10.7	11.3
1924–25	281.2	45.6	326.8	30.5	296.3	298	− 1.7	9.6
1925–26	330.3	24.6	354.9	28.5	326.4	305	+21.4	31.0
1926–27	231.8	83.6	315.4	28.7	286.7	300	−12.3	17.7
1927–28	276.1	42.5	318.6	28.5	290.1	303	−12.9	4.8
1928–29	281.3	66.6	347.9	29.3	318.6	302	+16.6	21.4
1929–30	337.3	5.5	342.8	29.2	313.6	302	+11.6	33.0
1930–31	228.1	62.0	290.1	27.5	262.0	295	−33.0	0.0
1931–32	264.1	79.8	343.9	29.1	314.8	305	+ 9.8	9.8

[a] Official data, as reported by the U.S. Department of Agriculture.

[b] Net imports of wheat and flour as wheat in "commerce général," August–July, compiled from *Statistique mensuelle du commerce extérieur de la France.*

[c] Ignoring changes in stocks; column 1 plus column 2.

[d] Acreage harvested in 1922–32, as reported by the U.S. Department of Agriculture, multiplied by the constant fac-

tor 2.2 bushels per acre, the average seed use given in *Annuaire statistique agricole, 1913–14*, p. 700.

[e] Column 3 minus column 4.

[f] Estimated by methods described in the text.

[g] Column 5 minus column 6.

[h] Excess of end-year stocks over the approximate minimum, and cumulative summations of data in column 7.

If statistics on consumption in its several forms (broadly, seed, food, feed, and industrial use) were all available, the subtraction of total consumption from "gross utilization" would leave remainders that could properly be taken to represent changes in end-year stocks, again granting the substantial accuracy of the several items in the calculation. In the absence of statistics of consumption, the only recourse is resort to estimation.

Estimation of one of the four elements of consumption—seed use—can be placed upon

[1] Here the sum of crops and net imports (or the difference between crops and net exports) is termed "gross utilization." Other terms like "apparent domestic utilization," "domestic disappearance," or "domestic retention" are often employed instead. The representation cannot be exact, for some of the wheat crop becomes available before August 1; and the summation, of course, can be no more accurate than the production and trade statistics from which it is computed.

vested, and seed actually used per acre rather than average or "normal" sowings. There is reason to believe that wheat acreage sown but not harvested, or wheat acreage resown, is not significant in France, and that trend or fluctuation in the quantity sown per acre is unimportant. Consequently the figures in column 4 probably represent actual use of wheat for seed with moderate accuracy, unless the acreage statistics are faulty or the average seed use per acre (a figure which dates back to pre-war years) is substantially above or below the truth.

Subtraction of total seed sown (column 4) so estimated from gross utilization (column 3) yields figures termed "net utilization" in Table 1, column 5. It is next necessary to find a basis for appraising the quantities consumed annually for purposes other than seeding—that is, for food, feed, and industry.

So far as we can ascertain, both feed use

and industrial use of wheat are unimportant in France.[1] Wheat too poor in quality for milling into flour ("tail" wheat), of which there must be more or less every year (perhaps 10 per cent of the crop in some years), is doubtless fed to livestock, and presumably some sound wheat as well. Some wheat is presumably used in starch manufacture or in fermented beverages. All told, however, the great bulk of the French annual wheat supply almost certainly is used in the manufacture of flour, which in turn goes for human consumption.

What, then, are the annual variations in the wheat equivalent of flour consumed? The best available quantitative data that can be brought to bear on this subject are the figures on "net retention" (column 5). This series, however, shows variations of rather large magnitude, the largest change between consecutive years being an increase of 52.8 million bushels, or over 20 per cent, between 1930–31 and 1931–32.

In some countries it may conceivably happen that aggregate human consumption of wheat in flour or wheaten bread varies as much as 20 per cent from one year to another. This may occur either in countries where the level of subsistence is so low that adaptations of consumption to domestic production are inevitable; or in countries where wheat plays a supplementary rôle in the cereal diet, and cereal price relationships are important in determining the quantities of wheat used for human consumption. France is not such a country. The general standard of living is too high, bread too important and cheap an item in the national diet, to warrant the inference that human consumption of flour per capita can vary more than a trifle from year to year except under extraordinary circumstances such as war brings.

It seems therefore justifiable to assume that year-to-year fluctuations in the use of wheat for food, feed, and industry together are distinctly small in France. They are probably due mainly to changes in the quality of domestic wheat crops. If the quality of wheat in a particular year is poor, rather more "tail" wheat is available than in a year of good quality; and more bushels of wheat will be required to produce a given weight of flour. Consumption of wheat presumably tends to be larger when crops are of poor quality than when they are good. Another factor that has probably been of some importance in affecting year-to-year changes in consumption is the occasional public regulation of extraction ratios and/or of percentage admixtures of other cereals with wheat.

For France, the data on net utilization seem to represent adequately enough the *trend* of total wheat consumption for food, feed, and seed (mainly food). Changes in stocks from the beginning to the end of the eleven-year period can hardly have been important enough to affect the slope of the trend. This trend has been approximately horizontal since 1923–24 (1922–23 was perhaps still more or less under war-time influences tending to keep consumption low). Since the population has increased slightly, per capita wheat consumption in France has probably tended slightly downward.

The figures given in column 6 of Table 1 represent the result of an attempt to estimate actual consumption of wheat for food, feed, and industry. The estimates rest heavily on the conclusions reached above: namely, that consumption per capita must be close to inflexible, though with some slight downward drift; and that variations must be due mainly to fluctuations in the quality of domestic wheat crops. Official statistics on average weight per hectoliter give some indications of changes in crop quality from year to year; the trade journals[2] provide supplementary information, mainly qualitative. One may obtain and utilize statistical data on cereal prices, on wholesale prices generally, on industrial output, and on unemployment.

Study of this material, taken in conjunction with the broad conclusions about wheat consumption set forth above, leads to preliminary quantitative estimates of consumption in particular years.

---

[1] No doubt some 30 per cent of the wheat milled is fed to livestock as mill offals; but we are here concerned with the gross quantity of wheat grain which is used to produce the flour consumed annually.

[2] For example, the *Bulletin de Halles, Bourses, et Marchés; La Cote Bodenheimer;* and the *Revue du Marché* of J. H. Goldschmidt and Company, Paris.

At the same time, however, it is necessary to consider such information as is available about the size of end-year wheat stocks. This information is mainly qualitative, the impressions of journalists who watch the French wheat position; it is in part quantitative, in the sense that prices and price relationships provide some indication whether end-year stocks are abundant or scarce.

The first requisite of estimates of consumption for food, feed, and industry is that the sum of the annual estimates must equal the sum of the annual figures on net utilization, with one important qualification. The first sum may exceed the second if stocks can be shown to have been higher on August 1, 1921, than they were on August 1, 1932; that is, if, over the period as a whole, stocks declined, actual consumption could have exceeded crops plus net imports minus seed. Conversely, the second sum may exceed the first if stocks were increased over the period as a whole.

The French statistics of net utilization show approximately a horizontal trend from 1923–24 to 1931–32, and an average of 301 million bushels. The procedure followed in the first instance was to take into account available evidence on changes in crop quality and in end-year stocks, assigning to individual years figures above or below 301 million bushels[1] when reasons appeared for supposing that consumption would be enlarged or contracted. At the same time it was essential so to assign estimates that resulting stocks estimates should accord with available evidence on stocks. It could properly be inferred, for example, that stocks as of August 1, 1921, were practically at a minimum; for net utilization was very low, and qualitative evidence pointed to low stocks. The same inference could be drawn regarding stocks on August 1 in 1923 and 1930. Stocks on these dates, therefore, could be represented by zero, indicating not complete absence of stocks but approximately a minimum level.

The calculation of end-year stocks involved,

---

[1] For most other countries approximate ordinates of trend rather than an average of the net utilization figures are the basic data in this procedure.

for the first year of the series (1921–22), the subtraction of the preliminary consumption estimate from the sum of the net utilization and the assumed stocks, which were taken as zero on August 1, 1921; the remainder would indicate the *increase* in stocks in 1921–22 if stocks were really at a minimum on August 1, 1921, and if the estimate of consumption were accurate. The calculation for the second year of the series involved subtraction of the consumption estimate for 1922–23 from the sum of the net utilization and the remainder obtained from the preceding calculation. Successive calculations for later years followed the same procedure, resulting in a series of eleven remainders, tentatively to be regarded as estimates of end-year stocks.

The tentative approximations both to actual consumption and to end-year stocks naturally resulted in some discrepancies. The first consumption estimates, it is true, conformed to the principles of approximately equaling in summation the sum of the net utilization figures, and of deviating only slightly from the eleven-year trend. But zero being taken as representing approximately minimum stocks, and three dates of minimum stocks being assigned, a remainder could not be accepted if, for example, it happened to result in a substantial minus quantity in a year when minimum stocks had been assigned. The remainders thus calculated required to be checked against the independent evidence regarding the size of end-year stocks in specific years. If a given remainder pointed toward large stocks in a year when other evidence pointed to small ones, or to small stocks when large ones were indicated, it was clear that the calculation of remainders must be revised through adjustment of the consumption estimates. Such adjustment could be made without doing violence to general reasoning or specific facts about consumption, or to the principles of bookkeeping balance, or to general and specific facts about stocks.

The procedure thus resembles statistical smoothing of a time series. The rough data (column 5) taken over a period of years must show the general level and trend of aggregate consumption for food, feed, and industry.

The smoothed curve (column 6) represents this general level and drift; and points on it represent estimates of actual consumption in particular years. Annual deviations (column 7) of the raw data from the smoothed measure roughly the probable increase or decrease in stocks in the course of a year. The "stocks at end" (column 8) are cumulative summations of these deviations, and represent the probable level of wheat stocks on about August 1 *at or above the minimum level.*

It may well be asked why a time series should be smoothed in so unconventional a manner. The answer is that no smoothed curve derived mathematically (or free-hand, as free-hand smoothing is usually done) will fit with known facts and soundly reasoned theories about either year-to-year changes in annual consumption or year-to-year changes in the level of end-year stocks. The method of smoothing described above permits such facts and theories to be utilized. Obviously, however, judgment plays an important part in the smoothing process. Quantitative estimates both of consumption and of end-year stocks different from those given in Table 1 might and probably would be reached by different individuals, even if precisely the same general method and precisely the same supplementary information were utilized. But it is safe to say that the differences would not be striking, for the basic theories about consumption are tenable and the published information about stocks tends to be conclusive.

OTHER COUNTRIES

This may also be said of estimates of consumption and stocks in such important wheat - consuming countries as the British Isles, Germany, Italy, and Spain. Supplementary information regarding the position in the first two countries is in fact more abundant and convincing than is true of other countries, including France. Broomhall's statements of wheat and flour stocks in United Kingdom ports give useful indications of changes in and minimum levels of end-year total stocks; and much information is available in the form of comments in journals on feed use and of statistical data on cereal

imports and prices. The large proportion of imported wheat in total supplies available facilitates the estimation. For Germany the supplementary evidence includes not only an official census of wheat ground in 1927–28, but also semiofficial estimates of farm stocks as late as June 15 since 1927, and estimates both of consumption and of changes in stocks from 1924–25, as published by the Institut für Landwirtschaftliche Marktforschung. These data warrant reproduction in Table 2 (p. 180), since they constitute the best available statistical summary of wheat disposition in Germany.

Estimates of consumption and end - year stocks in Holland, Belgium, Switzerland, and Greece may also be regarded as fairly reliable. The general trends of consumption are clearly indicated by the statistics of net utilization. The deviations of annual data from ordinates of trend are relatively small. Hence it is safe to infer that annual per capita or total wheat consumption for food does not deviate much from the trend; and this is confirmed for Holland by official statistics of flour consumption in calendar years. The supplementary information regarding consumption and end-year stocks is substantial in volume and of good quality, though least so for Greece. It suffices to indicate roughly both the years in which exceptional amounts of wheat were used for feed and the years in which end-year stocks were exceptionally heavy or light.

The bases for estimation are less adequate for the other countries whose end-year stocks are included in the world total ex-Russia. In the main, the evidence that must be used to supplement statistics of net wheat utilization is scanty, at least in English, French, and German journals. Deviations of annual data on net utilization from the smooth trends tend to be large. If one could be assured that in a given country consumption of wheat for food and feed tended to be stable, trend considered, the deviations could then be regarded as representing changes in end-year stocks. If, on the other hand, one could feel confident that wheat consumption for food and feed was very variable from year to year, the deviations could then be regarded as representing changes in consumption, and end-year stocks could be estimated as invariable. But nei-

ther Scandinavia, the Baltic states, Poland, Austria, Czecho-Slovakia, the Danube countries, Portugal, the northern African countries, Japan, nor India can be supposed to be an area in which fluctuations in net utilization represent changes either solely in stocks, or solely in wheat consumption for food alone, or solely in wheat consumption for feed.

feed in 1923–24 and 1928–29. But a good deal of uncertainty is unavoidable in the process of expressing quantitatively for any given year the probable total consumption, including feed use, and the probable change in end-year stocks.

The trends of net wheat utilization in the Baltic states, Poland, Czecho - Slovakia, the Danube basin, Portugal, northern Africa, In-

TABLE 2.—THE GERMAN WHEAT BALANCE, ACCORDING TO THE INSTITUT FÜR LANDWIRTSCHAFTLICHE MARKTFORSCHUNG, FROM AUGUST–JULY 1924–25*

(Million bushels)

Item	1924–25	1925–26	1926–27	1927–28	1928–29	1929–30	1930–31	1931–32
1. Crop								
a) As officially estimated	93.51	123.93	100.20	125.63	147.78	128.60	144.29	160.42
b) Correction	+9.37	+6.21	+5.00	+6.28	....	....	....	....
c) As corrected	102.88	130.14	105.20	131.91	147.78	128.60	144.29	160.42
2. Trade (including flour)								
a) Imports	87.78	77.97	97.59	96.19	95.31	54.31	31.93	35.57
b) Exports	5.66	20.10	5.59	7.50	17.53	6.65	0.74	12.35
c) Excess of imports	82.12	57.87	92.01	88.70	77.79	47.66	31.20	23.22
3. Changes in stocks								
a) With producers	....	−1.84	....	+5.51	− 1.10	− 7.35⎰	−7.35	⎰....
b) In second hands	....	....	....	....	+11.02	−18.37⎱		⎱....
4. Domestic use								
a) Shrinkage	3.07	3.90	3.16	3.97	4.45	3.86	4.34	4.81
b) Seed	10.69	10.99	12.02	11.80	10.95	12.05	14.48	15.18
c) Human consumption (roughly)	165.34	169.02	176.37	187.39	189.23	180.04	158.00	150.65
d) Feed use	5.88	5.95	5.66	11.94	11.02	6.03	6.03	13.01

* Data from the *Blätter für Landwirtschaftliche Marktforschung*, October 1931, p. 201, and December 1932, p. 315, as nearly as possible in the form employed in the later number. Similar balances for rye, oats, barley, corn, and potatoes are given in these publications. The compilations are the work of N. Jasny and A. Hanau.

Certain trustworthy hypotheses can be formulated, however, about the fluctuations of net utilization in several of these areas. Of the Scandinavian countries it can be inferred that human consumption of wheat is stable, trend considered; this is indicated by Swedish and Danish official calendar-year statistics of flour production[1] in spite of their palpable incompleteness. The variations in net utilization accordingly must be due mainly to changes in quantities of wheat used for feed and/or to changes in the level of stocks. Qualitative information is adequate to point toward exceptionally heavy use of wheat for

[1] See "The Wheat Situation in Scandinavia," WHEAT STUDIES, June 1931, Vol. VII, Charts 3 and 14.

dia, and Japan are relatively erratic; and the available supplementary information is not of substantial usefulness in explaining the annual fluctuations of net utilization. The presumption is that human consumption in these countries changes rather widely from year to year by comparison with what occurs in western European countries. In the main, these are areas where the general standard of living tends to be lower than it is in western Europe; or where the ratio of urban to total population is smaller; or where cereals other than wheat are relatively more important in the national diet. It seems unreasonable to suppose, for example, that wheat consumption for food could remain stable (trend considered) in northeastern Europe, where rye

is the principal bread grain; almost certainly more wheat would be consumed in a year when the domestic wheat crop was large and the rye crop small than in a year when the wheat crop was small and the rye crop large. The same sort of reasoning applies to Roumania and Jugo-Slavia, where corn is an important element in the national diet. Rice is dominant in Japan; rice and millets are important in India. Thus the supplies and prices of crops other than wheat require consideration in estimating consumption and end-year stocks. In some countries of this group absolute changes in the price of wheat probably affect the quantity of wheat consumed, more being used at low than at high prices.

In this group of countries, and in those of western Europe as well, there can be no question that wheat consumption in several has been affected (especially in the last four years) both by fluctuations in industrial employment and by governmental regulations, including milling quotas and tariffs. The quality of wheat crops is also of some significance.

Analysis of available information on these matters provides some basis for estimating annual wheat consumption and changes in end-year stocks. The information is not of equal completeness for all countries of the group; it is better for Hungary, Poland, Austria, Czecho-Slovakia, Roumania, and Japan than it is for the Baltic states, Portugal, Jugo-Slavia, Bulgaria, northern Africa, and India. At most, it serves to indicate what years were characterized by particularly low or high end-year stocks or by particularly low or high wheat consumption. Despite the limitations of data, however, a method of estimating consumption and stocks which seeks to take these factors into account is presumably superior to a method in which ordinates of mathematically fitted trend of net utilization are regarded as measures of annual wheat consumption, and deviations from trend as measures of changes in end-year stocks.

The general method described above has been employed in estimating changes in end-year stocks or excess of end-year stocks above minimum levels, in all of the countries covered except the United States, Canada, Ar-

gentina, and Australia. The method was not applied, however, to each of the long list of countries separately. Table 3 (p. 182) shows what groupings of countries were used, and gives the outcome of estimates for each individual country or for each group of countries to which this method was applied.

The method described yielded estimates of the excess of stocks above the minimum. To reach approximations to the size of absolute stocks, approximate minimum stocks had to be estimated and added to the figures in Table 3. The following approximate minima, in million bushels, were adopted as reasonable: European importing countries as a group, 150; India, 30; the four exporting countries of the Danube basin, 20; northern Africa, 8; and Japan, 4. These minima represent roughly 10 per cent of the annual average net utilization of wheat in each of these areas over the decade from 1922–23 to 1931–32. The use of 10 per cent implies that minimum stocks in any area cannot be supposed to amount to less than the quantity of wheat needed for consumption during from five to six weeks. The estimate is probably conservative for areas where wheat is grown mainly on small peasant farms, where commerce is relatively undeveloped, and where yields are highly variable from year to year—for example, India, northern Africa, and eastern Europe. It is probably liberal for several countries of western Europe which depend mainly on imported wheat, notably the British Isles, Switzerland, Belgium, and Holland.

The method used in estimating stocks in Europe (ex-Russia), northern Africa, India, and Japan can best be employed only rather late in a current calendar year. The basic quantitative data — statistics of domestic wheat crops and August–July net imports of wheat and flour by countries—are available only for a few countries within a few weeks following the August 1 to which the estimates of end-year stocks are to apply. Pertinent supplementary statistics, such as those on other cereal crops, prices, and employment, are even less promptly available. But even in late August and in early September it is possible to arrive at rough approximations of stocks on August 1 preceding; the necessary net import

statistics, in particular, can themselves be approximated for the last month or two[1] of the August–July crop year. Rough estimates of end-year stocks made in August or September

rope. Quite a different method is necessary in estimating August 1 stocks in this position, which (unlike stocks afloat to Europe) are not reported by Broomhall. It is obvious that

TABLE 3.—ESTIMATED EXCESS ABOVE THE MINIMUM OF END-YEAR WHEAT STOCKS IN SPECIFIED COUNTRIES, ABOUT AUGUST 1, 1922–32*

(Million bushels)

Year	British Isles	France	Germany	Italy	Spain	Poland	Belgium, Holland, Switzer-land	Greece	Austria, Czecho-Slovakia	Denmark, Norway, Sweden
1922.......	4.2	22.4	33.3	15.9	28.2	0.0	1.9	0.0	5.8	0.0
1923.......	0.2	0.6	0.0	11.4	4.5	0.0	0.8	0.0	0.0	1.5
1924.......	17.2	11.3	0.0	21.7	16.5	2.6	4.0	0.0	6.4	5.3
1925.......	17.9	9.6	0.0	0.3	0.0	0.0	0.5	0.0	1.3	0.4
1926.......	0.1	31.0	0.0	15.9	16.3	1.2	0.4	0.0	1.9	1.8
1927.......	7.9	17.7	1.4	24.7	15.2	0.4	0.3	1.2	0.0	1.1
1928.......	16.3	4.8	15.8	7.9	15.2	7.1	7.1	0.9	5.0	3.0
1929.......	5.8	21.4	30.1	23.8	6.8	2.9	8.9	3.4	6.5	5.5
1930.......	0.6	33.0	5.0	25.3	14.1	0.6	3.6	2.3	6.1	4.4
1931.......	10.4	0.0	0.0	15.8	9.1	6.2	9.6	1.1	4.4	1.1
1932.......	17.2	9.8	0.0	0.0	0.0	10.6	6.6	0.8	0.0	0.0

Year	Finland, Estonia, Lithuania, Latvia	Portugal	Hungary	Jugo-Slavia	Roumania	Bulgaria	Algeria, Morocco, Tunis	Egypt	India	Japan
1922.......	0.0	0.0	0.0	4.0	0.0	1.6	7.4	1.3	0.0	4.8
1923.......	0.5	1.1	4.0	0.0	9.0	3.0	0.0	0.7	7.0	0.0
1924.......	0.6	2.7	7.0	4.0	13.0	1.5	4.1	2.9	27.0	6.1
1925.......	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.1	22.0	0.0
1926.......	2.2	1.9	1.2	11.8	3.0	4.3	9.7	1.8	20.0	4.2
1927.......	1.9	0.0	1.2	13.7	9.0	1.8	13.9	0.0	4.0	1.9
1928.......	1.5	2.6	0.5	3.5	0.0	1.6	9.2	1.4	4.0	1.4
1929.......	1.1	0.9	18.0	18.5	10.0	8.6	9.5	0.8	0.0	3.4
1930.......	1.1	1.9	5.0	13.0	5.7	0.3	15.2	3.8	0.0	1.1
1931.......	2.9	1.4	11.6	6.9	13.4	7.9	4.2	0.0	42.0	1.2
1932.......	0.0	0.0	5.8	6.0	6.3	12.2	0.0	0.0	2.0	4.7

* Bases of estimation as described in the text. Zero represents approximate minimum stocks.

naturally require revision as useful information becomes available in October–December.

STOCKS AFLOAT TO EX-EUROPE

The methods of estimation thus far described apply to the estimates of end-year stocks in all countries and positions included in the "world" total except afloat to ex-Eu-

[1] Analysis of statistics of net imports in the last two or three months of the crop year is particularly important in estimating probable end-year stocks in countries which produce much less wheat than they import.

a general relationship would exist between the size of stocks afloat to ex-Europe on August 1 and the size of shipments to ex-Europe in a period immediately preceding August 1. Some suggestion of a basis for measuring this relationship is to be found in the relationship between stocks afloat to Europe and shipments to Europe in the closing four weeks of successive crop years. The stocks have averaged 107 per cent of the shipments, and at the extremes from as low as 94 per cent to as high as 123 per cent. Probably stocks afloat to ex-Europe on August 1 constitute a somewhat higher average percentage of shipments

to ex-Europe in the closing four weeks of the year, because the average distance from ex-porting countries to ex-European importing countries is probably longer than the average distance to European importing countries, at least at this season of the year. We have provisionally chosen to estimate the stocks afloat to ex-Europe by taking merely the total of shipments to ex-Europe (Broomhall's data) in the closing five weeks of each crop year. Experience may suggest modification of this procedure.

RESULTS AND USES

We may now summarize the estimates of end-year stocks reached by the procedures described above, together with the data which can be taken directly, without significant adjustment, from official and unofficial statements. The figures appear in Table 4 (p. 184).

The countries and positions covered by the figures correspond fairly closely to territory commonly included in familiar estimates of what is termed the "world wheat crop ex-Russia." They do not, however, include stocks in New Zealand, South Africa, Mexico, Uruguay, and Chile, whose wheat crops are almost invariably included in world totals ex-Russia; or stocks in Peru and Brazil, whose wheat crops are often included in world totals; or stocks in Turkey, Syria and Lebanon, Palestine, and some smaller producing countries, whose crops are not often included in such totals for the world ex-Russia but are included in estimates published by the United States Department of Agriculture. Of the countries omitted, none except Turkey ranks as a large wheat-consuming country, and only Brazil is a considerable factor in the world wheat trade. It is therefore proper to say that the stocks estimates given in column 1 of Table 4 apply to nearly all of the world ex-Russia, as the term is most commonly used. For use in analyses of the world wheat situation, the coverage appears adequate.

Some of the uses of the data summarized in Table 4 may now be indicated briefly. In the first place, they provide an approximate measure of the absolute level of total end-year wheat stocks in the world ex-Russia in successive years. Knowledge of this level, which

is difficult or impossible to infer from trade statements of world visible supply, is important both in evaluating the events of a year just passed and in forming a judgment about probable developments in wheat trade and prices in a coming year. To serve these purposes, more is contributed by estimates of stocks in various areas and positions than merely by estimates of aggregate stocks.

It would have been highly advantageous, in the autumn of 1929, to have clear evidence that the crop year had opened with heavy stocks in European importing countries, in the Danube basin, and in Argentina. Equipped with such information, the student of the wheat situation would have been in a better position than he was to forecast the volume of import requirements, the extent to which imports would be drawn from different sources of supply, and the outlook for wheat prices. It was important in the autumn of 1932 to have evidence that the very large end-year stocks in the world ex-Russia were concentrated in North America to a degree unprecedented in the preceding decade and that stocks in most of importing Europe were low. The size and the distribution of end-year wheat stocks in the world ex-Russia, in short, are both important to the student of wheat—in some years more than in others, but more or less in any year.

Again, it is common knowledge that there is a surplus of wheat in the world. Yet how large is the surplus, and how much has it varied in size? One method of measurement would be to regard average world visible supplies[1] on August 1, 1922–27 (before the surplus came to light), as representing "normal" world wheat stocks; and with this "normal" (about 156 million bushels) to compare the visible on the same date in 1928–32, regarding the excess as measuring the surplus. Another method would be to follow the same procedure, using the estimates of world wheat stocks ex-Russia in Table 4 (the corresponding average being 617 million bushels). The surpluses, so measured, compare as follows, in million bushels:

[1] As estimated in the joint compilation by the *Corn Trade News*, the *Daily Market Record*, and the *Daily Trade Bulletin*; see above, p. 169.

August 1	Calculated from world visibles	Calculated from world stocks
1928.............	71	103
1929.............	214	364
1930.............	255	309
1931.............	330	397
1932.............	266	355

These calculations yield divergent results,[1] and the surpluses measured from estimated world stocks are much larger than those measured from world visibles. Now the absolute size of the surplus is important because

aid in the solution of the wheat problem of any country.

Obviously the surplus may be measured in other ways than from world visible supplies or from estimated total stocks in the world ex-Russia. One method would be to utilize data not only on world visibles, but also on city mill stocks, farm stocks, and country mill and elevator stocks in the United States, and stocks in flour mills and on farms in Canada. These data are reported directly. This method would be more adequate than

TABLE 4.—WORLD WHEAT STOCKS EX-RUSSIA (APPROXIMATE), ABOUT AUGUST 1, 1922–32

(Million bushels)

Year	Total	Four chief ex-porters[a]	In North America			Aus-tralia	Argen-tina	Lower Danube[b]	India	Northern Africa[c]	European importers[d]	Afloat to Europe	Afloat to ex-Europe, Japan
			Total	U.S. grain	Canadian grain								
1922.....	626	228	159	117	42	18	51	26	30	17	262	49	14
1923.....	577	272	180	147	33	28	64	36	37	9	171	39	13
1924.....	701	284	191	143	48	27	66	46	57	15	238	42	19
1925.....	536	229	147	117	30	24	58	20	52	11	180	33	11
1926.....	612	224	140	100	40	17	67	40	50	20	223	39	16
1927.....	649	264	172	119	53	23	69	46	34	22	222	46	15
1928.....	720	341	219	127	92	27	95	25	34	19	237	45	19
1929.....	981	529	372	245	127	27	130	75	30	18	267	38	24
1930.....	926	525	423	296	127	37	65	44	30	27	248	39	13
1931.....	1,014	600	474	334	140	46	80	60	72	12	212	38	20
1932.....	972	615	515	379	136	40	60	51	52	8	195	31	19

[a] United States, Canada, Argentina, Australia.

[b] Hungary, Jugo-Slavia, Roumania, Bulgaria.

[c] Algeria, Morocco, Tunis, Egypt.

[d] Europe except the Danube basin, Russia, and Albania.

of its bearing on the outlook for the eventual disappearance of the surplus. This may occur through either reduction of wheat acreage, reduction of yield per acre, or expansion of wheat consumption (including shipments out of the "world ex-Russia," mainly to China). The smaller the surplus, the better are prospects for its early disappearance through one or more of these channels; the larger the surplus, the longer it is likely to remain in evidence. A reliable measure of the size of the surplus is also needed if one considers the appropriateness and probable effects of governmental measures designed to

measurement from world visibles alone. Yet it would be less adequate than measurement from direct estimates of end-year stocks throughout the world ex-Russia. It is only through the use of estimates covering a wide territory that proper account can be taken of the fact that end-year stocks in different countries and positions change not in the same but in different directions from one year to another.

These series of estimated end-year stocks also contribute to a sound appraisal both of the wheat supply position in successive years, and of disappearance of wheat from the area included within the world ex-Russia. By adding together the estimated stocks at the beginning of a crop year, the crop harvested during the year, and the exports from Russia, we reach a summation that serves to indicate roughly how much wheat was available in

[1] Even the direction of change in end-year stocks is not the same; between 1929 and 1930, for example, visibles increased while estimated total stocks declined. It now seems possible that a substantial decline may appear in visibles between 1932 and 1933, but none or a smaller one in estimated total stocks.

that year for consumption in all forms, for shipment to outside areas, and for carryover at the end of the year. Subtraction of the estimated end-year stocks serves to indicate the amount available for consumption and for shipment to outside areas, even though in part the estimated stocks rest upon estimates of consumption. The shipments to outside areas can be approximated from trade statistics, so that a figure can be derived for the amount actually consumed. The derived figure will be approximate at best, containing the inaccuracies inherent in estimates both of crops and of stocks. But any other calculation of world wheat consumption will be inexact to the extent that either the crop estimates or the stocks statistics are inaccurate. World visible-supply statistics are commonly used in such calculations; but these are inherently imperfect for representation of the extent of changes in total end-year stocks ex-Russia, and are consequently inadequate for the calculation.

The estimates of end-year stocks given in Table 4 are presented in the belief that they are sufficiently accurate to serve these important purposes with reasonable satisfaction, and much more adequately than other statistics of stocks that are currently available. Nevertheless, they must be regarded not as exact or complete, but as approximations subject to question and improvement. Their limitations in respect to scope, degree of accuracy, and date need not be repeated.

NEED FOR DIRECT ESTIMATES

The estimates are presented partly in the hope that they may help to stimulate improvement in the estimates for countries for which the present basis of estimation is unsatisfactory. At present, official estimates that are fairly comprehensive and trustworthy are available only for the United States and Canada. If similar official data were available even for those countries only which produce or consume as much as 100 million bushels of wheat a year, the world wheat situation could be much more confidently appraised.

The wheat-grain stocks lying within any of these countries at or near August 1 must be held mainly (1) on farms, (2) in elevators and warehouses, and (3) in flour mills. Official inquiries might conceivably be made regarding stocks in these three positions, at some date near August 1 annually, in Argentina, Australia, India, the British Isles, France, Germany, Italy, Spain, and Roumania. A beginning has been made in Germany; partial statements are available for the British Isles, Australia, and Argentina; and under the new Wheat Act, we may expect reliable data for Great Britain beginning in 1933. Similar inquiries in Belgium, the Netherlands, Switzerland, Denmark, Sweden, Austria, Czecho-Slovakia, Poland, Hungary, Jugo-Slavia, Bulgaria, and Greece would leave no important gaps in the information.

After a few years had passed, such statistics would serve greatly to facilitate understanding of a subject now all too obscure—the response of wheat consumption to supplies, prices, and the trade cycle in different countries, and in turn its effects upon them. With accurate data on end-year stocks, it would be possible (within the limits of accuracy inherent in crop and trade statistics) to determine how much wheat was consumed within a year in any country. Much fuller understanding of wheat consumption would be possible if, in addition, statistics were made available of the quantities of wheat ground into flour (or, alternatively, simply of flour produced); with these data, one could ascertain fairly closely how much of the wheat consumed in a year went to human consumption; how much to feed, seed, and industrial use together. Seed use can be estimated by methods described above; hence it would be possible to ascertain how much was used for feed and industry—really for feed, since industrial use is generally a small item.

Such statistics of end-year wheat stocks, as compared with estimates such as we have made, would also prove useful as a check upon the accuracy of crop estimates. Given also statistics of wheat milled, the check would be of substantial value. At present the only countries in the world whose wheat-crop estimates can be subjected to moderately satisfactory tests of accuracy, based upon disposition statistics, are the United States, Can-

ada, Argentina, and Australia; inadequate as the tests are, they nevertheless point to substantial errors in the crop estimates. It is not unreasonable to suppose that crop estimates of many other countries would be found to be even more inaccurate. In time, perhaps, more satisfactory methods of crop estimation would be utilized in many countries if the disposition statistics suggested the necessity of their adoption.

The expense involved in measurement of end-year wheat stocks in countries where the attempt is not now made would unquestionably be small. Sampling methods would suffice, and the personnel which now assists in the preparation of crop estimates could be utilized, at least in the estimation of stocks on farms. In view of the purposes which can be served by dependable wheat-stocks statistics, the necessary expenditure would seem to be justified, even to the extent of preparing stocks estimates at least as of the end of the crop year, and probably also as of the end of the first six months and of the first nine months.

In lieu of official reports or direct estimates of end-year wheat stocks, we offer the indirect estimates described above as useful approximations which seem to provide significant information not to be gleaned from the less comprehensive direct estimates currently available in trade and official sources.

This study is the work of M. K. Bennett

WHEAT STUDIES *of the* FOOD RESEARCH INSTITUTE

RECENT CONTRIBUTIONS FROM THE FOOD RESEARCH INSTITUTE

(Reprints available free on request)

G 56. "Agricultural Commodities and the Business Cycle," Holbrook Working. *Proceedings of the Institute of Finance,* 1931

G 57. "Review of *Japan's Economic Position*" (by John E. Orchard and D. J. Orchard), E. F. Penrose. *Journal of the American Statistical Association,* September 1931

G 58. "Economic Aspects of Adulteration and Imitation," C. L. Alsberg. *Quarterly Journal of Economics,* November 1931

G 59. "Farm Relief, Agricultural Prices, and Tariffs," Louis B. Zapoleon. *Journal of Political Economy,* February 1932

G 60. "Review of *Wheat*" (by W. W. Swanson and P. C. Armstrong), Holbrook Working. *Journal of Farm Economics,* April 1932

E 37. "Preparation of Glutenin in Urea Solutions," W. H. Cook and C. L. Alsberg. *Canadian Journal of Research,* September 1931

E 38. "On the Carbohydrates of the Muscles of the Frog," Melville Sahyun. *Journal of Biological Chemistry,* November 1931

E 39. "On the Carbohydrates of Muscle," Melville Sahyun. *Journal of Biological Chemistry,* November 1931

E 40. "Preparation and Heat Denaturation of the Gluten Proteins," W. H. Cook. *Canadian Journal of Research,* October 1931

FOOD RESEARCH INSTITUTE

STANFORD UNIVERSITY, CALIFORNIA

A research department of Stanford University, established in 1921 jointly by Carnegie Corporation of New York and the Board of Trustees of the Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

DIRECTORS

CARL L. ALSBERG   JOSEPH S. DAVIS   ALONZO E. TAYLOR

ECONOMISTS

MERRILL K. BENNETT   HOLBROOK WORKING

PUBLICATIONS

WHEAT STUDIES

Ten issues yearly, $6.00 per volume. Each volume contains a comprehensive review of the world wheat situation during the preceding crop year (price $1.00), three surveys of current developments (price $.50 each), and six special studies (variously priced; see inside back cover).

GRAIN ECONOMICS SERIES

A series (books, issued irregularly) covering topics in grain economics not suited to full discussion in *Wheat Studies*.

FATS AND OILS STUDIES

A series (books, issued irregularly) of studies in fats and oils of animal and vegetable origin, dealing primarily with economic aspects— production, trade, prices, and utilization—but with due reference to technical knowledge.

MISCELLANEOUS PUBLICATIONS

A series (books, issued irregularly) embodying the results of research in fields other than those covered by the series listed above.

CONTRIBUTIONS

Reprints from periodicals of articles written by members of the Food Research Institute.

List of publications available free on request. Address all communications to

FOOD RESEARCH INSTITUTE

STANFORD UNIVERSITY, CALIFORNIA

European Sales Agents:

Great Britain: P. S. KING & SON, LTD., 14, Great Smith Street, Westminster, S. W. 1, London
Continental Europe: MARTINUS NIJHOFF, 9 Lange Voorhout, The Hague, Holland