WORLD WHEAT STANDARDS

by

FARZAND ALI SHAH

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INTRODUCTION

Tho writor being head of a division dealing with the marketing of crops in the Dopartmont of Cooporation and Marketing, Ministry of Food and Agriculture, Government of Pakistan came to the United States to study the methods of marketing and grading of wheat and rice. On account of the importance of wheat in the economy of Pakistan. "World Wheat Standards" was selected as the subject for study.

Tho global character of wheat production and its preominont position as a staple food of the civilized nations of the world seems to have acquired a general recognition which needs hardly any further emphasis. The technological progress and the rise in the standards of living of the westorn countries havo, no doubt, led to the increase in the total production and international movemonts of wheat. In 1950, for instanco, the world output of wheat was estimated at six and onc-half billion bushels out of which over one-tenth entered into international trado.

Genorally speaking, tho study and investigations of the production of wheat appear to have overshadowed the marketing aspect, more particularly grading and standardization. As a result the student of international standards for wheat finds himself faced with tho paucity of relovant literature. In order to overcome this initial handicap the writer, therefore, planned a tour of the important wheat centers of the United States of

America and Canada. Contacts were also established with the diplomatic representatives of important wheat producing countries located at Washington, D. C. with a view to obtain the required information concerning wheat standards of their respective countries.

The following account which comprises the thesis has been divided into four main sections. The first section deals with the problem under study and also embodies the necessary background material. The second section contains an account of the existing wheat standards in some of the important countries. The third section consists of the material relating to the evaluation of these standards from the national and international points of view. The fourth or the final section contains conclusions and suggestions.

It goes without saying that the subject under study is of major importance as it concerns wheat producers, consumers and handlers throughout the world. In view of the limited time available it is difficult to claim that full justification has been done to such an important subject. It is, however, expected that this study might serve the purpose of attracting attention of research workers and official and non-official bodies concerned with a view to pursue it further.

THE PROBLEM

World Wheat Standards

The industrial revolution of the 19th century and the dynamic political ideas that culminated in the French and American revolutions have resulted in spectacular progress in the field of industry and agriculture in Europe and North America. The technological advancements made in agriculture have added, along with other products, large quantities of wheat to the world output. In addition there have been major improvements in quality. The rise in the standards of living of the people has consequently led to the increase in demand for wheat as bread grain involving huge international movements between the surplus and deficit areas. The miracle of transportation facilities has brought the distantly located countries closer to each other. This in turn has resulted in a general awakening to the possibilities of technological gains throughout the underdeveloped countries inhabited by more than a billion people. This awakening has been rightly designated as the challenge of the 20th century. This may be expected to result in a greater demand for wheat involving increased international movements in the years ahead.

The standards and grades of quality as will be seen from the following discussion are an essential adjunct to orderly and organized marketing and trade whether national or international. In certain countries, such as the United States of

America and Canada, the respective Governments have established with a great measure of success an elaborate system of fixed standards for grading wheat. The application of the official standards is jealously watched by the supervisory staff. Research to improve standards is encouraged with a view to effect further improvements. Those standards are not only applied to trade within the country but are also applicable to foreign commerce; transactions being based on the certificate final issued at the port of shipping. In certain other countries, as for instance, Australia, foreign trade is conducted mainly on the basis of fair average quality. There is a large number of such countries where standards are conspicuous by their absence. These countries are naturally deprived of the benefits of standardization, such as improvement in the quality of the crop, storage, handling and transportation. It is rather surprising that there are no international standards for wheat. The authors of the International Wheat Agreement do not seem to have paid much attention towards it. So far it does not seem to have attracted sufficient attention of the Food and Agricultural Organization of the United Nations as well. This organization is working towards the improvement of agriculture including marketing.

The object of this study, therefore, is to examine the various existing standards for wheat in some of the important wheat producing and trading countries in order to point out their shortcomings as well as suggest improvements. It also

aims at stimulating interest in the study and improvement of wheat standards in general and to attract attention of research workers and the relevant international organizations towards the consideration and exploration of some suitable international standards with a view to facilitate international trade in wheat in particular.

Need for Standards of Quality and Their Economics

Quality of Wheat. The primary fact to know before attempting to define quality of wheat is the purpose for which it is required; whether it is required for bread making, biscuits, cake, pastry, macaroni, etc. Broadly speaking, there are five distinct economic groups which have different meanings of quality in wheat. They are wheat grower, miller, exporter, broker and commission agent and the consumer. Maximum yield per acre is of utmost importance to the grower. In addition, there are some other considerations such as resistance to plant diseases, test weight, early maturing in spring wheat area and resistance to winter-kill in the winter wheat area. To the miller, quality means high flour yield, easy to process, low moisture content, low damaged contents and a good germination percentage which indicates soundness of kernel.

From the point of view of the exporter, the quality of wheat will be determined by the requirements of the importing country, and also whether it produces a particular type of

wheat or whether it entirely depends on imports. For instance, a country producing soft wheat varieties will be mainly interested in importing wheats of hard types; e.g., hard red spring wheat or hard red winter wheats for blending with the local wheat. Countries whose staple diet is wheat but do not produce it locally will naturally be interested in the import of bread wheats such as hard red winter wheats.

The broker and commission agent is an important link in the wheat trade as he handles and warehouses the food grains. His interest is that of his customers. He mixes and blends different types and varieties to satisfy his customers. The process of mixing and blending poor quality with good quality, sieving, cleaning, and drying results in upgrading the poorer wheat. The consumers' interest in wheat is indirect as they are interested in the bread made from the flour. The commercial baker, who is by far the largest user of flour, desires a high yield of loaves per cwt. He thus wants a flour with high water absorption ability, a flour suitable for his automatic machine operations, and flour with low ash content (mineral constituents) as their presence indicates the presence of bran which affects baking qualities.

Variations in Quality. It is difficult to acquire uniformity in the quality of agricultural products as they are not subject to the precision methods of manufacture which is a characteristic of industry. In agricultural products there are several variable factors, as for instance, size, shape,

moisture content, keeping quality, taste, aroma, color, texture, chemical constituents, etc., which do not submit to any rigid control. Reproduction in crops depends both on genetic constitution and environmental and climatic influences. In case of wheat, the effect of climate is indicated by the changes in protein contents, carbohydrates, fibre and ash. The changes in protein contents are most important as these are taken into account for commercial valuation. Carbohydrates or percentage of starch generally varies inversely to the percentage of protein. The fibre and ash are generally higher than normal when the kernel is shrunken and shrivelled.

LeClerc's well-known tri-local experiments conducted in the United States of America in 1909-10 go a long way to prove that climate and environment have an overwhelming effect on the quality of wheat. Samples of wheat of Russian origin which were sown in three states having different climates and further the seed produced from those samples in each state grown in the other two states showed clearly the wide variations in quality. The protein contents were highest in the dry area of Kansas, lowest in the humid area of California and average in the moderate area of Texas. Generally speaking, it signifies the importance of moisture during the sowing season.

Some of the agricultural commodities such as livestock are difficult to describe fully and, therefore, subjected to personal inspection by the buyer or his agent. Products like food grains and fibres can be described and sampled, the trading of

these commodities can, therefore, take place on the basis of description and samples. There are other products which lend themselves admirably to grading and standardization, as for instance, wheat, rice and corn. Trade in these commodities can take place on the basis of standards and grades. Simple, uniform, commonly understood and recognized grades if subject to efficient supervision can facilitate marketing and price determination without resorting to personal inspection or sampling.

Advantages of Standards and Grades. According to a dictionary definition the word standard means a criterion of excellence. This definition implies a product of quality. It is a common knowledge that the sterling mark on silver or 18-carat mark on gold provides assurance to the purchaser about its quality and protects manufacturer from unfair competition. Similarly, a grade label, which is recognized and accepted, if applied to a given lot of wheat, is the best assurance to the buyer and protects the seller against competition from unscrupulous dealers.

There is general agreement that standardization if intelligently applied and efficiently supervised provides great benefits. The spectacular progress which certain countries, such as the United States of America and Canada, have achieved in the marketing, transporting and warehousing of wheat in the recent past would not have been possible without the aid of standardization. Some of the benefits of standardization are given:

1. Standardized goods are priced more easily than non-

standardized goods. It reduces the number of uncertainties confronting buyers and sellers, and tends to induce stability of demand by providing consistent and dependable qualities.

2. Market quotations based on grades assist producers and handlers of agricultural commodities to market their products advantageously.

3. The application of standards shows the causes for market discounts and thereby indicates ways and means of crop improvement and handling practices.

4. In the case of grains, for instance, grading permits the economy of bulk-storage and transportation.

5. Standardization and grading facilitates financing and trading on the basis of warehouse certificates. It also establishes loan values in farm storage.

S. J. Duly (8) of the City of London College, who has made a special study of the grain trade and is a recognized authority on grain merchandizing, comments on the benefits of standardization as follows:

> The advantages of grading system are many. It is essentially a farmer's system. It is his safeguard. Grading takes place in the country of production and it provides the required incentive to the farmer well, since he has the assurance that his return will be determined by the quality of his crop. His grading certificate provides him with bank credit immediately. Then grading is the absolute prerequisite of bulk handling. If grain is not graded, it cannot be bulked with other grain, but must retain its identity and be sampled frequently for selling purposes. The immense economy of the terminal storage system is only possible after dependable grading. Next, it provides the basis upon which organised marketing with future sales and hedging alone becomes possible. This forms the most economic machinery for financing the

> crop, paying cash to the farmer months before the grain is exported, holding it, transporting it and getting it to the miller. Finally, it provides the last buyer with a standard article upon which he may depend, in the same manner that buyers depend on the trade-mark of the manufactured goods of reputable firms.
>
> The main disadvantages from the point of view of a European buyer is the impossibility of disputing the grade and securing arbitration upon questions of quality or condition when once the grain is sold on grade for shipment abroad. It thus appears to be essentially a system of an exporting country. It only becomes a possible international system on certificate terms when experience shows (as it does) that the grading in the exporting country is entirely dependable.

Effect of Grading on Cost. The consumer buyer cannot be expected to be an expert in a large number of articles he generally buys. Naturally, if standardized articles are made available, it facilitates purchases on account of consistent and dependable qualities. The processors prefer graded raw materials for the manufacture and maintenance of standard quality goods. Vegetable oil mills can be cited as an illustration of this type of processers. Uniformity in quality seems to represent an important demand characteristic which is practiced at different stages; at the farm, in the market, at the processing point, etc. Since different services involved in effecting uniformity at various stages add to the cost of the article, the increase in cost is offset by the accruing advantages; viz., simplification of the marketing process by enabling the buyers to appraise the value of goods of known quality and expedient price determination and sales which contributes to better organization of the market.

Price Relationship. Goods belonging to the same type or variety tend to create intense competition between themselves as there is a great degree of substitutability. The buyers or consumers exhibit their preferences for particular goods provided they are able to recognize the characteristics associated with the qualities they are seeking. Thus there are special demands for goods with special charactoristics and this variation in demand creates difference in prices. A commodity, therefore, should be divided into such grades which are easily recognized to determine qualities which are of economic importance influencing demand. These grades should also lend themselves to practical testing in order to measure the quality characteristics to a good degree of accuracy.

Cross Elasticities of Demand. The quality difference between different grades being minor, there exists a high degree of substitutability which creates high cross elasticities of demand characteristics in grade price problem. According to Waite and Trelogan (25) cross elasticities of demand appear to be good but in practice they are difficult to analyze due to the fact that the related factors cannot be held sufficiently constant to provide a series of observations and that the available data are inadequate. The extensive use of grading in agricultural products and the controlled differentiation in individual goods, however, lead to some observations of a general nature applicable to substitutable goods.

Under monopolistic conditions the manufacturer exercises a good deal of latitude in fixing differences on account of the

control on supplies. Under those circumstances, one price policy may be related to differences in costs which may be total cost with each grade, incremental costs relating to the manufacture of the last unit and selected costs such as conversion cost exclusive of raw material cost. The decision as to which cost to use and what margin of profit to obtain will depend upon the nature of competition and the volume of demand for all products. The second group of price policies may be related to the differences in demand for similar and substitutable goods. The price differential will be influenced by the monopolistic position enjoyed, difference in elasticity in demand and other considerations such as the psychological effect a high priced line will have on demand.

Variation in Supply. Price differentials between grades are generally determined under more purely competitive conditions and less control of supplies. If the latter are uniformly increased in all grades, the demand for high grade product will comparatively show more decline in price than that in low quality. A stage may, however, come when the price differentials may disappear altogether. This is characteristic of deep depressions and to a certain extent of seasonal variations. Conversely, if the total supply falls in relation to the demand, the price differential is likely to widen between the grades. Under price controls which are generally associated with short supplies and all prices pressing against the ceilings, the price differences tend to disappear unless they are provided for by regulatory measures.

If the demand for particular quality characteristics remains unchanged as in the case of flour mills sticking to the preparation of certain flours which further depend upon certain blends of wheats, the fluctuation in the supply of a particular quality for which there is a constant demand will sometimes be reflected in wide price differentials. The fluctuation in the production of high test weight or high protein content wheat can be cited as an illustration. A decline in its production with the demand remaining unchanged will result in high premiums in price.

Maximum Returns to Growers. The elasticity of demand and the relative supply of goods are the two main factors which affect the price differentials between grades and consequently the total return to the grower. Waite and Trelogan (25) have summarized it in the following words:

> In the consumer market the demand curve of the better grades in consequence tends to be less elastic than the demand curve for the poorer grades. In the absence of marketing charges and in the absence of substitution of one grade for another, total returns to growers would then be increased most by limitation of the marketing of the better grades of the products. When marketing charges are high, however, demand curves at the grower level may be less elastic for the lower quality of product than for the better qualities. In such situations total returns to growers would be larger if the given quality reduction were applied to the better grades.

Besides elasticity of demand, the relative supply of one grade affects the demand for other grades. The restriction of high goods yields higher returns at the cost of high income group and the restriction of low grade goods may yield high returns

at the cost of low income group.

It may be concluded from the foregoing discussion that under normal competitive marketing conditions quality differences in products seem to bear a direct relationship with prices. Grading involves costs in various services rendered which are reflected and at the same time justified in proportionately higher prices for graded and standardized goods. Grading acts as a catalyst in the price determination mechanism, makes possible improved marketing organization and ultimately leads to savings in avoidable losses in marketing and improvement in the quality of goods produced. It tends to cater to the needs and requirements of varying economic interests and thus enhances the marketing efficiency to the benefit of both producer and the consumer. Without being inimical to the interest of the consumer, grading benefits the producer from savings in the cost of marketing products which may be of little use to the consumers or intermediaries in the market and by improvement in the quality and size of the poorer quality portion of the crop.

Historical Background of Wheat

The origin of wheat is shrouded in the antiquities as recorded history provides a rather poor commentary on the time and place of its beginning. Various writers interested in this internationally important cereal have made pointed references to the deplorable lack of historical records about its origin.

Fisher (9), for instance, has quoted the great Fronch naturalist, J. H. Fabre, whose remarks aro reproduced below:

> History celebrates the battlefields whereon we meet our death, but scorns to speak of the ploughed fields whereby we thrive; it knows the names of the King's bastards, but cannot tell us the origin of wheat. That is the way of human folly.

The historical ruins in the East, which tell a tale of the old civilizations, however, throw some light on the past history of wheat. In the Indo-Pakistan subcontinent, for example, wheat appears to have been cultivated from timos immemorial (20). Wheat grains unearthod from the 3,000 year old ruins of Mohan jo Daro in the Indus valley (Pakistan) have been identified as Triticum compactum (dwarf) and Triticum sphaerococcum. Wheat of this type is cultivated to this day in the dry districts of southwest Punjab, Pakistan. Klages (16) says: "It is quite remarkable that many of our (American) present crop plants were improved and grown by primitive people". By crop plants he moans wheat and barley. He substantiates his statement by quoting Braungart through Dettweiler (6). According to this source, the lakc dwellers of Switzerland living in the late stone age and the beginning of bronze age, that is from 4,000 to 2,000 B. C. produced various crops; for example, small lake-dwelling wheat, Triticum vulgare antiquorum, the so-called Binkel or club wheat, Triticum vulgare compactum, Egyptian or English wheat, Triticum turgidum, a dense eared awnless ommer, Triticum dicoccum, einkorn, Triticum monococcum, etc.

Another writer, Jacob (13) has traced the origin of wheat

to Abyssinia, Africa, which reads as follows:

> Wheat, however, became the king of grains and romains so to this day. Since its rise to the throno, it has never boen deposod. Schweinforth and Lcgrain found wheat in the graves of tho Neolithic age, which are as old as the sixth and fifth conturies before Christ. Tho Austrian scientist, Ungor, found husks and grains of whoat embeddcd in the bricks of Dashur Pyramid, which was built round 3,000 B. C. The Chinese cultivated wheat as early as 2,700 B. C. and had developod elaborato rituals to honour it. Mention of wheat by the Assyrians and Babylonians is found on tho stone ruins of Tello, which date from 3,000 B. C. Who brought tho grain to all these people and who developed it from the wild state? Was there a nation who actod as intermediary for the exchange of the seed - such as Syria, the land of merchants, who traded betweon Egypt and Babylonia? Wheat in Egyptian was called Botet, in Babylonian Battutu - the same word. But how then we are to explain its progress to China? Perhaps at some time in tho dim past there was a bridge of vegetation between the Near East and the Far East. Or perhaps tho seed travelled in the crops or stomachs of migratory birds. All riddlo, all surmise.
>
> But now we can say with fair assurance where the oldest wheat originated. It oxisted in Abyssinia, whence it descended into the hot river valley of the Nile from the high table land which is the river's source. The seemingly insoluble problem of the origin of whoat was ingeniously solved in recent yoars by the Russian scientist, Vavilov. Vavilov postulated that every living thing has a "gen centcr" - a dofinite source for the first specimen; and further that gen center has to be recognisod as the place where the greatest number of varieties have dcvoloped in the narrowest area.
>
> The whoat that grew in Egypt was hardly like the wheat that today covers the great fields of America, Canada and the Russian Ukraine. It was an early form of it, emmer wheat. The Romans bred othor wheats out of this original variety and planted these new varieties extensively in Egypt. The Romans established their perfected wheat as the predominant grain of tho Mediterranean world. From Roman times on its history is lucid and without enigmas.

Production - Seasons of Sowing and Harvesting

Commercial Importance. Wheat occupies the highest position among food grains and is unrivalled as a bread crop. This position of wheat is mainly due to its gluten contents which imprison the carbon dioxide produced in the fermentation action of yoast. It produces bread of white color, light in weight, soft and porous, of high net energy value and above all highly palatable. These characteristics qualify wheat for the enviable position it holds as the staple food grain of the most advanced nations in the world. In his famous presidential address to the British Assooiation in 1892, Sir William Crookes remarked:

> We are born wheat eaters. Other races.....are eaters of maize, rice, millets and other grains; but none of these grains has the food value, the concentrated health-sustaining power of wheat, and it is on this account that the accumulated experience of civilized mankind has set wheat apart as the fit and proper food for the development of muscle and brain.

Adaptability to Different Climates. Wheat is grown under a variety of climatic conditions. It is grown as a spring crop in the prairies of Canada and the northern most parts of the United States of America, where extremely low temperatures prevail during winter months, especially when there is no protective snow cover. Wheat may be grown as a winter crop under high temperature conditions provided the high temperature period does not coincide with high atmospheric humidity. As a matter of fact, the combination of high temperature and high humidity

is fatal to wheat. This phenomenon explains the almost absence of wheat production in the south eastern portion of the United States and the eastern part of Pakistan. The same factors account for setting up the northern limits of wheat production in Argentina, the eastern boundry of wheat belt in India and the expansion of wheat into southern China.

Sowing and Harvesting Seasons. On account of its inherent characteristics which render itself suitable for production in various climates wheat is extensively grown both in the northern and southern hemispheres. Due to the wide variations in the climates of different countries wheat is sown and harvested almost during every month in some country or the other; new wheat being available throughout the year. Table 1 shows the sowing and harvesting calendars for wheat.

Yield Per Acre. The world wheats fall under two main categories according to the time of sowing; viz., winter wheats and spring wheats (18). The former roughly accounts for more than three-fourths of the total wheat acreage and the latter less than a quarter. Out of the total spring wheat area, about one-half lies in Russia and the balance in the United States and Canada. Its proportion to the total wheat acreage in these countries roughly amounts to 65 per cent, 30 per cent, and 90 per cent, respectively.

The yield per acre varies from 5 bushels in North African deserts to 43 bushels in Denmark and Netherlands, the average for the world remaining almost unchanged over the years at 14

Table 1. Seeding and harvesting wheat in different countries of the world.

Country		Wheat	
		Seeded	Harvested
Europe			
Belgium	W	Sept./Oct.	July/August
	S	March/April	July/August
Bulgaria	W	Aug./Sept.	June/July
	S	-	-
Czechoslovakia	W	Sept./Oct.	June/July
	S	Feb./March	June/July
Denmark	W	Sept./Nov.	August
	S	March	August
Estonia	W	Aug./Sept.	July/August
	S	-	-
Finland	W	Aug./Sept.	August
	S	May	August
France	W	Oct./Dec.	June/July
	S	March/April	June/July
Germany	W	Sept./Oct.	July/August
	S	-	-
Austria	W	Sept./Oct.	June/July
	S	Feb./March	June/July
Greece	W	Oct./Dec.	June-July
	S	-	-
Holland	W	Sept./Dec.	August
	S	Feb./April	August
Hungary	W	Sept./Oct.	June/July
	S	Feb./March	June/July
Italy	W	Oct./Nov.	June/July
	S	Feb./March	June/July
Jugoslavia	W	October	July
	S	March	July
Latvia	W	Aug./Sept.	July/August
	S	May	August

Table 1. (cont.)

Country		Wheat	
		Seeded	Harvested
Lithuania	W	Aug./Sept.	July/August
	S	-	-
Norway	W	Aug./Sept.	July/August
	S	May	August/Sept.
Poland	W	September	July/August
	S	-	-
Portugal	W	Oct./Jan.	June/July
	S	Feb./March	June/July
Rumania	W	Sept./Nov.	June/July
	S	March/April	July
Russia	W	Aug./Nov.	July/Sept.
	S	March/May	Aug./Sept.
Spain	W	Oct./Nov.	June/July
	S	-	-
Sweden	W	Aug./Sept.	August
	S	March/April	Aug./Sept.
Switzerland	W	Sept./Oct.	August
	S	April	August
U.K. and Eire	W	Sept./Dec.	Aug./Sept.
	S	Feb./April	September
America			
Canada (Prairies)	W	Aug./Sept.	July/August
	S	April/May	Aug./Sept.
United States	W	Sept./Oct.*	May/June
	S	April/May**	Aug./Sept.
Mexico		Sept./Jan.	April/June
Argentina		April/August	Nov./Jan.
Uruguay		April/August	Nov./Jan.
Chili		May/August	Dec./Jan.
Brazil		March/July	Sept./Jan.

Table 1. (cont.)

Country	Wheat	
	Seeded	Harvested
Africa		
Algeria	Nov./Jan.	May/July
Morocco	Dec./Feb.	May
Tunis	Oct./Dec.	May/June
Egypt	November	April/May
South Africa	March/June	Nov./Dec.
S.W. Africa	April/July	Oct./Dec.
N. & S. Rhodesia	Jan./April	October
French W. Africa	June/August	Oct./Jan.
Equatorial Africa	June/August	Oct./Jan.
Gold Coast	-	-
Kenya	May/August	Nov./Dec.
Tanganyika	April/Mid June	July/Sept.
Nyasaland	May/June	July/Oct.
Nigeria	November	March
Mozambique	Feb./April	Sept./Oct.
Asia		
Cyprus	Oct./Jan.	May/June
Turkey	Oct./Nov.	July/August
Palestine	Nov./Jan.	May/June
Iraq	Oct./Dec.	April/June
Iran	Oct./Dec.	April/June
Afghanistan	Sept./Oct.	April
India# Punjab	Oct./Dec.	March/May
India Others	Sept./Dec.	Feb./May

Table 1. (concl.)

Country		Wheat	
		Seeded	Harvested
Burma		Oct./Nov.	February
Japan	W	Sept./Dec.	May/August
	S	April/May	August
Korea	W	Sept./Dec.	May/August
	S	April/May	August
Australia			
New South Wales		April/June	Oct./Jan.
Victoria		May/July	Dec./Jan.
Queensland		May/June	Oct./Nov.
South Australia		April/June	Nov./Jan.
West Australia		April/June	Nov./Jan.
Tasmania		June/July	Dec./Jan.
New Zealand	W	April/June	Jan./Feb.
	S	Aug./Sept.	Jan./Feb.

W = Wintor wheat.
S = Spring wheat.
* = Except Texas, seeded August/September, harvested May.
** = Except Minnesota, seeded February/March, harvested June/July.
# = India and Pakistan.

Source: Corn Trade News, Golden Jubilee, 1888-1938.

bushels. The outturn per acre of the main wheat exporting countries averages 16.2 bushels for Canada, 14.7 for the United States, 11.6 for Australia and 11.9 bushels for Argentina. In the United States wheat belt the average is: Kansas 13.6 bushels, Nebraska 15.5 bushels, Texas 11.3 and the Dakotas 10.9 bushels.

It will be interesting to compare the yield per acre of wheat in the main exporting countries with some of the net importing countries in Asia; e.g., India and a slightly surplus country, such as Pakistan. The average yield for the Indo-Pakistan subcontinent has been estimated at 10.6 bushels (20) as against 14.7 for the United States of America. In the Punjab, which comprises the main wheat belt in Pakistan, the yield per acre works out at 12.3 bushels. According to the same source, the yield per acre in India varies from 3.8 bushels in Hyderabad State in the south to 14.7 bushels in Bihar and Orissa in the north.

Total Production. The total annual production of wheat of specified countries for the triennium 1948-50 is given in Table 2. Accounting for the missing data and those for other countries not shown in the table, the total production of the world is estimated to vary from 6.27 billion bushels in 1949 to 6.42 billion bushels in 1948; the average for the period being 6.37 billion bushels. North America, Europe and Asia jointly account for 73 per cent of the total production; their respective shares being 24.9, 23.5 and 24.6 per cent. The next important producer is the U.S.S.R. (Europe and Asia) accounting

Table 2. Wheat crops of specified countries, 1950-49-48, in thousand bushels.

Continent	Country	Years		
		1950	1949	1948
North America	Canada	461,730	367,406	386,345
	Mexico	20,200	17,270	18,370
	United States	1,026,755	1,141,188	1,313,534
	Estimated total	1,509,000	1,526,000	1,719,000
Europe	Albania	-	-	-
	Austria	14,500	14,000	11,000
	Belgium	22,560	21,899	15,065
	Czechoslovakia	-	57,000	52,000
	Denmark	10,660	11,023	9,296
	Finland	11,800	11,900	10,200
	France	280,000	296,996	300,000
	West Germany	95,500	90,800	73,700
	Greece	33,070	28,094	30,931
	Ireland	12,000	14,560	18,500
	Italy	285,000	275,000	250,000
	Luxembourg	1,300	1,200	1,100
	Netherlands	12,000	15,627	11,235
	Norway	2,470	2,462	2,779
	Portugal	20,830	15,110	13,064
	Spain	140,000	110,000	110,000
	Sweden	27,120	25,615	25,806
	Switzerland	7,900	9,320	7,150
	United Kingdom	90,000	82,283	88,144
	Estimated total	1,530,000	1,505,000	1,455,000
U.S.S.R. (Europe & Asia)		1,110,000	1,100,000	1,025,000
Asia	Iran	72,750	58,790	70,730
	Iraq	20,210	18,370	11,020
	Lebanon	1,840	1,990	2,100
	Syria	25,720	20,000	24,130
	Turkey	170,200	195,000	145,000
	China	-	825,000	925,000
	India Union	228,107	204,288	201,190
	Pakistan	147,766	153,291	124,770
	Japan	49,160	47,656	38,250
	Estimated total	1,630,000	1,475,000	1,600,000

Table 2. (concl.)

Continent	Country	Years		
		1950	1949	1948
Africa	Algeria	38,500	39,000	38,500
	Egypt	41,000	45,000	41,500
	French Morocco	25,000	24,500	26,000
	Tunisia	17,270	20,100	11,000
	Union of S. Africa	-	14,340	17,540
	Estimated total	150,000	157,000	150,000
South America	Argentina	230,000	210,000	190,000
	Brazil	-	-	13,000
	Chile	33,880	30,530	40,910
	Peru	-	4,500	3,670
	Uruguay	13,000	16,607	18,810
	Estimated total	300,000	280,000	273,000
Oceania	Australia	190,000	218,106	190,703
	New Zealand	-	4,700	5,960
	Estimated total	195,000	222,806	196,663
Estimated World Total[1]		6,405,000	6,270,000	6,420,000

[1] Estimated world and continent totals include allowances for any missing data for countries shown, and for other producing countries not shown.

Source: Office of Foreign Agricultural Relations.

for 16.9 per cent of the total which is followed by South America, Oceania and Africa in the order of importance. It may be added that the average annual production during the period under review has shown an increase of slightly over 300 million bushels over the corresponding figure for the period 1935-39.

Qualities of Wheat Produced

General. Wheat has a very wide range of cultivation both from the point of view of latitude and elevation as it is one of the most adaptable of plants. Dr. E. A. Fisher (9) has stated this point so clearly and authoritatively that a quotation from his writings is pertinent:

> Although variety and, to a less extent, soil are important factors in determining quality in wheat, the climatic factors are so dominating that they should be clearly understood by students of milling.....The main climatic factors are winter temperature, summer temperature, annual rainfall and the way it is distributed throughout the year, relative humidity (i.e., the relative dryness or dampness) of the air, and the hours of day light and of sunshine throughout the growing and ripening periods. Again, these are not independent factors and their effects are due largely to the way in which they act together. Thus, it is not entirely the high rainfall that makes the wheat of the humid areas inferior, i.e., softer and weaker, in quality, but the combination of the factors-high rainfall, high relative humidity of the air and, in consequence of these two, lack of sunshine. As an illustration, it has been said that 'ripening is promoted in a dry air and a humid soil, but is retarded in a humid air and dry soil'. The influence of atmospheric humidity on the development and maturity of the wheat grain is most important, although not clearly understood. It is undoubtedly injurious if long continued, especially if it occurs near the time of ripening. Great and continued humidity delays maturity, retards protein production in the grain, thereby softening it, weakens the straw, and generally produces conditions favourable for the attacks of fungoid diseases.

Exporters and Importers. Wheat is cultivated in practically every country, but all countries are not self-supporting in this important food grain. Broadly speaking, the world can be divided into exporting and importing countries as there are a few countries who do not fall under either of these categories. The United States of America, Canada, Argentina, Australia, Russia, Pakistan and Danube basin countries (Rumania, Bulgaria, Jogoslavia and Hungary) comprise the main exporting countries; whereas, United Kingdom, Germany, Belgium, Holland, Italy, Switzerland, Spain, Portugal, Sweden, Norway, Denmark, Greece, India, China and South Africa are the main importing countries.

Qualities of Wheat Produced in the Main Exporting Countries. Canada occupies a place of distinction in the wheat world. It has the area, the soil and the climate suitable for wheat growing which have made it one of the greatest wheat growing and exporting countries of the world. In 1950, Canada had over 27 million acres under wheat and produced nearly 462 million bushels. The varieties of wheat grown are mainly hard red spring, although some winter wheats are also grown. The prairie provinces of Manitoba, Saskatchewan and Alberta produce the hard red spring varieties and the peninsula of Ontario the winter wheats. Spring wheats are recognized as the strongest wheats in international commerce on account of having a high protein content of excellent quality. The wheat kernels are plump in size and heavy in weight indicating high yield of flour. The color of the flour is white. According to an experiment conducted by the

United States Depsrtment of Agriculture (18) a number of years ago, the weight of bread prepared from a barrel of 196 pounds of flour from Canadian wheat amounted to 293 pounds against 289 pounds from that of United States and Russian wheats, 286 from that of Australian and 285 pounds from that of Argentina, English and Italian wheats. Thatcher, Marquis, Garnet, Reward, Red Bobs and Ceres are some of the important hard red spring wheat varieties. Dawson, a white soft wheat and Mindum, an amber durum wheat are also grown in Canada.

The United States of America produces many types of wheat on account of its large range of climatic conditions. Spring wheats are cultivated in the great plains to the north where conditions for the growth of strong wheats are admirable. These areas consist of north-central Iowa, Minnesota, North Dakota, and South Dakota. Farther south and in the north-central where winters are mild, autumn sowing of wheat with its increased production advantage takes place. The hard red winter wheat area covers Texas, the western part of Oklahoma, western Kansas, Nebraska and the northwestern corner of Missouri. The soft winter wheats are grown in Missouri, in the region of the Mississippi Valley, the states of Indiana, Illinois and Ohio. In these regions the climate is humid and mild, and hence suitable for the production of softer varieties. The fourth wheat producing region lies on the Pacific Coast being separated from the rest of the country by the Rocky Mountains. This area is predominantly a white wheat producing area. The climate and soil conditions are suitable for the production of both winter

and spring wheats.

Hard red spring, durum, red durum, hard red winter, white, mixed wheat and soft red winter comprise the seven commercial classes of wheat in the United States according to the Official Grain Standards. Most of these classes have two or three subclasses. Treating durums under one class, there are mainly five divisions. The proportion of each class in the production of wheat during 1950 (1) stood as follows:

	1,000 bushels	Per cent of total
Winter		
Hard red	471,079	45.9
Soft red	165,931	16.2
Total	637,010	62.1
Spring		
Hard red	207,304	20.1
Durum	36,795	3.6
Total	244,099	23.7
White		
Winter and Spring	145,646	14.2
Grand total	1,026,755	100.0

Wheat varieties grown in the United States of America are continually changing because of the development and distribution of improved strains by State and Federal Agricultural Experiment Stations (1) and by private breeders. According to the varietal survey there were 199 distinct varieties of wheat in 1949. The following are, however, some of the important varieties of each class:

Hard red spring:	Mida, Thatcher, Rival, Ceres, Roscuo, Marquis, Cadet, Pilot, Regent and New Thatch.
Durum:	Stewart, Mindum, Carleton, Pentad, and Kubanka.
Hard red winter:	Pawnee, Comanche, Triumph, Turkey, Wichita, Tenmarq, Westar, Early Blackhull, Cheyenne, Blackhull, Nebred, Redchief, Yago, Karmont, Chiefkan, Wasatch, and Kanard.
Soft red winter:	Thorne, Clarkan, Fairfield, Redheart, Vigo, Fultz, Fulcastor, Trumbull, Kawvale, Mediterranean and Austin.
White wheat:	Yorkwin, Elgin Alicel, Federation, Boart, Rex, Gold Coin, Golden, Cornell 595, Hymar, White Federation 38 and Lemhi.

Argentina is very much similar to Canada in having vast areas and comparatively small population resulting in a major portion of the wheat crop being available for export during a normal year. Since it lies in the southern hemisphere the wheat season there is just the reverse of what it is in America and Europe.

Barleta in Argentina is perhaps the oldest and most widely sown variety of wheat. It resembles the Turkey red wheat of Kansas, U.S.A., but is somewhat softer. Ruso is a commercial variety cultivated extensively in the western part of the province of Buenos Aires and in the territory of La Pampa. It is being replaced by Kanred and other improved varieties. Favorito is a commercial variety grown generally over the entire cereal zone of the country. It is a high yielder but inferior in baking qualities.

Under normal producing conditions, a major portion of the wheat produced in Argentina is exported. The export wheats have specific names. Rosafe is the commercial name given to wheat

grown in the regions of Rosario and Santa Fe, which is shipped by way of Rosario. It ranks high among South American wheats. It is semi-soft in character as it is produced under fairly moist climatic conditions. Barusso is Barleta or Ruso wheat shipped from the port of Bahia Blanca. It has its own character on account of the cooler climate in which it is grown. Baril is contraction for Barleta and Ruso. There is no special point for loading this wheat although it is generally understood that the wheat is shipped from Buenos Aires. Entre Rios is the name given to the wheat of the province of Entre Rios. It is usually a hard wheat of good milling quality.

In general the Argentine wheats are called Plate wheats. They are characterized by good baking quality and poor milling yield. Rosafe is used as "filler" in the United Kingdom. According to Shollenberger (24) the Argentine wheat which is mainly red consists of 16 per cent hard, 70 per cent semi-hard and 14 per cent soft. Average protein is 12.5 per cent.

Australia is one of the four important wheat exporting countries of the world. The chief wheat growing State of the Commonwealth is New South Wales, Victoria coming next in importance and is followed by South Australia and West Australia. Particularly all wheat shipped is of white variety, plump kernels and of high milling quality. The moisture content averages about 10.5 per cent, and the test weight ranges between 60 and 64 pounds. The protein contents are rather low.

Improvements in Australian wheats were carried out by the

late William Farrer. He achieved remarkable success in introducing the variety Federation which was produced in 1901. It became popular in 1910 and proved a success under wide range of conditions. It was still the leading wheat of Australia in 1925. Other Farrer wheats which were widely grown were Florence, Rymer, Bobs, Comeback, Bunyip, Firbank, Cleveland, Thew, Tarragon, John Brown, Warren, Plover, Schneider, Jumback, Jonathan, Genoa, Bomen and Clarendon.

Russia. Prior to World War I Russia was popularly known as the "Granary of Europe". In those days its annual exports far exceeded those of any other country. The vast range in the soil and climatic conditions of this immense country makes possible the production of different varieties and types of wheat. For instance, both winter and spring wheats are grown in the European Russia. Practically all Russian wheats can be classified as hard wheats, most varieties being red grained. Much research seems to have taken place in improving the wheat varieties, the popular new variety being known as "Ukrainka" which was selected from the Hungarian wheats. Other hard red winter varieties are Miltunum and Cooperatorka. Caesium is a hard red spring wheat. The durum varieties include Chernouska, Beloturka, Hordeiforme, Melanopus and Carnovka.

Due to the scarcity of data more detailed discussion about the qualities of Russian wheat is rather difficult. A general suggestion about their quality is made by Kent-Jones (15) which is reproduced:

> Before the war, Russian wheats were plentifully used by English millers, but since 1914 they have been scarce. A number of consignments have arrived this year (1926), however, and they appear to maintain their pre-war features. They are fairly glutinous, containing 10.5 to 13.5 per cent protein, although the gluten is of a flowy nature. They lack stability. They usually weigh 58 to 62 pounds (imperial) to the bushel. Rye is the important impurity, and unless removed before milling, tends to accentuate the lack of stability. The north Russian wheats shipped from Baltic ports generally have a higher moisture content and yield flour of less stability than south Russian wheats.

The Danube Basin comprises the territory covered by Rumania, Hungary, Bulgaria and Jugoslavia. The soil and climatic conditions of this area are suitable for wheat cultivation. With the moderate climate, winter wheat, with few exceptions, is characteristic in the Danube Basin. The types of wheat do not vary to any considerable extent, and in general they can be compared to some softer Russian wheats, with slight variation in the size and structure of the grain, due to environment and cultural practices.

In Hungary winter wheats are grown principally. The native wheats are said to be Eszterhaza, Hatvan, Bankut, Szokacs and Ozora. The first two varieties are soft red winter, the third hard red winter and the last two spring wheats. Rumania raises both winter and spring wheats. The principal area of production is along the Danube River. Two varieties Samanta 117 and Samanta 1252 were developed by the Samanta Society for seed and plant selections.

The native wheats in Hungary are relatively hardy but not high yielding. Eszterhaza No. 18 and Hatvan varieties are

alike, soft red winter wheats, Bankut as hard red winter wheat and Eszterhaza No. 163 as hard red spring. The milling quality was good for all these varieties except Eszterhaza No. 163 which had a lower quality. The flours were difficult in baking quality due to short fermentation time of dough, small size, poor color and coarseness of the loaf of bread baked from dough (3).

Pakistan. A country hardly five years old, carved out of old British India in August, 1947, is perhaps the latest addition to the list of wheat exporting countries of the world. Wheat is the second largest crop of Pakistan after rice and occupies about one-fourth of the total area under food crops. It is grown all over Pakistan but the areas of concentrated production are located in west Pakistan where it forms the staple diet of the people. The average annual production, after meeting the domestic requirements, leaves a sizable export surplus roughly amounting to 300,000 tons (long) or 11.2 million bushels (19).

Vulgare and durum are the two main species of wheat grown in west Pakistan; the provinces of the Punjab and Sind and the states of Bahawalpore and Khairpore being the main areas of production. These are almost entirely winter wheats. Vulgare type wheats have plump, medium size, fairly hard and amber colored grain, which yield a high outturn per acre. Locally they are known to the trade as sharbati on account of the amber color. In foreign commerce they are popularly known as 'Karachi wheats', Karachi being the port of shipment. The avorage moisture content does not exceed 10 per cent. Water absorption is good,

milling quality excellent and the dough prepared from them is extremely stable. As such, Pakistani wheats seem to be eminently suitable for blending with wheats having less stability. Some of the outstanding types of sharbati wheats which are cultivated on a fairly large scale in west Pakistan are 8A., C 591, C 518 and C 228. Durum wheats have a limited local commercial importance and their production is negligible.

It will not be out of place to refer to the qualities of wheat grown in the United Kingdom as it occupies a place of pre-eminence, being the largest single importer of wheat in the world. With its huge population of about 50 million, its wheat crop in 1950 was estimated at 90 million bushels. The quality of the wheat is influenced mainly by the climatic conditions; i.e., excessive rains and insufficient sunshine.

Common wheats of both spring and winter habits are grown, red and white varieties of the latter and red variety of the former type predominate. The red winter wheat Squareheads Master is the most widely grown and the most generally suitable for the different types of soil in England. Yoeman, also a red winter wheat, is unique among English wheats as the only variety that produces a flour suitable for making shapely and well-piled loaves of pleasant flavor without the addition of strong wheats from abroad. Other red winter varieties grown are Little Joss, Swedish Iron, Standard Red, Chevalier, Crown, Biffens Yoeman and Percivals Fox. White winter wheats although leas popular with the English farmer are grown to a certain extent; Gartons

Victor and Wilhelmina being the important varieties. Red Marvel is the most conspicuous among the red spring wheats, which is followed by April Bearded and Red Nursery in the order of importance.

The ordinary wheat of the United Kingdom is of the weak class eminently suitable for the manufacture of biscuit flour. According to Coleman and Shollenberger (3), the majority of the English wheats are not suitable for bread making. The flour lacks 'strength'. These wheats are of low protein content, low water absorption and of short fermentation time. They generally contain about 20 per cent moisture at the time of marketing. With the exception of Biffens Yoeman and Standard all English wheats produced a high percentage of flour.

International Trade in Wheat

The pattern of international trade is influenced by a number of factors both economic and political. The attitudes of the countries concerned in general and that of the dominant country in particular have contributed in a very large measure to the different patterns which prevailed during the last three or four centuries. The Mercantilist period was characterized by the "favorable balance" of trade idea, the balance being realized in precious metals, as well as particularism and protectionism. The Classical economists, led by Adam Smith, advocated free trade, adoption of gold standard, convertibility of currency,

multilateralism and in short universalism. The inter-war period, however, was characterized by bilateralism, discriminations, restrictions on imports, tariffs, quotas and the growth of inconvertibility and exchange controls. The post-war period has no doubt witnessed a trend and a serious attempt being made towards a reconciliation between the two extreme ideologies; i.e., universalism and particularism with a view to retain domestic autonomy and at the same time avail of the benefits of geographical specialization. The Havana charter and the "General Agreement on Tariffs and Trade", although unsuccessful so far, are by far the first and most serious attempts made in the right direction. The establishment of the International Monetary Fund and the International Bank for Rehabilitation and Development constitute the practical progress made so far in this direction.

Of the main exporters of wheat, Russia, which was regarded as the "Granary of Europe" and was the largest exporter in the pre-war period, receded to the backgrounds in the post-war years; during this period its exports became erratic and were not of very great significance, at least to western Europe. Since World War II, it has almost disappeared from the international wheat trade sphere. The four Danube Basin countries which contributed considerably to the inter-European wheat trade, particularly eastern and western Europe up to the beginning of the last war have gone the Russian way. The position of India has reversed, from an important exporter up to World War I to that

of the second largest importer in 1951. Pakistan, a young country carved out of old India, has emerged on the scene with a sizable export surplus. France, one of the largest wheat growing countries occupies a peculiar position. The home crop generally nicely balanced to domestic requirements results in France being either a small importer or a small exporter.

The international trade in wheat and wheat flour in terms of wheat during the period 1949-51 and the average for the quinquennium 1934-38 is given in the following table. The United States of America, Canada, Australia and Argentina are the main wheat exporters. The total quantities of wheat entering the international trade have increased from 12 million tons (440 million bushels) during 1934-38 to nearly 27 million tons (991 million bushels) during 1951, an increase of about 125 per cent (Table 3). In the pre-war period Canada was by far the largest exporter, followed by Argentina, Australia and the United States of America in the order of importance. During the last triennium the United States of America has assumed the position of the largest exporter followed by Canada, Australia and Argentina. Argentina's exports show a slight fall as against a similar rise in Australian exports. Canadian exports have nearly doubled and those of the United States of America have recorded a phenominal increase in 1951, amounting to over twelve times those of 1934-38 period.

More than 50 per cent of the total wheat entering the international trade during the last three years has been accounted

Table 3. Wheat and wheat flour (wheat equivalent), in thousand metric tons.

Country	Years			
	1934-38	1949	1950	1951
	Exporting			
Argentina	3,349	1,837	2,750	2,450
Australia	2,919	3,255	3,273	3,517
Canada	4,793	6,917	5,641	7,871
United States	1,036	11,037	6,513	12,863
Total	12,097	23,046	18,177	26,701
	Importing			
Europe				
Belgium	855	628	658	1,035
Germany (F. Rep.)	161	3,085	1,246	2,603
Greece	246	543	421	618
Norway	132	168	209	301
Italy	339	1,720	886	1,643
Netherlands	586	424	667	942
United Kingdom	5,655	5,515	3,780	4,820
Others	640	2,063	1,629	2,088
Total	8,620	14,146	9,496	14,050
North & Central America, Total	647	1,064	1,173	1,879
South America				
Brazil	962	833	1,148	1,305
Chili	13	5	123	241
Peru	115	232	244	204
Venezuela	33	124	155	177
Others	107	167	262	258
Total	1,230	1,361	1,932	2,185
Asia				
India	-	1,695	1,593	3,322
Indonesia	110	88	74	189
Japan	305	2,120	1,403	1,649
Philippines	125	258	227	246
Others	717	1,187	865	1,303
Total	1,257	5,348	4,162	6,709

Table 3. (concl.)

Country	Years			
	1934-38	1949	1950	1951
		Importing		
Africa, Total	212	747	989	1,482
Oceania, Total	73	199	163	206
Other areas, Total	58	181	262	190
Grand total	12,097	23.046	18,177	26,701

Source: Food and Agriculture Statistics, FAO.

for by the European countries, followed by Asia, South America, North and Central America, Africa, Oceania and others in the order of importance. The United Kingdom is the single largest importer of wheat in the world, its intake having varied from slightly over one-half during 1934-38 to one-fifth during 1951. Other important importers in west Europe are Germany, Italy, Belgium and Netherlands. Among the Asian countries, India is perhaps the largest buyer of wheat, obviously the second largest in the entire wheat trade, Japan is the second largest importer of wheat in the Asian countries.

THE PRESENT STANDARDS

The United States of America

General. The grain grading system in the United States of America is approximately one century old. Tho first attempt at grading was made by the Chicago Board of Trade in 1856 (4). The standard wheat grades fixed were "White", "Red", and "Spring", with prime quality and variations from prime qualities to be specified. After a year or so the Board appointed the grain inspectorate. The markets at Toledo, Detroit, Cleveland and St. Louis followed the lead given by Chicago and introduced grading.

At every market the determination of grades was influenced by the dominating interests, such as millers, warehouse owners,

brokers and commission agents which resulted in the adoption of grades characterized by wide variations. The terms used were ambiguous and confusing. The use of the discretionary powers vested in the grading staff was not above reproach. This state of affairs led to the passage of a law in the State of Illinois for uniform inspection of grain all over the State. During the seventies and eighties of the nineteenth century grain grading spread to other centers and nearly one dozen Boards of Trade established their own grades and inspectorates. The remaining states followed suit. In 1916 there were 64 points in the United States where grain was inspected and graded and 30 different states or trade bodies had established grain standards. It is important to note that no two sets of rules were exactly alike which resulted in an unsatisfactory state of affairs in the local as well as foreign trade. The first attempt for having a national legislation was no doubt made in 1892, it was not until 1916 when the Congress passed the Grain Standards Act which is in force today with a number of amendments incorporated subsequently.

The important features of this Act (5) consist of the provisions relating to (1) the establishment of official grain standards, (2) the Federal licensing and supervision of the work of the licensed grain inspectors and (3) the entertaining of appeals from the grades assigned by the licensed inspectors. The Secretary of Agriculture is authorized to make investigations and to establish Federal Standards for the more common

grains.

Grain Inspection Under the Act. Federally licensed grain inspectors are either employees of the State or trade organizations such as the Board of Trade. There are some who work independently for fixed fees which are paid by those who avail of their services. The Federal Government does not employ the licensed inspectors. The United States Department of Agriculture, however, employs grain grading supervisors who look after the work of the licensed inspectors. They are stationed at important assembling and distributing centers. They also attend to the appeals from the grades assigned by the licensed inspectors. The Grain Standards Act in part makes it possible to get all grain graded by licensed inspectors which is shipped in interstate or foreign commerce from a point where such an inspector is located if the grain be merchandised by grade.

Sampling. The drawing of a correct and representative sample is an essential prerequisite to scientific grading. The departmental instructions issued to this effect provide for a sample of approximately not less than two quarts or say five pounds. In the case of bulk grain in a car, truck or wagon, the sample is taken with a double tube compartment trier 62 7/8 inches long by probing it at not less than five places well-distributed in different parts of the car. Each probe is emptied on a piece of canvas and the grain representing different layers examined. If the grain drawn from different parts and layers of the car does not show any marked difference, the grain

from different probes is mixed to represent an average sample.

A sampler has been developed in the Pacific Northwest for cutting the grain stream as it falls from the truck. The sample from bulk grain in bins where sample drawing is associated with risk and hazard is taken from the falling stream of grain pouring into or from such bins. The instrument used is called a spout sampler or 'Pelican'. For drawing samples from sacks a trier of sufficient length as to reach the center of the sack is used. The number of sacks to be selected at random depends upon the wishes of the sampler who attempts to obtain a representative sample.

Wheat Classes. The determination of the class to which a particular sample belongs depends upon the knowledge and experience of the grador as there is no mechanical test for this purpose. On account of the ecological factors certain classes of wheat are produced in particular areas of the States. The grader has, therefore, to rely on his knowledge about the distribution of production of wheat in addition to its color, kernel structure and variety. According to the Standards Act, wheat has been divided into seven classes; viz., Class I, Hard Red Spring Wheat; Class II, Durum Wheat; Class III, Red Durum Wheat; Class IV, Hard Red Winter Wheat; Class V, Soft Red Winter Wheat; Class VI, White Wheat, and Class VII, Mixed Wheat. The Act provides that wheat of any class except mixed wheat may contain not more than 10 per cent of wheat of a different class or classes either singly or combined. It may be

added that the number of classes has increased gradually as a result of the variation in quality due to the increased number of wheat varieties and production conditions and the diversified requirements of the baking trade.

Subclasses and Texture. With the exception of Red Durum, each class of wheat is further divided into a number of subclasses ranging between two and four. This division is based on the texture of wheat which refers to the hardness or softness of kernels. Hardness in wheat kernel indicates glutenous and softness starchy characters. It is specified in terms of "dark, hard and vitreous kernels" in case of Hard Red Spring and Hard Red Winter wheats, in terms of "hard (not soft and starchy) kernels" in case of White wheat and in terms of "hard and vitreous kernels of amber color" in case of Durum wheat.

Standards and Grades. The United States Official Standards (10) for wheat consist of (a) test weight per bushel, (b) damaged kernels (wheat and other grains), (c) foreign material and (d) wheats of other classes. Each class of wheat has been divided into five numerical grades and the sixth "sample grade". These grades specify minimum test weight per bushel and the maximum limits of the remaining standards. The "sample grade", however, covers wheat which does not meet the requirements of the five numerical grades and contains moisture more than 16 per cent in the case of Hard Red Spring and Durum wheats and 15.5 per cent in case of other classes of wheats. Dockage (separable foreign material) and moisture content do not

form the basis of each of the five numerical grades separately. These, however, form a collective basis for all the numerical grades. In addition, there are special grades; e.g., tough wheat, smutty wheat, garlicky wheat, weevily wheat, ergoty wheat and treated wheat.

Basis for Grade Determination. The official grain standards provide that each determination of dockage, temperature, odor, garlic and live weevils or other insects injurious to stored wheat shall be upon the basis of the grain as a whole. All other determinations shall be upon the basis of the grain when free from dockage. All determinations that are based on fractional parts of a sample are made on standard-sized portions cut from the sample by means of the "Boerner divider". Percentages except in the case of moisture, shall be percentages ascertained by weight.

Test Weight per Bushel. Plumpness of grain has been considered both by producers and consumers as an important quality factor. This is indicated in a general way by the test weight per bushel of wheat expressed in terms of pounds per measured (struck) Winchester bushel (2,150.42 cubic inches). The millers prefer wheat of high test weight per bushel as it is an important index of pounds of flour that may be milled from a bushel of wheat; the wheat of high test weight generally yielding large amount of flour and wheat of low test weight yielding smaller quantity of flour.

A standard weight per bushel apparatus known after the name

of E. G. Boerner who designed it according to the specifications of the United States Department of Agriculture is used for conducting this test. In case of wheat approximately 1 1/8 quarts of dockage free grain are used. One-quart bucket of the apparatus is placed beneath a funneled hopper having a capacity of 1 1/8 quarts of grain. The bottom of the hopper has an opening of 1 1/4 inches in diameter and is fixed at a distance of 2 inches from the top of the bucket. The grain is allowed to pour into the bucket until it overflows. The bucket without being moved or jarred is levelled off with a special, smooth, round edge stick in 3 zigzag strokes. The minimum test weight for the top most grades of all classes of wheat is specified 60 pounds which gradually decreases in case of each subsequent grade according to the class charactoristics.

Shrunken and broken kernels in a sample of high test weight wheat reduce its commercial value and their presence, therefore, is considered objectionable. Shrunken and broken kernels may be found in all classes of wheats, but Hard Amber Durum is generally most subject to broken kernels on account of its extreme hardness. The official standards specify limits to the presence of these kernels in the three top grades of dockage free grains. The standards provide 7 per cent limitations on the first two top grades and 10 per cent on the third top grade on the presence of shrunken and/or broken kernels. The latter are further qualified by the provision that they include shrunken and/or broken kernels of grain and other matter that will pass through

a 20 gage metal sieve with slotted perforations 0.064 inch wide by 3/8 inch long (small chess sieve). In case of Durum and Red Durum the limits comprise not only those shrunken and/or broken kernels which pass through the specified sieve but also those who remain on the sieve. The combined corresponding limits for these two classes are 10 per cent and 15 per cent.

Damaged Kernels (Wheat and Other Grains). Soundness is an important quality factor which is indicated by the absence of objectionable foreign odors and the quantity of damaged kernels. The Official Standards for No. 1 grade of different classes of wheat allow a maximum of 2 per cent of damaged kernels with a tolerance of higher percentages in the subsequent grades below No. 1.

Damaged kernels may be divided into two types, field damaged and storage damaged. The former may be further divided into preventable and non-preventable damage. Grade loss due to sprouted grain, stack-stained, ground-damaged and weather-damaged kernels and damage due to such fungus diseases as smut are more or less preventable. Frost damage and such fungus damage as scab and cobrot are rather non-preventable. Damage which is caused by defective storage is preventable. It includes heat-damaged, weevil-damaged and moldy grain. There is no mechanical test for determining the damaged contents of wheat. The inspectors are, however, trained to identify each type of damage with the aid of type samples and official interpretations of the same supplied to them.

Damaged kernels of wheat advorsely affect the milling and baking qualities of wheat. Frosted wheat, for instance, when the entire seed coat is affected, yields flour of a poor dough quality. Heat-damage is highly objectionable as the flour produced from such wheat is of very poor color and the bread prepared from it is small in volume, the crumb is discolored, the texture poor and the broad emits objectionable odor besides being less palatable. Under the damaged kernels tolerance, therefore, special limits for heat-damaged are particularly provided for in the Official Standards.

Foreign Material. The foreign matter that cannot be removed as dockage in wheat is called "foreign material". It generally consists of larger seeds of buck wheat, vetch, corncockle, Kinghead, wild rose, chess, quackgrass, small kernels of barley, oat groats and other seeds and grains similar in size to wheat kernels. These impurities are objectionable as they affect the milling and baking qualities of the flour. The presence of rye in wheat, for instance, affects the yield of the flour as well as the color of the flour. The presence of foreign matter other than grains; e.g., corncockle, is perhaps more objectionable. It has an adverse effect on the volume, color and texture of the loaf and may even reduce the water absorption quality of the flour. Particles of outer coating of corncockle may appear as black specks in flour prepared from wheat contaminated with corncockle. In the official grades special limits for this type of foreign material known as "matter except other grains" have been provided. Sieves are generally used in addition to hand

picking in the separation of foreign material from the usual 50 gram dockage free sample.

Wheats of Other Classes. The classes of wheats are based on general characteristics which include the color, shape and length of kernel, and the shape of the germ, crease and brush. Some varieties possess charactoristics of two or more classes of wheat. Knowledge of variotal characteristics is, therefore, essential for determining wheats of other classes. The official numerical grades allow a total tolerance of 5 to 10 per cent of wheat or classes other than the one being graded. It will be noted that the mixture of Durum and/or Red Durum in wheats of other classes and that of Soft Red Winter wheat and Red Durum in Durum is more objectionable due to the quality differences. The official grades, therefore, provide special limits for them under the main standard.

Dockage. It includes weed seeds, weed stems, chaff, straw, grain other than wheat, sand, dirt and any other foreign material which can be removed readily from the wheat by the use of appropriate sieves and cleaning devices such as Carter dockage tester, electrically operated. Dockage also includes underdeveloped, shrivelled and small pieces of wheat kernels removed in properly separating the foreign material, and which cannot be removed by proper rescreening or recleaning. The quantity of dockage is calculated in terms of percentage based on the total weight of the grain including the dockage. The percentage of dockage is stated in terms of whole per cent, fraction of a per cent being disregarded. Dockage when less than one per cent is not at all

mentioned. Although dockage is mentioned along with the grade designation, it does not form the basis of the grade; no maximum limits being fixed as in the case of foreign material or damaged kernels.

Moisture Content. Dryness in wheat is an important quality factor, as wheat which contains moisture in excess of its normal air dry condition is unsafe for storage, especially when it is stored at high temperature. Moisture in wheat up to 14 per cent is considered safe. Any excess over this limit is likely to spoil it in storage or transportation. Damp grain is unsuitable for milling purposes. Damp flour cannot remain cool and sweet in storage. Air oven is specified as the official tester for determining the moisture content in wheat. In practice, however, the moisture content may be determined by any device which yields results equivalent to those obtained by air-oven test. There are two moisture testers in use which give quicker results than the air-oven method.

One of these rapid moisture testers is known as "Tag-Heppenstall Moisture Meter". It is electrically operated and is used by all Federal Supervisors and most of the licensed inspectors. One-hundred-fifty grams of wheat are passed between two roller electrodes. The meter measures the electrical resistance of the grain as it passes between these electrodes. The electrical resistance is converted into percentages of moisture by means of conversion tables and a set of instructions in this respect. The second type of rapid tester in use is known

as the "Brown-Duvel Moisture Tester". One-hundred grams of wheat are mixed with 150 cubic centimeters of suitable engine oil in a distillation flask. Heat is then applied and the water is distilled into a graduated cylinder to determine the percentage quantity of moisture in the grain. Like dockage, moisture also does not form the basis of the individual five numerical grades. It is, however, basic to the determination of special grades; viz., sample grade and tough wheat grade.

Special Grades. The Official Grain Standards provide for special grades as the numerical grade does not always indicate the real commercial value of the grain. Special grades designate superior quality as in the case of high test weight per bushel, general appearance of the grain and size of the kernel. Terms indicating superior quality are suffixed to the grade number; e.g., No. 1 Heavy. Special grades also indicate conditions resulting from deterioration or change in quality such as due to weathering, excess moisture, artificial treatment; e.g., chemical bleaching or mechanical scouring; it also denotes the presence of live insects injurious to stored grain or the presence of garlic, ergot or smut. These terms are added to the grade designation following the class or subclass name; e.g., No. 1 Amber Durum, Tough, Smutty, Ergoty, Dockage 2 per cent. The analysis of the sample for the purpose of applying a special grade is based on the sample as a whole as in the case of garlicky wheat or on the grain when free from dockage, as for instance, Treated and Tough wheat.

Grading Equipment. Uniformity in the methods of analysis of wheat is essential in order to obtain comparablo results in assigning grade designations. This can be better achieved by the use of standard apparatus as individual judgment is more likely to vary from person to person. In the United States a number of standard apparatus is being used to obtain uniformity in the methods of analysis as well as to save time and labor. Some of these apparatus are mentioned below:

1. Probes. These are usod for drawing samplos of wheat. The standard probe used for sampling bulk wheat in cars is double-shell slotted brass probe 62 7/8 inches long. Between each slot the inner shell (tube) is separated by partitions so that each slot is the entrance to a separate compartment. The "bag trier" is used for drawing samples from sacked wheat. Its length varies from 6 inches to 12 inches.

2. Spout Sampler or "Pelican". It is used to obtain sample from a falling stream of bulk grain and enables the sampler to obtain complete cross sections from the stream of grain. The stream of grain is cut at frequent intervals and the samples so obtained are mixed and roduced in size by means of a "Boerner divider".

3. Moisture Testers. The elocttric moisture meter known as "Tag-Heppenstall Moisture Moter" and the Brown-Duvel Moisture Tester aro most commonly used for determining the moisture content of wheat. Air-oven is the official standard for measuring moisture in wheat and the above-mentioned two testers which are

more rapid give results equivalent to those of air-oven method.

4. Sample Divider. In order to obtain a thoroughly representative sample for fractional analysis "Boerner Divider" is used to reduce large sample to smaller samples.

5. Test-weight per Bushel Apparatus. There are several types of this apparatus which can be used for measuring test-weight per bushel. The official type is the one designed by Mr. Boerner according to the specifications as laid down by the United States Department of Agriculture.

6. Balances. In the analysis of wheat samples, two types of balances, large size and small size, are used. The latter is used for weighing analytical separations, such as damaged and heat-damaged grains and samples weighing up to 50 grams. This balance should have a graduated beam to read 1 gram and fractions of a gram and sensitive to one-hundredth of a gram. A set of weights from one gram to 50 grams should be provided for for this type of balance. The former or the large size scale is used for weighing samples in excess of 50 grams, such as those tested for dockage and moisture. It should have a graduated beam sensitive to one-tenth of a gram and with a set of weights from 1 gram to 1,000 grams.

7. Dockage Tester. Cartage dockage tester is in common use for separating dockage from wheat. It is equipped with specially constructed sieves or riddles and is electrically operated.

8. Sieves. A set of standard hand sieves prepared from

metal 0.032 inch thick is required to supplement the machine sieves or riddles of the Cartage dockage tester. These sieves should be 13 inches in diameter and of the shape that they will nest freely with each other and with a bottom pan. The perforations of sieves require frequent checking by means of 'go' and 'no go' cylindrical plugs. A tolerance of plus or minus 0.005 inch is allowed.

(a) Fine Seed Sieves. These sieves have round hole perforations 1/12th inch in diameter and are used for removing fine seeds, such as mustard in dockage determination in wheat.

(b) Small Buck Wheat Sieves. These have equilateral triangular perforations, the inscribed circle of which is 5/64 inch in diameter. These are used for removing wild buck wheat, pigeon-grass and seed of similar size in dockage determination of wheat.

(c) Small Chess Sieve. It has slotted perforations 0.064 inch wide by 3/8 inch long and is used for removing long-seeded flax seed from wheat.

(d) Large Chess Sieve. It has slotted perforations 0.070 inch wide by 1/2 inch long and is used for removing chess seeds, quackgrass and similarly shaped seeds from wheat.

Canada

General. The history of wheat standards in Canada is about like that of the United States of America. During the 19th cen-

tury various produce exchanges and trade associations introduced different sets of standards with a view to improve the marketing of wheat. The necessity for a uniform yardstick of quality for wheat was felt throughout the wheat producing areas of the country which resulted in the appointment of a Chief Inspector in 1904. Further progress was made in 1912 when the Dominion Parliament passed an Act, which, however, had to be revised in 1930 to meet the changed conditions in the marketing of wheat. This Act is called the Canadian Grain Act, 1930, and is still in force with a number of amendments made subsequently.

Under this Act statutory grades (12) for wheat have been fixed by the Act of the Parliament. The Board of Grain Commissioners created under the same Act administers grade standards in addition to the control of warehouses, transportation and the licensing of dealers. The Board also fixes commercial standards every year through its Grain Standards Committee based on the quality of the crop. "Off" grades are also fixed which include all wheats which do not meet the requirements of statutory or commercial grades. It may be added that grade standards are fixed separately for Western Canada and Eastern Canada. The following discussion is based mainly on Western Canadian Standards as Western Canada accounts for nearly 95 per cent of the total production of wheat in this country.

Grain Inspection and Appeals. The Board of Grain Commissioners maintain an inspectorate for drawing samples of grain

and analyzing the same for assigning grades. In December, 1951, there were over 120 inspectors under the supervision of a Chief Inspector. Unlike the inspectors in the United States of America, they are all employed by the Government. The Chief Inspector's office is located at Winnipeg, Manitoba. The inspectors are posted at all the terminal elevators. They are provided with standard samples of wheat every year by the Western Committee on Grain Standards for their guidance. This Committee which consists of representatives of producers, millers, warehousemen, Chief Inspector, Chief Chemist, chairmen of the Grain Appeal Tribunals, Chief Dominion Cerealist and the Board of Grain Commissioners meets annually as soon as possible after the first day of August to select and settle standard samples for each statutory grade. The committee also names and defines all such commercial grades of Western grain as, in its opinion, it is advisable to establish for the current crop year and selects and settles the standard samples representing the minimum of each of such commercial grades.

The shipper has the option to ask for a reinspection and/or lodge an appeal against the grade analysis made by the inspector with the Grain Appeal Tribunal. Appeal Boards in the Western Canada are situated at Winnipeg, Calgary, and Edmonton. Each Board consists of eight members, including the chairman, who is an independent salaried official. Appeals can, however, be lodged with the Board of Grain Commissioners if the decision of the Appeal Tribunal is not satisfactory. The Board conducts

investigations through its Assistant Commissionors without any cost to the farmer.

Sampling. The method of sampling is almost the same as explained under the Standards of the United States of America with the exception that the Canadian probe is 72 inches long instead of 62 7/8 inches in the United States. The minimum number of probes also differs which is 7 in Canada as against 5 in the United States. It may be noted that where impurities in any of the 'off' grades are designated by count, the official sample size is based on 500 grams or 17 1/2 ounces.

Classes or Types. Statutory grades are based on particular classes or types of wheats which are: Red Spring wheat, Garnet, White Spring wheat, Winter wheat and Amber Durum. Commercial grades may cover more than one class; e.g., Red or White Spring or Winter. 'Off' grades, however, are based on Red Spring, Garnet and Durum.

Grading Factors. The main grading factors are: (a) Weight per Measured Bushel, (b) Variety, (c) Hard Vitreous Kernels, (d) Soundness, (e) Purity and (f) Moisture Content. With the exception of weight per measured bushel, purity and moisture content the grain is evaluated for grading mainly on a system of visual inspection. The Statutory Grades are six each for Red Spring wheat and Amber Durum, three each for Garnet and Winter wheat and four for White Spring wheat. The Commercial grades, however, ranged from one to five during 1951-52. Their number may fluctuate with the condition of the crop every year.

Weight per Measured Bushel. It is the same as "Test Weight per Bushel" under the United States Official Grain Standards. It indicates plumpness and milling value of the grain; i.e., the amount of flour that can be made from a bushel of wheat. The apparatus used is more or less of similar design; i.e., beam and bucket, but the difference lies in the unit of measurement; viz., the bushel. In the Canadian system the bushel used is Imperial, whereas in the United States it is the Winchester; the former being approximately 3.2 per cent larger than the latter. The bucket used in Canada is the Imperial Pint Kettle and a round rod used as the strike-off-stick. Minimum weight per measured bushel is fixed for each grade. Under the Statutory grades the top most grades in respect of Red Spring wheat, Winter wheat and Amber Durum wheat are assigned 62 pounds each and those for Garnet and White Spring wheat 60 pounds each. A sliding scale is, however, used for the lower grades, the lowest being 53 pounds for Red Spring wheat No. 4 Special Grade.

Variety. Certain varieties of wheat have some inherent quality characteristics which account for their commercial valuation. The Canadian Standards are perhaps the only standards which permit or prohibit the inclusion of certain varieties in the top grades. In the case of Red Spring wheat, for instance, "Marquis or equal to Marquis" variety or varieties are allowed in the three top grades. Similarly in the two top grades of Amber Durum, "Mindum or equal to Mindum" variety is allowed.

Hard Vitreous Kernels. The percentage of hard vitreous kernels indicates the quality of wheat as it is an index of gluten content in wheat kernels; the gluten content varying in direct proportion to the quantity of hard vitreous grains. As such, common and Durum wheats command blending value for bread making and macaroni, respectively. The presence of piebald and starchy kernels, on the other hand, degrade wheat according to grade definition. The minimum of hard vitreous kernels in the top grades of Red Spring wheat and Durum is 80 each, of Garnet 75, White Spring 65 and Winter wheat 60 according to the Official Statutory Standards. This grading factor appears to be the counterpart of subclass in the American standards for wheat. The main difference is that the stipulation of a certain minimum percentage of hard vitreous kernels in American standards constitute the subclass which does not form the basis for individual grade, as it is the same for all numerical grades. In the Canadian Standards, however, the percentage of hard vitreous kernels is basic to the various grades.

Soundness. In grade definitions it is designated as "The Standard of Quality". Soundness is affected by disease (smut, smudge or black point), weather (excessive moisture, sprouted, frosted, bleached or improperly ripened), storage (heated, musty or bin burnt), and mechanical damage (cracked, broken or peeled). The terminology used as the grade basis is rather indefinite; viz., well matured, reasonably well matured,

practically free from damaged kernels, reasonably free from damaged kernels, etc. The absence of a special tolerance for 'heat damaged' in the Canadian standards indicates that it does not constitute a serious problem there as it is in the United States.

Purity. Impurities such as small seeds, broken kernels and trash which can be easily removed in cleaning are called dockage and expressed as percentage. Wheat containing mixture or impurities which are capable of being cleaned and have value is graded as C.C. grades (cleaned until clean). Impurities which cannot be removed by cleaning adversely affect the grade of wheat and cause it to be degraded, rejected or placed in the mixed grades according to the proportion of impurities. The limits fixed for "matter other than cereal grain" in respect of different statutory grades are a bit loose; e.g., practically free and reasonably free. In the case of American standards, however, definite limits for the total foreign material and special limits for "matter except other grains" have been provided for.

Wheat of Other Classes or Varieties. Due to the inherent varietal quality characteristics the mixture of different varieties is discouraged as it tends to lower its commercial value. Total as well as special limits have been fixed for different grades. Special limits have been provided for in respect of Durum in common wheats and Red Durum in Amber Durum.

Moisture Content. The provision for moisture content is

almost the same as in the case of United States Standards already discussed. For routine grades a moisture content of 14.5 per cent is permitted. Moisture in excess of this limit degrades the grain.

Commercial Grades. These grades are fixed every year by the Grain Standard Committee. They relate to the grain which does not meet the requirements of the Statutory Grades on account of defects in quality due to the climatic or other conditions.

Off Grades. Wheat which does not meet the requirements of the Statutory or Commercial grades is designated as "Off" grade. The main causes are excessive moisture, foreign odors, heated, bin-burnt, musty, frosted, sprouted, smutty or cracked kernels and admixtures of other grains or foreign material, such as gravel, Ragweed, Tartarian wheat, etc. These grades are designated as follows:

1. Rejected and Sample Grades. Those grades include all wheat excluded from the above two main categories of grades on account of damage, foreign odors, excessive mixtures of other grains or other foreign matter.

2. Smutty Grades. It includes all grain which has an unmistakable odor of smut or which contains smut balls or smut spores.

3. Tough Grades. These grades include all wheat containing over 14.5 per cent and up to 17 per cent moisture.

4. Damp Grades. These grades include all wheat contain-

over 17 per cent moisture which is unfit for warehousing.

Grading Equipment. The mechanical aids used in connection with the grading of wheat in Canada (26) are almost the same or designed on the same principles as those used in the United States of America. Probes and triers, for instance, are of the same design and based on the same principle with slight difference in their lengths. Brown-Duval type is used as the official moisture tester which is fairly common in the United States of America. The sieves used for cleaning are No. 10 wire sieve and No. 5 zinc buck wheat sieve. Cowan dockage tester and Emerson dockage tester are used for separating wild oats and Durum wheat, respectively. The principal scale used for percentage readings in dockage tests is the 500 gram scale. For determining test weight per bushel an Imperial Pint Kettle is used.

Australia[1]

Australian wheat unlike the Canadian or American wheats is almost of one class; i.e., white. The incidence of diseases and the admixture of foreign seed are also comparatively less. These circumstances appear to explain to a great extent the

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[1] Information was supplied by Mr. A. C. B. Maiden, Commercial and Agricultural Attache, Australian Embassy in the United States of America at Washington, D. C.

absence of an elaborate grading system for wheat in Australia.

The quality standard for wheat prevalent in Australia is known as the f.a.q. (fair average quality) which is fixed in different states each year based on the representative samples of the season's crop. It is simply the average sample arrived at from the representative samples of the States' crop. These samples are drawn from different wheat districts in the State, given an appropriate statistical weight, mixed together and then the f.a.q. is the average sample drawn from the representative mixture of the samples of the State wheat crop. The f.a.q. is fixed by the Corn Trade Section of the Chambers of Commerce in the various States. These Chambers of Commerce are private organizations, those located in big cities, generally have grain section which deals with the fixation of the f.a.q. standard. It represents the standard for the State for the season and may vary from season to season and from state to state during the same season. The f.a.q. bushel weight for 1951-52, for instance, has been reported as 63 pounds for New South Wales, 64 pounds for Victoria, 63 pounds for South Australia and 62 1/2 pounds for Western Australia. The bushel weight in New South Wales during 1947-48, 1948-49, 1949-50 and 1950-51 was 60 1/2, 63 1/2, 63, and 61 1/2 pounds, respectively.

The domestic sales in Australia generally take place on f.a.q. basis, all wheat is pooled and consequently sold as such. In the recont past, however, there has been only one exception; i.e., during 1947-48 when some 20 million bushels of badly

rain-damaged wheat were set apart from the f.a.q. wheat. In the foreign trade f.a.q. standard samples for the season are despatched to buyers before purchase. In the United Kingdom, which constitutes the largest single buyer of Australian wheat, these samples are sent to London where they are 'adopted' by the London Corn Trade Association. Should the cargo happen to fall below the standard, appropriate allowances are deducted from the settled price through a system of arbitration. It is important to note, that like Canada, the marketing of wheat in Australia takes place through one agency only; i.e., the Australian Wheat Board. This Board sells wheat on the local market and arranges for its export. The Board is composed of representatives of farmers, millers, commercial interests and the like with a Government nominated chairman.

Argentina

Argentina ordinarily is the biggest single exporter of wheat from South America. Plate wheats which are exported to the European markets are said to consist of small grain, lean and red coated and contain admixtures such as weeds, oats, etc. The bushel weight is generally lower than the American Hard Red Winter wheat and it varies from year to year.

The European buyers buy on f.a.q. (fair average quality) a system midway between the two extremes. According to this system the buyer recognizes (a) a standard of fair average

quality based on tho representative samples and applicable during the crop season and (b) bushel woight or test weight per bushel as a yardstick of value. The main principle underlying the method of determining f.a.q. standard has been explained under the Australian system above. The weight per bushel determination in the Argentine Republic is made with a schopper scale having a capacity of ono-quarter liter and is expressed in terms of kilograms per hectoliter. In the schopper method the grain is placed in a cylinder which is the exact diameter of the test kottle and a weight is placed on top of tho grain. This grain then falls into the test kettle and is stoked off with a knife-edged gate.

There are thus two factors in the determination of the price paid for a parcel of wheat, (a) the weight per bushol and (b) personal judgment of the quality with reference to the standard ruling at the time. In the event of bushel weight being reduced on account of the presence of admixture or thin grains, the price paid for is subject to a proportional reduction.

The following quotation from a report (11) issued by the Armour Research Foundation in 1943 throws some light on the wheat standards in Argentina:

> The F.A.Q. (Fair Average Quality) standard still prevails, but efforts are being made to break away gradually from this system and to adopt fixed standards. Tho ordinary grading factors, such as, test weight, foreign material, moisture, damaged, etc. are included in the present system, but no permanont standards are establishod which fix the

limits of these factors for each class of grain. In addition to the fact that the producer by the F.A.Q. system receives no reward for superior quality grain, a far more serious defect is that the present standards provide no practical basis for the storage operations of bulk grain where the identity cannot be retained. The F.A.Q. system should be abandoned, but the opposition from the European market can be expected since the further introduction of "Certificate final" will be resented. Argentina suffers and Europe profits by the present grain grading system.

Another article (23) which appeared in the Foreign Agriculture of August, 1951, depicts the latest position of wheat standards in Argentina as given below:

> IAPI (The Argentine Trade Promotion Institute) buys and sells exclusively on the basis of Argentine grain standards promulgated in recent years. Direct export sales to foreign Governments are made on the Argentine certificate of grade and specific weight replacing the f.a.q. (fair average quality) London contract previously used in the Argentine export trade. A small volume of f.a.q. shipments are still made when exporters buy from IAPI and sell abroad for their own account.
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> Most of Argentina's exportable wheat this year was sold in Government-to-Government transactions with Brazil, India and Italy subject, therefore, to shipment on the Argentine certificate rather than on the f.a.q. basis. The latter basis is being used very little for wheat since only small quantities are being shipped by private traders who bought from IAPI for resale abroad. Buyers abroad frequently criticise the Argentine certificate as being inadequate, prefering the f.a.q. basis whenever possible, but the scale of IAPI operations is so large that the new system appears firmly established.

J. H. Shollenberger (24) has made the following comments on the quality characteristics of Argentine wheat:

> In test weight the Argentine wheats usually average fairly high and never reach the lower extremes met with in the United States for the reason that rust infection and hot winds are not so prevalent there as in the United States.

The damaged kernel content of Argentine wheats is generally low, except for the presence of weevil damaged kernels. In fact, weevil infestation is quite general and frequently very serious throughout the northern half of the grain zone. In this section weevils are an ever present menace to the wheat and corn crops. They make their first attack on the crop while the grain is still in the field.

Stinking smut is of frequent occurrence in the wheats of the southern portion of the grain belt but seldom in sufficient amount to require special treatment of them in cleaning for milling purposes. In the northern part of the grain belt smut is of infrequent occurrence.

The foreign matter content of Argentine wheat is usually so low as to be of little or no importance in marketing. Wild oats and mustard seed are probably of most frequent occurrence. Wild oats occur chiefly in the wheats from the southern part of the grain belt. Corn cockle and rye are occasionally present but in very insignificant amounts. Garlic is not present.

The odor of sweet clover occurs in some of the wheats, but only in those from the Province of Entre Rios located in the northeastern portion of the grain belt.

The United Kingdom[1]

The quality of wheat grown in Great Britain is characterized by high moisture content, poor protein contents and low water absorption due primarily to the climatic and soil conditions. It is usually sold on sample but in the Statutory Order governing the selling prices and the disposal of wheat a definition of "millable wheat" is used. This order prohibits

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[1] Information was supplied by Mr. G. H. C. Amos of Home Grown Cereals Division, Ministry of Food, London, U. K.

tho use of millable wheat for any purpose except flour milling and seed subject to certain exceptions. The definition of millable wheat which is almost identical to the Wheat Act of 1932 reads as follows:

> Millable wheat means wheat which is sweet and in fair merchantable condition, reasonably free from sprouted or smutty grains, commercially clean as regards admixture and tailings and commercially free from heated or mouldy grains or objectionable taint, and capable of being manufactured into a sound sweet flour fit for human consumption having regard to the customary methods employed in the milling industry for cleaning and conditioning wheat.

Whoat must conform to tho standard to obtain the guaranteed price in the Wheat Order, in the same way as before the war whoat sold by the grower had to be certified as millable in order to entitle him to claim doficiency paymont under the Whoat Act.

The Ministry of Food in the United Kingdom assumed the role of the sole importor of wheat with the break of the last war which necessitated changes in the normal conditions of the trade. It is still holding that position. The London Corn Trade Association is the recognized authority for standards for imported wheat. This Association determines the bushel weight by means of a 20-liter schopper scale. The first determination is in kilogram per hectoliter and by a table of equivalents can be changed into pounds per imperial bushel which is approximately 2 pounds more than the Canadian bushel and nearly 4 pounds more than tho Winchester bushel used in the United States of America. Generally speaking, private

trade in wheat was carried out on the basis of the fair average quality (F.A.Q.) of the season's shipments from each source and judged on standards made up monthly in London from the arrivals in the United Kingdom during the month. The best and the very worst samples drawn from the deliveries were, however, excluded.

Of late there have been some changes in the general F.A.Q. practice. In case of imports from Australia the standards are now made in the country of origin covering the whole season, which are adopted by the London Corn Trade Association. Wheat in the United States of America is now bought on "certificate final" basis but pre-war the United Kingdom buyers always insisted on buying on sample. Canadian wheat is always sold on certificate of quality. It is understood that Argentina endeavors to sell wheat on certificate basis but the Ministry of Food does not accept it. Some shippers who sell Argentina wheat to the Ministry of Food, however, take the risk and sell it on F.A.Q. basis.

Indo-Pakistan Sub-Continent[1]

Due to its dry nature, time of availability and its suitability for blending, the Indo-Pakistan wheat whenever avail-

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[1] This publication relates to the conditions prevailing in the undivided India during the last 30's, which as a matter of fact have not undergone any appreciable changes in particular grading. From the production point of view, however, Pakistan can be treated as net exporter during a normal year, whereas India's dependence on import of wheat has rather increased recently.

able had a ready market in Europe, and more particularly in the United Kingdom. Up to the first World War there were regular exports from this area, which in the subsequent period gradually diminished. This trend was, however, reversed in 1948-49 when the new country (Pakistan) comprising some of the main wheat producing areas of old India commenced exporting wheat. It should be noted that grading as recognized in the United States of America or Canada does not exist in these two countries.

It will, however, not be out of place to mention briefly the current practices of grading in a rather wider sense of the word as practiced at different stages of marketing. Some of the farmers who grow improved varieties of wheat, thresh and keep separately that of better quality. It is sent to the market and the low quality retained for home consumption. The efforts made by farmer on rough sort of grading are more often than not negatived by the marketing practice of group sales of lots of varying qualities, locally known as Dara sales. The retailer also attempts grading, his grading depends on keeping his purchases separate, on cleaning, and on blending; the main consideration being cleanliness, structure of the grain, whether soft or hard, plumpness and general appearance. The personal experience of the individual is the guiding principle and the superior grade according to one might be just the reverse to the other.

In the wholesale market the sale may take place either on sample, on fair average quality, or on standard contract basis. The sale on sample is more common in certain parts of India; e.g., the Central Provinces and the Bombay State. The commission agent who acts on behalf of the seller draws a sample from the cart-load of wheat and takes it around to the different buyers. Or these samples may be exposed on a table at the commission agent's shop for the inspection of prospective buyers. In certain markets the sellers and buyers or their agents may assemble at a particular place at the fixed time and strike bargain on the basis of samples present. This practice is in vogue to a limited extent only in the case of sale of large quantities and between distant buyers, due most probably to the lack of facilities for arbitration in case of dispute.

The commission agent for the seller is generally responsible for effecting grading known as f.a.q. or fair average quality. The f.a.q. of a particular market is determined by averaging out of lots of varying qualities arriving at that place. The f.a.q. of one market is generally at variance with the other mainly on account of the dominating variety produced in the area served by the market. This practice reverses what the cultivator has already attempted to do, namely, to keep his produce in separate lots according to quality. The disputes arising out of quality difference are ordinarily settled in a court of law, as arbitration arrangements are only provided for contracts in vogue at large markets where trade associations exist.

Sales on standard contracts fall under three categories; viz., export contracts, mills contracts and 'futures' contracts. The fundamental principles of these contracts do not differ very much from each other and as such reference will be made in the following lines to export contracts mainly. These contracts are used by the shippers and exporters at the ports while purchasing from the upcountry markets. Slight differences may appear in details but the main essentials of the form of agreement are almost identical. One of the forms of agreement is known as "Karachi Pass" which is rather common. It implies acceptance by the seller of the buyer's weights and analysis in respect of the wheat railed by him to the shipper at the port of loading in consideration of which he may have received an advance of 80 to 90 per cent of the value of wheat, the balance to be adjusted after the wheat has passed acceptance and has been analyzed and weighed over at the destination.

The main conditions of the contract include the quantity of wheat purchased, its quality and source of origin and the crop year. The type of packing to be used and the delivery period is also stated. In case of difference in the quality of packing used the buyer has the right to charge an allowance. The basis of admixture are laid down. In the event of goods tendered containing more than the stated free allowance the buyer may either (a) accept the goods with allowances in accordance with buyer's scale of allowances for excess refraction in force from time to time which are known to the seller, or

(b) accept the goods and reclean the wheat at seller's expense, or (c) accept the goods with an extra allowance to be fixed by buyer over and above the allowance according to the scale, or (d) reject the goods claiming and recovering from seller any loss.

The contract is generally of non-mutual character meaning that if the goods contain less than the free tolerance, no allowance would be given to the seller. In the event of failure to deliver, short delivery or rejection the buyer has the right to (a) cancel the contract, (b) to claim and recover from sellers, the difference if any, between the value at the contract price of the goods short delivered or rejected and the value of a like quantity of similar goods at the market rate at any center upcountry or at the port or even in the United Kingdom, or (c) to buy the equivalent quantity of wheat which has not been delivered or has been rejected and to recover from sellers the difference, if any, and (d) in the event of no goods being available in the local market buyers have the option of purchasing at the port or at any other places upcountry and to recover from seller the difference between the contract rate and the rate of purchase, due allowance being made for differences in freights and terms of purchase. In case of disputes arbitration arrangements are provided for to take place at the port headquarters of the shippers.

The contract, as mentioned above, provides for laying down the basis of admixture; i.e., proportion of other food grains, non-food grains, weed seed, dirt, sand, dead seed, etc.

In addition it provides that the goods are to be free from damaged and touched grains. Also it stipulates produce of a particular district and average quality of the season.

The Food Department of the Ministry of Food and Agriculture, Government of Pakistan is perhaps the single largest buyer of wheat in the country. It not only buys for the requirements of the military but is also the only organization allowed to handle inter-provincial and foreign trade in wheat. It uses a standard contract for the purchase of wheat, which specifies admixtures, the proportions of free tolerance, the rates at which recoveries are made for excess refractions and the rejection basis. A copy of these specifications is given in Table 4.

Table 4. Punjab specifications for food grains to be exported to other Provinces or State out of West Punjab and also inforce in Bahawalpur State.

Admixture or impurity	Tolerance basis	Wheat Rates at which recoveries shall be made for excess	Rejection basis
(a) Dirt	1½%	Over 1½% to 3% at full value Over 3% to 5% at full value plus cleaning charges to buyers at Rs.5/- per 100 bags Over 5% at double value plus Rs.5/- per 100 bags cleaning charges	Over 3½%
(b) Other food grains	2%	Over 2% to 6% at half value Over 6% at full value	Over 8%
(c) Damaged	1%	Over 1% to 2% at half value Over 2% at full value	Over 4%
(d) Slightly damaged	1%	Over 1% to 3% at ¼ value Over 3% to 5% at ½ value Over 5% at full value	Over 4%
(e) Shrivelled	1%	Over 1% to 3% at ¼ value Over 3% to 5% at ½ value Over 5% at full value	Over 5%

Table 4. (concl.)

Admixture or impurity	Tolerance basis	Wheat Rates at which recoveries shall be made for excess	Rejection basis
(f) Weevilled New crop to:			
end of May	Nil	Any excess at full value	
end of June	Nil		
end of July	Nil	Up to 1½% at ¼ value Over 1½% at full value	
end of August	½%	Over ½% to 1% at ¼ value Over 1% at full value	
end of Sept.	1%	Over 1% to 2% at ¼ value Over 2% at full value	
end of Oct.	1½%	Over 1½% to 3% at ½ value Over 3% at full value	
end of Nov. to new crop	2%	Over 2% to 4% at ¾ value Over 4% to 5% at ¾ value Over 5% at full value	Dec. 1 to end Dec. Over 4%. Jan. 1 to end Feb. Over 5%. To end of crop over 6%.
(g) Red wheat	20%	Over 20% at ¼ value	

EVALUATION OF THE PRESENT WHEAT STANDARDS

The preceding sections comprise the background material and the present standards for wheat in some of the important wheat producing and exporting and importing countries. In this section, however, an attempt has been made to evaluate these standards with a view to determine to what extent they meet the general requirements. Since most of the grading factors are almost common irrespective of the fact whether the standards are fixed or not, a study has been made to judge the efficiency or otherwise of the various methods adopted in different countries to determine these factors. Besides, dealing with the standards of wheat of the various countries individually, this section also contains some discussion of the criteria for evaluating the standards.

Critoria for Wheat Standards

A study of the systems of grading wheat in different countries will show that grading appears to have existed almost everywhere, but the manner in which it was carried out might vary widely from place to place and from time to time. The previous discussions, for instance, include reference to the confusion which resulted in the wheat trade in the eighteenth century in the United States of America on account of the grading systems adopted in this country. The present systems of

grading in the important wheat producing countries were, therefore, not established in one single operation or by one single individual or a group of individuals. These systems have apparently undergone a process of evolution. The economic needs of the time and the predominating economic interest seem to have influenced a good deal the growth and the pattern of the system. In order to determine whether the present systems adequately meet the required needs it is desirable to discuss the criteria for the wheat standards.

There are a number of tests to which the wheat standards might be subjected. According to President Theodore Roosevelt's annual message (4) to the Congress in 1907, "Grades should approximate the highest degree of uniformity and certainty". By grades the President meant grain grades. He further commented on the state of grain grading in the country at that time:

> The present diverse methods of inspection and grading throughout the country under different laws and boards result in confusion and lack of uniformity, destroying that confidence which is necessary for healthful trade.

In order to ensure confidence in the grades, therefore, it is essential not only to have uniformity and certainty of almost highest degree but also continuity. The grades should not vary from crop to crop. The continuity in grades enables the trade to make contracts even before the crop is ready and also enables the millers to work out their programs of purchase of different varieties from various sources beforehand, thus facilitating trade in this commodity. The grades should be simple,

intelligible to the interests concerned and practicable in the sense that they could be applied by means of conducting simple and rapid tests capable of being carried out on the spot. The grades should be widely accepted. Since the production of wheat is characterized by a large number of qualities under the influence of seed sown, soil and climatic conditions, the grades should be such as to cover all qualities raised. Any grading system in which discretionary powers of the grading staff predominate in the assignment of grades, is likely to result in discrepancies on account of human element involved. Grades should, therefore, be subject to as much positive measurement as possible so that the grading factors could be gauged with exactitude. The grading equipment should be standardized and subject to a periodical inspection with a view to avoid discrepancies occurring on account of age and maladjustments. Last but not the least is the uniformity in the inspection system which should be of an independent nature, capable and free from any kind of bias or prejudice in its performance. With a view to insure fair play provision should be made for appeal from the assignment of grade and inspection both on national and international basis.

It will not be out of place to quote here the basic requirements for grain standards from Mr. W. B. Comb's paper on "Measuring Storage Qualities by Grain Standards" (5) which corroborates the main criteria for wheat standards discussed in the foregoing paragraphs:

We have mentioned previously that two requirements for a good set of standards are (1) that they should be uniform, and (2) that they should be widely accepted. Drawing freely on other sources[1], we might list several more basic principles or requirements for a national set of grain standards about as follows:

1. Grain standards should contain the fewest possible restrictions consistent with setting apart or obtaining the quality of grain desired by the user.

2. All parties whose interest are affected by the standards should have a voice in their preparation.

3. The uses for which the grain is intended should determine the limitations in the various specifications.

4. Excessively severe limitations are suicidal. They lead to constant demands for concessions. Better a few moderate requirements rigidly enforced than a mass of excessive limitations which are difficult of enforcement and which lead to constant friction and sometimes deception.

5. The purchaser has the right to assume that every bit of the grain making up his shipment meets the requirements of the grade since it is what he contracted for and expects to pay for. In other words, the purchaser has the right to expect an even quality throughout the lot of grain.

6. On the other hand, when a purchaser buys grain on grade it is equally unfair that he should expect any guarantee from the seller covering the behaviour of the grain in storage or in processing.

7. It must be remembered that no tests give the absolute truth and when the results of a test are

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[1] The address in 1903 by the late Dr. Charles B. Dudley before the American Society of Testing Materials, and the address in 1935 by the late Edward C. Parker before the Grain and Feed Dealers National Association in St. Louis.

near or just outside a strict specification, the product delivered may actually be all right. It seems better, therefore, in setting up the grades, to allow a small margin from the desired specification equal to the probable error in the sampling and testing methods and to place the published limits in the standards so as to include the tolerance allowed.[1]

8. Some producers and handlers of grain may object to grade specifications on the ground that they are annoying and harassing. But it should be remembered that a good set of standards, carefully worked out, as the result of the combined efforts of all interest in the industry, and which are rigidly enforced, is the best possible protection which the honest dealer can have against unfair competition.

9. Complete workable grain standards represent a very real achievement. They should combine the harmonised antagonistic interests of both producer and consumer. They should have the fewest possible requirements consistent with securing satisfactory deliveries. They should be so comprehensive as to leave no chance for ambiguity or doubt and above all they should embody the results of the latest and best studies of the characteristic qualities of the grain which they cover. In addition to the interest of producer and consumer, they must also consider the requirements and problems of the people who handle the grain in the merchandising process.

10. The standards must be so drawn that they can be accurately and uniformly applied in a practical manner by grain inspectors, giving due consideration to the fact that the trading operations in grain on the grain exchanges are conducted swiftly and that it is impossible to hold grain for any great length of time in a public conveyance such as a railroad car or steamship.

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[1] To illustrate, the tough grade for spring wheat includes wheat containing more than 14.5% moisture as the lower limit for this grade. This figure of 14.5% might be made up, for example, of a limit of 14.3% plus a tolerance of 0.2%--the 0.2% being the tolerance for the probable error in testing methods. It is, therefore, unnecessary and is, in fact, unlawful to allow for another tolerance when the results of the moisture tests exceed 14.5% because the tolerance is already included in the standards.

11. The requirements of the warehousing must be met. First, practical consideration must be given to the quality of the grain as it is produced and not as it might be produced so that a practical trading volume of grain will be provided in the grades most used for warehousing. At the same time, the quality of the grain in these warehousable grades must be such that the keeping quality of the grain will not be impaired.

12. The quality of the grain in the contract grades used in the futures trading should be such that buyers of these contracts will not hesitate to take delivery of the grain, but the specifications for the contract grades should be liberal enough to include a practical volume of the average grain crop for trading. Should unusual conditions lower the general quality of the crop then it is better to change the contract grade to a lower grade, than to liberalize the standards to take care of an unusual situation. The price levels of grain all over the country are based on the selling price of the contract grades and it is highly important that we do not impose a drag on the price level by admitting qualities in the contract grades which are unacceptable to the majority of grain consumers.

13. The inspection must be done by a disinterested third party of recognised ability and authority, and provision for appeal from this inspection must be made.

Efficiency of Grading Factors

Although grading systems obtaining in different wheat producing countries vary, there seems to exist a good deal of similarity in the grading factors as they are based on the commercial value factors. Generally speaking these factors can be designated as cleanliness, plumpness of the kernel, soundness, dryness of the grain, and purity of class.

Cleanliness. It is a value factor of first importance as it indicates freedom from extraneous matter which adversely affects the quality of the grain. Hand-sieves with standard-

ized perforations and/or mechanical devices equipped with standard sieves are used for performing this test. The material thus removed is termed as "dockage". The methods used for determining dockage, therefore, seem to be adequate for the purpose.

Plumpness of the Kernel. This factor is determined by the method known as "test weight per bushel". In the United States of America more wheat is graded into numerical grades on the basis of this test than by any other single factor. The test weight per bushel indicates quality in a general way. This test falls down when starchy or soft-textured wheats are compared with hard and vitreous wheat, or when wheats that have been rained on and then dried are compared to wheat which was harvested during more favorable weather. This is mainly due to the difference in the density of hard and vitreous kernels and starchy and soft-textured grains. Like texture, moisture content also affects density which decreases with the increase in moisture and on redrying it leaves its permanent effect on the grain. Shape and size of the grain are other factors affecting test weight on account of the intergranular space. According to J. D. Jones (14), the air space in stored No. 1 Northern Manitoba wheat, Hard Red Winter wheat and English wheat amounted to 43.6 per cent, 46.2 per cent, and 47.1 per cent, respectively.

Weight of 100 or 1,000 kernels as an alternative test for test weight has been recommended as it eliminates difference due

to shape and size of the grain. The reason why this test has not replaced the test weight per bushel apparently seems to be that the latter is perhaps capable of more rapid performance than the former. It would perhaps be helpful if weight per 1,000 kernels test is conducted as a supplementary test where the other test yields doubtful results.

Soundness. The soundness of the grain is affected when it is damaged, field-damaged or store-damaged. The damage to the grain may be caused by heat, germination, frost, exposure to weather, by certain molds and fungi and insects. The determination of damaged grains is largely a matter of opinion and is likely to result in discrepancies. It is, however, understood that the percentage of free fatty acid is directly proportional to the degree of damage. The fatty acids are highest in the heat-damaged types.

Dryness of the Grain. The dryness of the grain or its moisture content is of utmost importance for storing grain for any length of time as well as for milling purposes. Since moisture content and temperature are the most important factors which affect the keeping quality of the grain, the former ranks second to weight per bushel test in grading wheat. It may, however, be noted that moisture does not form the grading factor in some countries, such as the United States of America in designating one numerical grade from the other. It is handled on a different basis, distinguishing all numerical grades from 'tough' grade and 'sample' grades.

Although moisture content formed an important basis for determining commercial value of grain in the wheat trade since long, the only method used up to the early part of the twentieth century was by feeling the grain. The method was rather crude as it roughly indicated whether the grain was damp or dry and could not tell whether the grain was suitable for storage without any commercial hazard. During the early part of the current century a moisture tester was developed in the United States of America which is known as "Brown-Duvel moisture tester." It indicates fairly accurately the amount of moisture in wheat. More recently electrical devices have been developed for moisture testing which are more rapid and yield fairly accurate results.

Purity of Class. Certain classes of wheat have some inherent quality characteristics which distinguish them for distinctive uses, for instance, Hard Red Winter and Hard Red Spring for bread, Durum for semolina, White for pastry flour, etc. Classification of grain, therefore, takes place on kernel characteristics which are common to the class. This test primarily depends on the knowledge and experience of the grader and thus involves a good deal of human element.

The above-mentioned five factors constitute the main basis for determining quality and grade most of the wheat. Besides, there are some other factors such as subclasses in the official grain grades of the United States of America, variety and percentage of hard vitreous kernels in the Canadian grades, presence of garlic, smut, etc. common to both of those countries,

the determination of which is more or less based on visual examination.

Wheat Standards in Some of the Important Countries

The United States of America. The first grades in this country were written almost one century ago when there were only a few varieties of wheat produced and the problems were accordingly few. As a result of the continuous research in the field of production a large number of new varieties and types of wheat have been introduced with a corresponding increase in the number of grades. The latter have also been influenced to a great extent by the prevalence of diseases affecting the cleanliness of the grain and the admixture of foreign seed, to which they are particularly subject. The increasingly varied requirements of the market following in the wake of rise in the standard of living of the people possibly account for this increase to some extent. Although a number of economic interests are involved in wheat; e.g., the producer, the miller, the broker and the commission agent, the exporter and the consumer (commercial bakeries), the differences in grades are in respect of milling values only and not of 'strength' or baking qualities.

The early improvements in the grain inspection field as well as some of the recent ones, have been in the engineering fields. A number of valuable devices have been introduced for use in sampling wheat, determination of test weight per bushel,

in sieving and in moisture testing. The problems of wheat quality have increased with the large increase in varieties grown under all variations of climate and soil, with high-speed harvesting methods and with long-time storage programs. The answer to many of these problems will be found in the realm of chemistry. The wheat standards of the future will, therefore, be based on the work of cereal chemists, provided they are capable of removing their tests from the laboratories and so simplify and standardize them that they may be fit for practical application as routine tests by the grading staff.

If grading is intended to meet the purpose for which wheat is primarily used, the wheat standards of the United States of America have seriously failed in this respect. It is estimated that more than 85 per cent of the wheat production is consumed for bread-making. The quality characteristics of wheat which render it eminently suitable for bread-making are not only the quantity of proteins but also the quality of gluten. The official grain standards do not reflect these qualities except in a very general way by the provision of subclasses.

The National Association of Chief Grain Inspectors at its annual meeting held at Memphis during September, 1951, voted to recommend the elimination of the subclass Dark Hard Winter in the standards for Hard Red Winter wheat on the grounds that it serves no useful purpose. If their contention is valid, it would seem that the subclass Dark Northern Spring of the class Hard Red Spring wheat would be equally lacking in usefulness.

Serious doubts are, however, expressed as to the usefulness of any of the present subclasses of the classes Hard Red Spring wheat, Hard Red Winter wheat and Soft Red Winter wheat. Moreover, it is said that the actual determinations of the percentage of dark, hard and vitreous kernels for the purpose of establishing the proper subclass are seldom made.

Dr. Lawrence Zeleny (27), in an article on bread baking qualities, has remarked as follows:

> The present wheat standards do not adequately reflect the potential bread baking value of wheat because no test of baking quality that is practical from the standpoint of routine inspection has been available. It has been suggested frequently that the protein test be used to evaluate wheat in the standards but the protein test is not simple and rapid enough for the requirements of routine grain inspection, it requires rather elaborate and expensive equipment, and it fails seriously to reflect potential bread baking quality when the wheat gluten is of inferior quality because of varietal characteristics or as result of unfavourable climatic conditions during the development of the wheat in the field or damage after harvest.

In the Progress Report (17) on a Research and Marketing Act project dated September, 1950, it is mentioned as follows:

> Although the United States standards do classify wheat in a very general way according to protein content and gluten quality, there still remains within each of the classes of "bread wheat" and within each subclasses such wide variations in protein content and gluten quality that grading of wheat in accordance with the standards does not satisfactorily classify it in respect to its potential bread-baking quality. Kernel texture is ordinarily only a very crude index of protein content, and certain fairly widely grown varieties of hard red winter have inherently inferior gluten quality, even though their protein content may be relatively high.

A reference to the discussion on 'test weight per bushel' under the foregoing section on "Efficiency of Grading Factors"

would recall the drawbacks of this test which are fully applicable to the wheat grades in the United States of America as this test is by far the most important test for grading wheat. It might be recapitulated that the test weight per bushel fails when starchy or soft-textured grains are compared with hard and vitreous wheat or when wheats that have been rained on and then dried are compared to wheat which was harvested during more favorable weather. As a result of his investigations, Dr. C. O. Swanson (22) found that weathered wheat kernels lose color but there is no loss in baking quality. As a matter of fact, in certain cases the quality of the weathered wheat improved; whereas according to the official grain standards such wheat will be degraded.

The U. S. standards are further criticized on account of the fact that the amount of dockage has no effect on the determination of numerical grade of the sample and that dockage is calculated in whole per cent only, fractions less than one per cent are being disregarded. In commercial practice, the dockage may not be paid for when grain is sold, the very presence of dockage, however, adversely affects the keeping quality of the grain. It is not understood as to why Congress raised the limit of calculating dockage from one-half per cent to whole per cent shortly after the passage of the Grain Standared Act in 1916 (21). Actual recent experience, however, shows that this concession seems to have worked in favor of certain unscrupulous warehousemen storing grain on account of

the Commodity Credit Corporation. Another common criticism levelled against the wheat standards is the practice of upgrading wheat by means of mixing practiced by the elevator operatives. The receipts and shipments of wheat at the terminal elevators seem to show a marked difference in quantities on the basis of grades which is apparently due to the blending of lots containing varying percentages of damaged kernels and moisture.

The grade requirements for Hard Red Winter wheat (10) grade No. 1 are, minimum test weight 60 lbs. and maximum limits for total damaged kernels, foreign material and wheats of other classes 2 per cent, 1 per cent, and 5 per cent, respectively. The corresponding tolerances for grade No. 2 of the same class of wheat are, 58 lbs. 4 per cent, 2 per cent, and 10 per cent. The difference between the tolerances for the two grades amounts to 2 lbs. in test weight, 2 per cent in damaged kernels, 1 per cent inforeign material and 5 per cent in wheat of other classes. In other words, there exists a fairly wide margin between the lower and upper limits of wheat of grade No. 2. The foreign buyers generally complain of "skimming" at the source; i.e., better quality stuff being purchased by the local buyers. The blend consisting of the mixture of very high No. 2 with No. 3 is just passable in No. 2 grade. Wheat exported to foreign countries, generally represents the lowest possible level of quality in a particular grade.

During a visit to the Board of Trade of Kansas City in May, 1952, it was observed that the price of grade No. 2 Hard Red Winter wheat for cash sales was higher than that for "future" delivery. This unusual phenomenon was, however, accounted for by the difference in the quality of the wheat belonging to different levels of the same grade as mentioned above. The quality of the grade No. 2 wheat in cash sales generally approximates the uppermost level of the grade, whereas that in the futures sales represents the lowest limit of the grade. This margin in the extreme limits also facilitates the blending and upgrading in the warehouses and elevators.

Canada. The Canadian wheat standards have much in common with those in the United States of America. Both these countries have elaborate grading systems characterized by fixed grades. In addition to the statutory grades fixed by the Canadian Parliament there are a number of commercial grades which vary from harvest to harvest according to the condition of the crop. In regard to the increase in the number of grades, Leonard D. Nesbitt (18) has remarked as follows in "The Story of Wheat":

> Over the years there has been a constant increase in the number of grades of wheat delivered by farmers. In 1948 alone Alberta Pool Elevators received 207 grades of wheat. The cause, therefore, is the sowing of unsuitable varieties of wheat, intermixtures in seed, intrusion of weeds, rust, smut and other diseases, unseasonable frosts, hail, drouth and wet harvest weather.

There are, however, some distinguishing features in the Canadian grading system. The most important of these is the

provision for variety and the minimum percentage of hard vitreous kernels in the 4 top statutory grades which for No. 1 Hard and No. 3 Northern are 80 per cent and 35 per cent, respectively. These grades, therefore, show a closer relationship between the grades and protein content. Moreover, the wheat production which is of a marked varietal homogeneity provides normal means for grading quality.

The Canadian Grain Act confers on the Federal Government complete powers to control the handling of grain, by means of the powers vested in it in the matter of interprovincial transportation and of patents and copyrights. Restrictions are imposed by the Act on the transportation of the grain except from or to licensed elevators and on the use of the established grade names used for designating grain. The Act provides, with a view to Canadian wheat of the top four grades not being adulterated during the handling at terminal elevators, that wheat of these grades shall only be stored with grain of like grade. The supervision of necessary binning is effected by the Board of Grain Commissioners by a system of registration of all receipts and shipments at terminal elevators and an annual weighover of stocks in store, any surpluses caused by the transfer of grain from lower to higher grades being claimed by the Board on behalf of the Government. These controls on weight, storage, means of transport, etc. have rendered the working of the wheat grading system effective and efficient.

Notwithstanding the fact that the grading system has shown

better results, it has its own drawbacks. The weight per bushel test, for instance, has the inherent defects already mentioned under the discussion on the United States Standards. Then, there is the possibility of mixing of very high No. 1 with No. 2 and the blend being just passable as No. 1. The lots of wheat entering the expert channel generally represent the lowest possible level of quality in a particular grade. The maximum difference between the grades in respect of minimum percentage of hard vitreous kernels indicating the kernel texture consists of 15 per cent, the effect of which factor can be easily cushioned by that of any other grading factor thus resulting in a higher protein content in the lower grade. This is the case with wheat of the grade No. 4, which frequently seems to have a higher protein content than that of No. 3 grade.

Australia. In Australia the grading system in vogue is known as f.a.q. or fair average quality, which is an intermediate between the two extremes, fixed grades and sample basis. The f.a.q. standards are worked out every year immediately after the crop is harvested. The f.a.q. standard samples are despatched to the buyers on the basis of which transactions for the season take place. Only one grade is fixed which fluctuates from season to season. Australian wheat is almost entirely white wheat of one class and is not affected by disease or admixture of foreign seed to any thing like the extent of that grown in America.

Of late there have been suggestions from certain quarters and requests from bakers for changing over to the fixed grade system but with little success. In 1934 the Royal Commission on the wheat industry suggested that serious consideration be given to shifting to a grading system and away from the f.a.q. Nothing has, however, happened so far, most probably due to the following reasons:

(a) There is not much difference in quality between the different varieties of wheat grown in Australia. Very little of Australian wheat can be classified as hard.

(b) The lack of facilities for bulk handling in Australia has perhaps been an important retarding influence on the introduction of fixed grades which are comparatively more complex in their nature and composition. In South Australia all wheat is still bagged and there are no bulk handling facilities at all.

(c) An allover shortage of food grains in the world since last war has been another contributing factor for sticking to the f.a.q. system. It has enabled Australia to dispose of her wheat on f.a.q. basis at very satisfactory prices and has perhaps reduced the incentive to change.

The fact that there have been from time to time requests from the bakers for change over to fixed grade system and that the Royal Commission on wheat industry suggested that serious consideration be given to shifting to a grading system indicate that all is not well with the f.a.q. system in

Australia. Some of the drawbacks of this system seem to be the lack of incentive to the farmer to grow good quality wheat as he does not get a premium for high quality produce. The merchants mix good quality with low quality lots to arrive at the f.a.q. standard. There is lack of incentive to cleaning wheat and the production of high milling quality. The change in the standard from season to season is not conducive to better production and marketing. All these factors might ultimately lead to a general decline in the quality of wheat.

Argentina. The grading system in Argentina has until recently been mainly the same as that in Australia; i.e., fair average quality. Even now the shipments by private traders abroad, although constituting a small proportion of the total exports are on f.a.q. basis. In view of the fact that Argentina produces dissimilar varietal quality of wheat, in addition to the drawbacks mentioned under Australian system, another serious drawback is that the system provides no practical basis for the storage operations of bulk grain where the identity cannot be retained.

With the setting up of the IAPI (The Argentine Trade Promotion Institute) in the recent years, fixed standards for wheat have been promulgated. IAPI, therefore, buys and sells exclusively on the basis of these standards. It is understood that Argentina endeavors to secure the acceptance of certificates by the Ministry of Food in England who is the sole importer of wheat into that country. The latter does not appear to have so far accepted the Argentine certificates.

Most of the Argentina's exports of wheat during 1951, however, took place on government-to-government basis with Brazil, India and Italy subject, therefore, to shipment on the Argentine certificate rather than f.a.q. basis. The foreign buyers frequently criticize the Argentine certificate as being inadequate and preferring the f.a.q. basis whenever possible.

Indo-Pakistan Sub-Continent. As already mentioned in the foregoing section on "Present Standards" grading as recognized in the United States of America or Canada does not exist in India and Pakistan. The system of standard contracts for export, futures trading and the mills is of 'non-mutual' character. In other words, if the seller offers a lot of wheat of a higher than the basic quality provided for under the contract he does not receive any premium in price. Similar is the case in respect of the 'tolerance basis' in the standard contract for wheat purchased by the Government agency for inter-provincial or foreign trade. This is rather discouraging as it lacks incentive to the production of better quality of wheat and selling it in a cleaner condition. These contracts appear to have been designed mainly in the interest of the buyer.

A look on the copy of the Punjab Specifications for Food Grains (wheat) given in the previous section will show that the tolerance basis indicates quite a low quality of wheat, damaged kernels (damaged, slightly damaged, shrivelled and weevilled) 3 to 5 per cent, foreign material (dirt and other

food grains) 3½ per cent and wheat of other classes (red wheat) 20 per cent. When compared with the official grades for White wheat of the United States the tolerance for damaged kernels falls between those for grade Nos. 2 and 3, foreign material between those for grade Nos. 3 and 4 and wheat of other classes below grade No. 5. If the change over to any recognized system of grading is likely to take some time, it will be desirable to change the basis of standard tolerances from non-mutual to mutual. The price should be fixed on the basis of the standard contract and any premium payable because the wheat is of a higher than the basic quality provided for under the standard contract, should be paid and conversely any deductions on account of the wheat containing a greater percentage of impurities than the tolerance, should be made with reference to the actual facts of the case.

CONCLUSIONS AND SUGGESTIONS

International Wheat Standards

The wheat grading systems obtaining in the different wheat producing countries of the world can be grouped under three categories; viz., 'fixed grades', 'fair average quality' and 'miscellaneous' such as standard contracts. The methods of purchase followed by the European buyers also fall under three headings; i.e., 'government certificate final', 'fair average

quality' and 'sample'. The grading systems in force in the United States of America and Canada are those of the fixed grade type and the exports to foreign countries almost exclusively take place on certificate final basis. Fair average quality system of grading prevails in Australia and Argentina (recent trend in Argentina although not yet well established and widely recognized is towards fixed grades and foreign sales on government certificate final). The same f.a.q. system of purchase is followed by the European buyers of wheat from countries with miscellaneous or no recognized system of grading.

The method of sales on certificate final basis implies generally a government-to-government transaction with a dependable system of grading in the country of origin. The buyer is left with no option to dispute the grade and secure arbitration upon questions of quality or condition when once the grain is sold on grade for shipment abroad. It is thus essentially a system of an exporting country. On the other hand, the fair average quality system implies new standards every year and the preparation of samples and the power of arbitration generally vested in the country of import. This system not only lacks incentive to the improvement of quality in the producing countries but also places the exporter almost at the mercy of the importing country and may, therefore, be called as essentially a system of an importing country. Both these systems, the certificate final and fair average quality thus represent

approximately opposite sides of the picture of international trade which does not appear to be in the best interests of the wheat industry as a whole. In the circumstances, it seems highly desirable to strike a compromise between the two extremes with a view to arrive at a workable medium which should be conducive to better production of wheat as well as fair to both exporter and importer. A solution of this problem might be found in the establishment of an international standards system controlled and supervised by an independent international body making provision for arbitration in case of disputes on questions concerning quality or condition.

The next question naturally arises as to whether such a proposal is practicable in view of the heterogeneous qualities of wheat produced in different countries under varying soils and climates. Or, whether a common set of standards could be worked out which might be applicable to the qualities of wheat produced all over the world. There is no doubt that the qualities produced are many and there is an appreciable difference in the standards used. Nevertheless, there does exist a sort of uniformity in the disuniform standards in so far as the main basic determinations are concerned. These, for instance, are weight per measure determination, moisture determination, the damaged content and the extraneous matter content. If these determinations could be worked out by uniform methods, they could be useful in the determination of equivalent values. Uniformity in the methods of sampling and testing could also be brought out along with the wheat stand-

ards themselves. The example of the American grain standards could be usefully studied and modified in working out international standards as they are typical of the large number of wheat qualities produced under a fairly wide variation in soil and climate.

Another question in this connection, however, arises as to who should take the initiative. Countries who are enjoying privileged positions in the international trade in wheat by virtue of their political status and the overall shortage of wheat in the world might not find it very pleasant to forego certain privileges expected to result from the proposed change. Besides, there may be a number of other difficulties in the way of adopting international standards, such as harmonizing the conflicting interests involved. But, the benefits likely to accrue from the adoption of such a system are expected to outweigh the sacrifices to be made by some countries. As such no obstacle of any kind should appear insurmountable if the work is taken up by the right type of organization and pursued with vigor and earnestness. The Food and Agricultural Organization of the United Nations, no doubt, is the right sort of organization eminently suitable for this type of work as improvement in the marketing of agricultural commodities constitutes one of its outstanding objectives. A start might, however, be made by appointing a "study group" consisting of representatives from various interested countries, who should go into the question and thrash it out in a conference.

Imperfect Standards

There is no denying the fact that wheat as a broad crop occupies an enviable position among all the food grains produced in the world. Also, that the wheat industry has reached such a stage that standardization and grading appear to have become almost a necessity rather than a luxury in order to keep pace with the increasing problems concerning production as well as marketing. There are certain underdeveloped wheat producing countries practicing grading which falls short of what is recognized as grades and standards in some of the more developed countries such as the United States of America and Canada. But of late there has been an awakening in these less-developed areas and there exists a keen desire for improvement. Some countries are following the fair average quality system and there are definite indications that the trend is towards having a fixed grade system, as for instance, Argentina. Countries like the United States of America and Canada claim to have the most elaborate systems of grades and standards. To sum up, the fixed grade system seems to constitute the highest stage of development so far reached in this respect.

The fixed grade system as discussed earlier at some length in particular in the section on Evaluation of Standards is mainly based on physical analysis. In the determination of a good number of grading factors no positive measurements have yet been introduced and visual examination involving a lot of human element plays the predominant role. Some of the mechan-

ical devices used for the determination of some of the grading factors still leave much to be desired. On the whole the fixed grade system has so far failed to meet the purpose, that is, the determination of the quality and, therefore, cannot be claimed as perfect. This does not mean that fixed grade system should be discarded as being imperfect. To be fair, this system, in spite of its drawbacks, has rendered a unique service in the development of the wheat industry and has benefited almost all the economic interests involved in varying degrees. It, however, calls for more attention of the research worker, in particular that of the cereal chemist, with a view to raise it nearer to the level of perfection.

Role of Standards in the Technical Assistance Programs

Technical assistance programs are being launched by the various organizations of the United Nations; viz., Food and Agricultural Organization, World Health Organization, etc., the United States of America (Point IV Program), and the British Commonwealth (Colombo Plan). The object of all these programs is to provide technical assistance to the people of the underdeveloped countries with a view to raise their standard of living.

Agriculture is by far the most important industry and the bulk of people depend upon it in most of the countries comprising the underdeveloped areas. In some of the Asiatic countries; e.g., Pakistan, India, Iraq, Syria, etc. wheat plays a

prominent role in the economy of the country and any improvement effected in this industry is sure to help the country as a whole. The methods of marketing agricultural commodities, in particular wheat, are such that the farmer does not get a reasonable share out of the price paid by the ultimate consumer of his product. The quality of the product is poor as there is an utter lack of incentive to the production of better qualities, the methods of marketing are primitive and defective and there is very little protection to the producer from unfair competition. Since a good set of standards, properly worked out and rigidly enforced provides in addition to numerous other advantages, the best means of such protection to the farmer and an incentive to the production of better quality products, it is essential that standards and grades should receive due attention in the set up of the various technical assistance programs of the underdeveloped countries. The marketing aspect should not be allowed to be overshadowed by the production programs which are equally important for increasing the output. It will, perhaps, be an ideal situation conducive to far better results if both production and marketing aspects are tackled side by side.

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WORLD WHEAT STANDARDS

by

FARZAND ALI SHAH

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AN ABSTRACT OF A THESIS

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Wheat is the second largest food crop of Pakistan after rice and occupies about one-fourth of the total area under all food grains produced in the country. The production of wheat is concentrated in western Pakistan where it constitutes the staple diet of the people. The average annual production, after meeting the domestic requirements, provides a sizable export surplus roughly amounting to over 11 million bushels. The writer being the head of a division dealing with the marketing of crops in the Ministry of Food and Agriculture, Government of Pakistan, was selected for higher training in the methods of marketing, in particular standardization and grading of wheat and rice and sent to the United States of America under the Point IV Program.

The training program which was developed at Washington, D. C. was broadly divided into two parts, one dealing with observatory tours of the States and a few other countries and the second, comprising intensive study at the Kansas State College, Manhattan, Kansas. This is how "World Wheat Standards" developed as a subject of this thesis.

The purpose of the study is to examine the various existing standards for wheat in some of the important wheat producing and trading countries with a view to introduce them after suitable modifications in Pakistan. It also aims at stimulating interest in the study and improvement of wheat standards in general and to focalize attention of the research workers and the international organizations concerned on the

exploration of some suitable international standards in order to facilitate international trade, in particular.

The general method of attack followed in tackling the problem is that of survey and combination of relevant facts and data more or less inaccessible. The progress of study and investigations of production seem to have overshadowed those of marketing, in particular standardizations and grading. As such, there is a general paucity of suitable literature on standards.

The work on the collection of the relevant material, in fact, started in 1950 when the writer had to prepare and put up a scheme to the Government on the introduction of wheat standards. After reaching the States in October and before joining the College in the spring semester of 1952, a period of more than three months was spent in collecting suitable data from the libraries, by interviewing a large number of authorities concerned and observing actual grading at a number of centers in the United States and Canada. These data were further analyzed, verified and supplemented during the spring semester and the summer school of 1952 at the College under the guidance of a number of professors.

The body of the thesis is made up of four main sections. The first section comprises background material, the second details the present standards, the third embodies evaluation of present standards and grading factors involved and the fourth or the final contains conclusions and suggestions.

Wheat is an international crop. It is produced almost all over the world due to its adaptability to different climates. The total production of wheat during the period 1948-50 averaged about 6.4 billion bushels. It holds a pre-eminent position among all the bread crops and constitutes the staple food grain of the most advanced nations of the world. The qualities of wheat produced are many which are subject to variety and kind of soil and to a great extent to climatic conditions. Quality in wheat is a variable factor as it differs from one economic interest to another. It is primarily the purpose for which it is used, which determines its quality. Unlike industry, agricultural products which include a number of variable factors are not subject to the precision methods of manufacture. As such, it is difficult to acquire uniformity in their quality. Wheat, however, is one of those commodities which are subject to description and sampling and lend themselves admirably to grading and standardization.

Standardization is of utmost importance in the marketing of agricultural commodities, more so in the case of wheat which enjoys the world market. Standardization is essentially a farmer's system, as it is his safeguard and provides the required incentive to better production. It also provides him with quick bank credit and benefits him from savings in the cost of marketing worthless produce and by improvement in the quality and size of the lower portion of the crop. It is the absolute prerequisite of bulk handling and provides basis for organized

marketing. It facilitates price determination and tends to induce stability of demand by providing consistent and dependable qualities. Finally it provides the ultimate buyer with a dependable standard quality.

Under normal competitive marketing conditions quality differences in products seem to bear a direct relationship with prices. Grading involves costs in various services rendered which are reflected and at the same time justified in proportionately higher prices for graded articles. The elasticity of demand and the relative supply of goods, however, affect the price differentials between grades and consequently the total returns to the grower.

Generally speaking, the wheat grading systems obtaining in the different countries can be grouped under three categories: "fixed grades", "fair average quality", and miscellaneous, such as standard contracts. The "fixed grades" system is in vogue in the United States of America and Canada, "fair average quality" in Australia and Argentina and miscellaneous in countries like India and Pakistan. It may, however, be noted that there is a trend towards a change over to fixed grade system as recently observed in Argentina. Although the methods of grading vary from country to country, there exists a good deal of similarity in the grading factors used as they are based on commercial value factors. The most common factors are cleanliness, plumpness of the kernel, soundness, and dryness of the grain.

The determination of the grades is mainly based on physical analysis most probably due to the lack of rapid, practicable and routine chemical tests. A few determinations; e.g., weight per bushel test, percentage of foreign material and moisture determination are subject to positive measurements and can be gauged with exactitude, whereas the balance, such as, determination of class, subclass, variety, damage contents, etc. must depend on visual examination which involves human element and ultimately lead to discrepancies. Even certain positive measurements, such as, weight per bushel is not free from serious drawbacks as it falls down when starchy and soft-textured wheats are compared with hard and vitreous wheat and weathered wheat compared to wheat which was harvested during more favorable weather.

Fixed grades obtaining in the United States of America are a fair index of milling values only and not of "strength" or baking qualities. The provision of subclass, however, reflects in a very general way the protein content of the sample. In addition to the drawbacks mentioned in the foregoing paragraph, the official grain grading system is being accused of upgrading practiced by the elevator operatives. Lots of unclean, damaged and moist wheat are mixed with better qualities and thus upgraded. The export qualities and those delivered against "futures" contracts represent wheat belonging to the lowest level of the grade concerned, whereas, in cash sales, in particular, purchases by the mills, the goods delivered

represent wheat belonging to the uppermost level of the grade and better qualities.

These drawbacks are common to the Canadian system also except that it provides certain proportion of hard vitreous kernels in the statutory top grades indicating closer relationship between grade and protein content. The maximum difference between the grades in respect of minimum percentage of hard vitreous kernels indicating the kernel texture consists of 15 per cent, the effect of which can be easily cushioned by that of any other grading factor thus resulting in a higher protein content in a lower grade. The systems in both of these countries are further criticized for having an increasingly large number of grades as a result of sowing unsuitable varieties of wheat, intermixtures in seed, intrusion of weeds, rust, smut and other diseases, unseasonable frost, hail, drouth and wet harvest weather.

The fair average quality system is in vogue in Australia and to a small extent in Argentina (in case only of shipments by private traders abroad). In Australia, its existence is explained by the fact that there is not much difference in quality between the different varieties of wheat grown. The lack of facilities for bulk-handling in particular in South Australia and an allover shortage of food grains in the world since last war have had a retarding influence on the introduction of fixed grades and reduced the incentive to a change to fixed grade system. The f.a.q. system is, however, accused of lack of incentive to the farmer to grow better and high milling

quality wheat, lack of incentive to cleaning wheat and the practice of mixing hi h with low quality wheat to arrive at the f.a.q. standard. The seasonal changes in the standard do not lead to better marketing. The cumulative effect of all these factors might result in a general decline in the quality of wheat.

England and the west European countries constitute the biggest import market for wheat. Recently India has emerged as a heavy importer and was perhaps second to England only during 1951. In Europe three methods of purchase are followed: the "Government certificate final", "fair average quality" and on "sample" basis. The certificate final basis for purchase is applicable to the shipments from the United States of America and Canada where dependable fixed grade systems are in vogue. Fair average quality standard arrived at in the country of import on the basis of shipments or worked out by the exporting country and adopted by the importer forms the general method followed in purchases from countries with standards other than the fixed grade system. Arbitration in case of disputes arising out of questions of quality and condition takes place in the country of import.

The study of wheat standards in various countries shows that fixed grade system obtaining in the United States of America and Canada represents the highest stage of development so far reached. This system has no doubt rendered a unique service in expanding and improving the production of wheat, in

introducing bulk-handling methods for storage and transportation, in creating organized marketing systems, etc. In spite of all these good points this system is still imperfect as it does not indicate the "strength" or baking quality for which purpose most of the wheat purchased is used. There are some other defects in the system, a reference to which has already been made. The future standards no doubt will be made by cereal chemists provided they are capable of removing their tests from the laboratory to the country points in a form that can be applied as a routine test by the grading staff.

There is a considerable international trade in wheat which is likely to expand in the years ahead due to the increase in demand resulting from the increase in population and the rise in the standard of living. The present main methods of purchase; i.e., certificate final and on fair average quality basis do not appear to be satisfactory. The former is essentially a system of an exporting country and the latter essentially that of an importing country. In order to be fair to seller as well as buyer and to retain the benefits affecting production, marketing, storage, transport, etc. it seems desirable that a system of international standards under the auspices of the Food and Agricultural Organization of the United Nations with a suitable provision for arbitration in case of disputes arising out of quality or condition might be given a serious consideration. The appointment of a "study group" by the Food and Agricultural Organization to go into this question is, therefore, suggested.

The so-called underdeveloped countries inhabited by over one billion people have predominantly agricultural economies. Wheat plays a very important role in the economies of some of them, but they are, as a rule, void of any semblance of grading system as recognized in the United States of America and Canada. The economic development of these countries has been taken up very seriously by the different organizations of the United Nations, Point IV Program of the United States of America and the Colombo Plan of the British Commonwealth. Technical assistance is being provided by these organizations with a view to raise the standard of living of the people. The administrators of these programs should give serious consideration and importance to the introduction of grade standards for agricultural commodities especially wheat, as standardization constitutes an essential means for the economic development of the people of agricultural countries.