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DEPARTMENT OF AGRICULTURE

1954 Farrer Memorial Oration . . .

QUALITY IN THE AUSTRALIAN WHEAT CROP

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IN all commodities exported, including wheat, there is unmistakable evidence that buyers no longer seek just quantity; they also demand quality. In fact, they will buy the best quality they can at the cheapest possible price, irrespective of who produces it. This is one of the most significant developments since the war. This new insistence on reasonably priced quality goods means we are back to normal world competition—that the seller's market has given way to a buyer's market.

It was always reckoned that the quality factor would eventually assert itself again, but more so in some commodities than in others. The fat lamb and beef markets are cases where we have known well we could not hope indefinitely to sell all we had on a bulk basis, irrespective of quality. But with other commodities we have never been really quality conscious. One of our major commodities—wheat—has always been marketed from Australia on a bulk basis, irrespective of its baking quality.

Although wheaten flour is used for a number of purposes other than bread making, by far the greatest proportion of Australian flour is made into bread and I propose to deal only with this aspect of wheat utilization.

QUALITY IN WHEAT

Misconceptions and wrong use of the word "quality" are inevitable with a commodity like wheat, which is subject to so

much handling and processing before it finally reaches the housewife's table as bread. The farmer sells his wheat straight from the harvesting machine to the merchant. The wheat then passes to the miller who grinds it to flour which he sells to the baker, who bakes the bread.



Dr. A. R. Callaghan, C.M.G., D.Ph., B.Sc. (Oxon), B.Sc.Agr. (Sydney), who was awarded the Farrer Memorial Medal for 1954. Dr. Callaghan, who has had a distinguished career as an agriculturist, was born at Perthville, in New South Wales; was a 1925 Rhodes Scholar; a plant breeder on the staff of the N.S.W. Department of Agriculture; the Principal of Roseworthy Agricultural College, S.A., and now is Director of Agriculture, South Australia. In 1953 he was elected Federal President of the Australian Institute of Agricultural Science.

The merchant is satisfied provided the farmer's wheat is a good sample, reasonably free from cracked grain, cocky chaff and other harvesting debris. In other words, the merchant's interpretation of quality rests essentially on the physical nature of the sample. This, in fact, is the basis of the "f.a.q." which is the standard by which overseas buyers purchase Australian wheat.

Although "f.a.q." stands for "fair average quality", it really means a fair average sample of our wheat. It is a grade determined afresh each year, not a permanently-defined fixed grade in the sense of other official wheat grades, as in Canada or in the United States of America.

The baking quality of the wheat is not considered in determining the f.a.q., which has, nevertheless, remained a satisfactory standard because Australian wheat has sold readily on the world's market by virtue of its special characteristics for blending with high baking quality wheats of other regions. For this reason the merchant has never been interested in the baking quality of the wheat he sells—the sample has been all that has mattered.

The miller is interested especially in milling quality, that is, the amount of flour he can expect to make from the wheat. The cleaner the sample and the higher the bushel weight, the greater the yield of flour. He is also interested in ease of milling. If, therefore, the miller only had to satisfy his own requirements he would choose a clean sample of wheat of high bushel weight and of dry, starchy texture.

BAKING QUALITY

The baker's concern is with the suitability of the flour for bread making and he places emphasis on the baking quality of

the flour obtained from the miller. He requires a flour of good colour, good gluten content and high gluten quality and, especially, a flour which will enable him to make the greatest number of loaves from a given quantity. While he must have flour which will make a good loaf of bread, he is also interested in its water absorbing capacity so that it will give him the best yield of loaves per ton.

This makes it clear that there are at least three different interpretations placed on the word "quality" as applied to wheat. The merchant means physical quality, he seeks a fair average sample. The miller means milling quality, he seeks high flour yield. The baker thinks of baking quality—the yield of loaves and the quality of the bread itself.

THE FARRER MEMORIAL MEDAL is awarded annually to commemorate the work of Australia's great wheat breeder, William James Farrer, and to mark distinguished service to agricultural science. The oration by the recipient is an important item on the programme of the congress of the New South Wales Agricultural Bureau at which the award is made.

The bushel weight indicates the yield of flour that can reasonably be expected and is accordingly a measure of milling value. But there is no ready rule of thumb means of assessing the true baking quality of a sample of wheat; it certainly cannot be done by looking at it or weighing it.

The baking quality of a wheat is determined by its innate constitution, and wheats all over the world are divided into three main classes—strong, medium and weak—which express their flour strength, which in turn determines their baking quality. Protein quantity, measured either by the dry gluten content or by chemical analysis, is not the only criterion, because the quality of the protein (or gluten) is so important. Quantity of gluten is largely determined by environment while quality is mainly determined by heredity.

There is nothing original in these thoughts and to illustrate this, may I quote the words of Farrer, used in 1898. He said:

"If I ask the farmer what he considers to be the qualities of the best grain he will probably answer at once 'The quality

that brings the most money into my pocket'. If wheats were sold at relative prices which were determined, as they ought to be, by their intrinsic value, then this would be a satisfactory answer. As things are it is not, for practically the only quality of the grain which is of importance to the farmer is that of being produced abundantly.

"The miller will answer that the qualities which he specially values are those of yielding flour (a) in large-quantity (high percentage extraction) and (b) easily (without much grinding).

"When the baker is asked he will say that his principal requirements are (a) that the flour shall be of good colour and capable of being made into white bread and (b) that it shall take up much water in being made into dough and so make much bread.

"The consumers' wants in a wheat are that its flour be nutritious and strength sustaining and capable of being made into a loaf which is light, white, and so attractive to the eye, agreeable to eat and easy to digest."

The principles are much the same to-day as they were in Farrer's day. Over half a century of experience, scientific wheat breeding, and altered home and world demands, as well as improved methods of determining all the qualities of wheat, have made wheat marketing reforms both possible and desirable.

F.A.Q. IN AUSTRALIAN WHEAT

Under the name of "standard sample" the f.a.q. system was first introduced in 1888 by South Australia. It was later adopted by other States to meet the marketing requirements of their export wheat. For sixty-six years the system has persisted and become widely recognised as the marketing basis for Australian wheat. It has served Australia remarkably well and merchants still venerate it as something sacred and not to be tampered with.

I have no intention of developing an argument for or against f.a.q. Reforms are needed, but that need not affect the f.a.q. marketing system which has been tried and used for so long, without being found very

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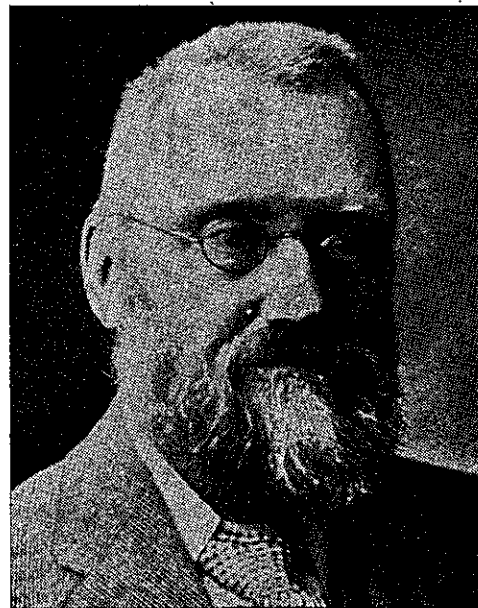
wanting, on our recognised, and what one might term our conventional markets—those of the United Kingdom and Europe generally. As a system, f.a.q. has been criticised for years, but no one has yet proved it to be other than a success. It still stands the test on the conventional markets.

As early as 1899, Professor Lowrie was an ardent advocate for the reform of f.a.q. He said:

"I have heard many farmers express surprise and disgust when shown the

William James Farrer

—1845-1906—



Son of an English farmer, Farrer came to Australia in 1870 and was a surveyor on the staff of the N.S.W. Lands Department. In 1898 he was appointed to the staff of the Department of Agriculture following the recognition of the value of his experiments with wheat. For his work as a wheat breeder, Farrer has been termed "Australia's greatest benefactor", pioneering the development of varieties suitable to Australia and making possible the extension of our wheat-growing areas by millions of acres.

"standard sample" going out as representative of the Colony's wheat. It has certainly contained a percentage of rubbish

that should not be there—drake, wild oats, chaff, shrivelled and broken grain and other impurities such as barley, small pellets of stone, etc. If wheat merchants in London pay attention to this sample it must affect disadvantageously the reputation of our wheat. While our wheat is ungraded and sold as one sample merchants have no alternative but to blend samples, and the resultant mixture works out to be a sad advertisement for our farm management and our price is affected accordingly."

These dire results have never eventuated but there are many who still prophesy that they will.

From what I have already said you will observe that it is not my intention to attack the f.a.q. system. Let us concede, however, that the f.a.q. as a system has its limitations, especially with respect to new markets which are demanding wheat which will produce high quality loaves without the need for blending.

All previous attempts at marketing reform have begun by attacking the f.a.q. system and have been shattered by its strength as a medium for marketing the average sample of Australian wheat on the conventional markets, which incidentally still account for a large proportion of our harvest—something like 52,000,000 bushels out of our total average crop of 180,000,000 bushels. As far as the f.a.q. is concerned there is no reason why we should not leave well alone. This, however, should not in any way debar Australia from thinking in terms of making a separate class for high-baking quality wheat, a medium strong to strong class, which would meet home requirements and quality markets which should be exploited and developed while opportunity exists.

PROTEIN QUALITY

Farrer, Norris and Guthrie in early studies found that high protein flour did not necessarily bake the best loaves and they were the first to recognise the importance of protein quality as distinct from quantity. Since their time there has been considerable clarification of the importance of and the

part played by the quantity and quality of the grain protein, and also in methods at our disposal for measuring the value of flours for baking.

It is now generally conceded that the quantity of protein is chiefly determined by environment while its quality is influenced more by heredity. Millington and Remilton, in the March 1954 issue of the "Journal of the Australian Institute of Agricultural Science," present a new concept of the protein story which may be of significance. They quote evidence to the effect that the amount of protein produced per acre in a region or State tends to be constant, irrespective of variety, so that a high protein level in the grain tends to be balanced by a low yield. This, however, has by no means been proved.

Millington and Remilton go on to say: "Since the withdrawal of the nitrogen from the soil appears to be on the average relatively constant regardless of variety, it is important that the maximum strength be developed per unit of protein present in the grain."

From South Australian data these workers found that Javelin and Bencubbin, for instance, had very similar protein contents when grown under the same conditions, but Javelin had a better strength figure in all tests at each level of protein, and would consequently produce stronger flour while yielding as well as Bencubbin. The data also indicated that a variety such as Scimitar only showed superior flour strength at comparatively high levels of protein, so that its cultivation cannot be recommended for districts which normally produce grain of a low protein content. On the other hand, once a critical level of about 10 per cent. protein has been reached its high efficiency in terms of strength per unit of protein makes it a most desirable variety.

Present knowledge of the protein characteristics of existing varieties make it a feasible proposition to think in terms of an association between the variety and a minimum level of protein content as a basis for a classification system,

LIMITING FACTOR

It is clear that over-cropping and exploitation of our wheat lands can result in a reduction in the quantity of protein, soil nitrogen being the limiting factor. The remedy for this is in the hands of the farmer, but only by breeding the right varieties and growing them can we cover the quality factor of the protein. The problem then resolves itself into one of growing better quality varieties on soils in good heart. This calls for co-operation between the farmer and the plant breeder, as well as a proper understanding on the part of those who buy and sell our wheat.

While premiums may be offered for high baking quality wheat for home consumption, the final answer is not so much dependent on premiums, but rather on the breeding of varieties which combine good baking quality with high yield; such varieties require good husbandry and fertile soils to enable them to produce their full characteristics.



FIVE PERIODS

For the purposes of reviewing the relative importance of baking quality in the Australian wheat crop it is logical to think of five distinct periods:

1. The Farrer period, because undoubtedly Farrer was the first to recognise the need for improving the baking quality of Australian wheat.
2. The period when Australian wheats gained a characteristic and unchallenged position on the world's markets as the finest white wheats for blending purposes. This is the period when Australia reaped the benefit of Farrer's remarkable contribution of white wheat varieties of satisfactory quality.
3. The third period, which reached its climax some twenty-five years ago, was marked by criticism, by our previously

well-satisfied customers, of the standard of baking quality of our f.a.q. wheat. This was the period when very weak wheat varieties, some of which produced flour of poor colour, had attained the leading position in the Australian harvest. This period represents the outcome of efforts to increase yield without taking into sufficient consideration factors of baking quality, and it coincided with a period of over-cropping which was taking a heavy toll of the fertility of wheat land soils.

4. As a result of these unfavourable reactions, the fourth period emerged when departments of agriculture in Australia directed attention to the need for safeguarding the future quality and good name of Australian wheat. In this period wheat breeders concentrated on combining yield with baking quality factors, a programme made possible by the availability, for the first time, of simple tests for quality which could be made on small samples.
5. The present period represents the first fruits of a concerted effort on the part of wheat breeders, in most states of Australia, to breed better baking quality wheats, so that to-day, for the first time, Australia can say at least one-quarter of its wheat crop is of medium strong and strong baking quality.

When Farrer began his work, the flour from Australian-grown wheat was generally regarded as too poor to bake satisfactory bread—flour for bread was imported from overseas. Farrer's first efforts at quality breeding resulted in the variety Bobs. This wheat was of such strong baking quality, that, blended with the very weak wheats then grown, it lifted their value for bread making almost beyond recognition. Dr. Sutton of Western Australia told me recently that a miller of Gunnedah wrote to Farrer about this time to say he had a mill full of flour that he could not sell. Farrer advised him to buy some Bobs wheat and blend its flour at the rate of one bag in five with the poor quality flour he held. Shortly afterwards the same miller reported that he was having

no difficulty in selling his flour. Bobs, however, although it gave Australia a strong quality wheat, was a low yielder.

Farrer's next release in the quality class was Comeback which undoubtedly ranked as one of the strongest wheats in the world and combined all the good characteristics of Australian wheat. Its great disability, however, was that it was a poor yielder.

FEDERATION

Federation wheat, which ushered in a new era in Australian wheat growing, was a vastly better quality variety than those previously grown and it had those desirable characteristics which served to build the name of Australian wheat on the overseas market.

Farrer's work, carried on so faithfully by his immediate successors, of whom the names of Pridham, Pye, Gordon and Sutton are perhaps outstanding, added further increments of yield to the Australian harvest. In this post-Farrer period, the milling properties of Australian wheat were recognised in Great Britain as being second to none. It was a dry wheat, easy to mill, giving a high yield of bright, white flour of excellent bloom and flavour. Apart from giving a high commercial yield of flour, it was a profitable wheat to use in blending because of its high water absorbing capacity.

Just as Canada became famed on the world's markets for its hard red wheat of high baking quality, so Australian white wheat became famed on the British market for its outstanding characteristics of colour, dryness and blending value. The zenith of this period was when Australian wheat actually brought a premium on the United Kingdom market over the main grade of Canadian Manitoba.

During the depression years, which were by no means peculiar to Australia, there was a marked increase in world production of soft white wheats. Since then Australia has not enjoyed a premium because there has been a higher proportion of white wheats on the world's market. This has also coincided with a low level of baking quality in our f.a.q. because of the dominating influence of some very weak wheats which lacked the usual Australian whiteness of colour. These



Federation

developments led at the time to a thorough stocktaking of the situation in Australia by the departments of agriculture, a stocktaking which resulted in wheat breeders of the Commonwealth setting about the task of producing better quality, high yielding wheats, even at the expense of discarding promising high yielding segregates which were poor in quality.

WATERHOUSE

The challenge to improve the general standard of baking quality in our Australian wheats was enthusiastically accepted by most wheat breeders throughout the Commonwealth, making use of the new aids for testing quality of small samples of wheat. There

seems to be no doubt that Professor W. L. Waterhouse was the first in Australia to achieve in full measure what Farrer originally aimed to do, that is, to combine a high yielding, good quality wheat with rust resistance. It was very fitting and appropriate that the first Farrer scholar should have achieved this distinction.

Other breeders have achieved extraordinary results over the last 20 years in combining high baking quality with greater yield. So that to-day, the farmer is able to grow varieties which not only yield well but have high baking quality. They are wheats giving flour which, to use Farrer's words again, are "capable of being made into a loaf which is light, white, and so attractive to the eye, agreeable to eat and easy to digest."

To illustrate this, I have had wheat of two varieties, of contrasting baking quality, gristed and baked. The loaves presented are from *Quadrat* and *Gabo*—the one a weak baking quality wheat, the other a medium strong to strong variety.

A comparison of the leading varieties in Australia to-day with those of 20 years ago illustrates the significant shift that has taken place as a result of plant breeding efforts. This shift has been in favour of better quality wheats. In 1932 only one-thirtieth of the wheat acreage in Australia was devoted to medium strong to strong varieties, but the most recent data (1952) indicates that one-quarter of the acreage is now devoted to this class of wheat.

Twenty years of sound policy, aimed at lifting the making qualities of wheat, have resulted in phenomenal success. This is clearly disclosed by an analysis of the acreages devoted to different wheat varieties in 1952, the last figures available, as compared with those in favour twenty years ago (1932). I offer no apology for drawing on South Australian data first. Of the twelve leading varieties grown in South Australia in 1932, eleven were of the weak or very weak quality class and only one was classed as medium strong (*Ford*).

The twelve leading varieties accounted for 72 per cent. of the total acreage, made up of 68 per cent. weak or very weak and 4 per cent. medium strong. In 1952, of the twelve leading varieties grown five were strong wheats, one medium strong and six weak. More significantly still, the 77 per cent. of the total acreage accounted for by the first twelve wheats was made up of 43 per cent. strong, 3 per cent. medium strong and 31 per cent. weak.

Over all wheats grown now in South Australia, 51 per cent. of the acreage is devoted to medium to strong varieties.

BREAKWELL

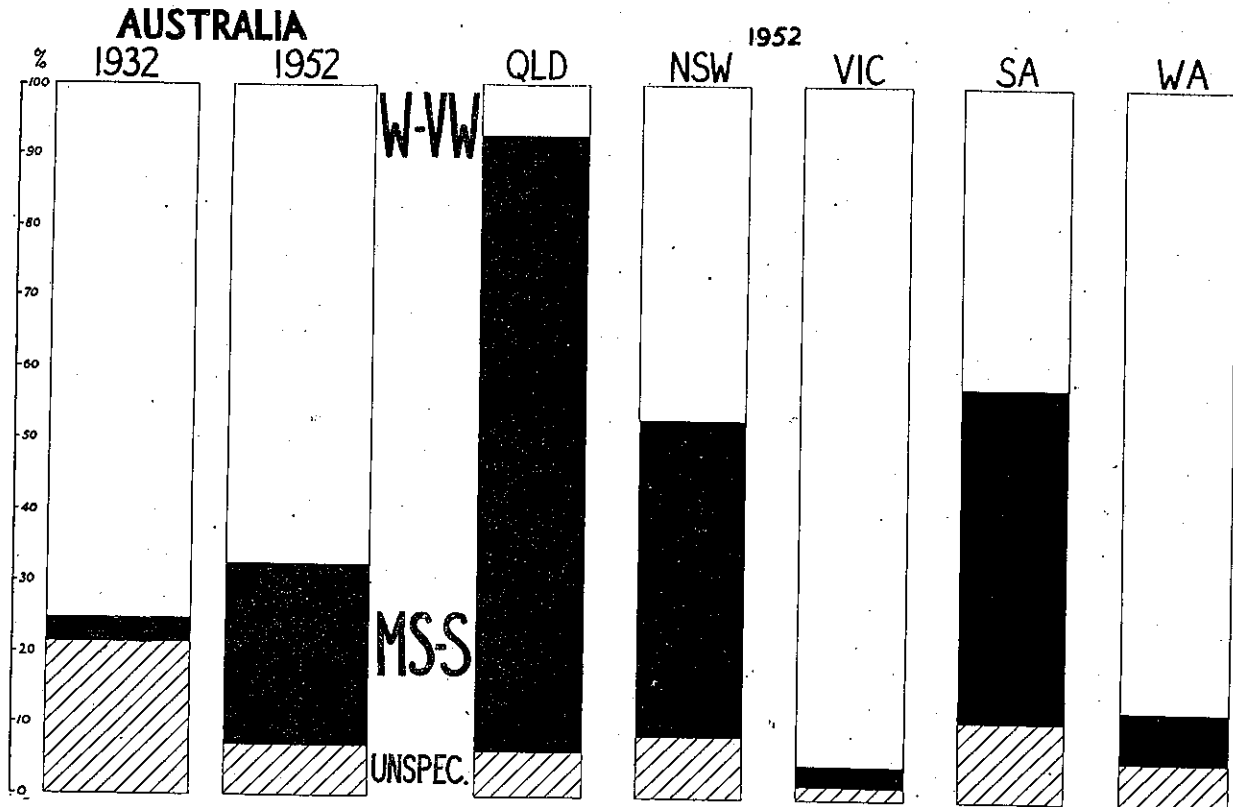
At this stage I would like to pay a personal tribute to Mr. E. J. Breakwell who, as plant breeder at Roseworthy Agricultural College from 1933 to 1947, was responsible for breeding some of the best high yielding, good quality wheats ever bred in Australia. Of these *Scimitar*, *Javelin*, and *Dirk* are outstanding.

By way of underlining these developments, last year in South Australia the Best Crop Championship as well as the Quality Wheat Crop Championship of the State were won by the same man with the same crop, the quality variety named *Dirk*. This is epoch-making and is undoubtedly a remarkable achievement, made possible by the farmer's skill and over twenty years of effort by South Australian wheat breeders who have succeeded in combining high yield with baking quality.

N.S.W. CONTRASTS

The contrasts of to-day and twenty years ago in New South Wales are equally vivid. Of the leading varieties in New South Wales in 1932 all were weak or very weak with the exception of *Ford*, which was the tenth variety and accounted for only 2.5 per cent. of the total acreage. The ten leading varieties in New South Wales at this time accounted for 76.3 per cent. of the total acreage, made up of 73.8 per cent. weak

Acreages of Australian Wheat Varieties



AUSTRALIA, 1932: Weak to very weak—75.4 per cent.; strong to medium strong—3.3 per cent.; unspecified—21.3 per cent.

AUSTRALIA, 1952: Weak to very weak—67.4 per cent.; strong to medium strong—25.6 per cent.; unspecified—7 per cent.

VARIETY CLASSIFICATION BY STATES—1952

QUEENSLAND (455,000 acres): Weak to very weak—7 per cent.; strong to medium strong—86.7 per cent.; unspecified—6.3 per cent.

NEW SOUTH WALES (2,835,000 acres): Weak to very weak—46.7 per cent.; strong to medium strong—44.6 per cent.; unspecified—8.7 per cent.

VICTORIA (2,499,000 acres): Weak to very weak—95.3 per cent.; strong to medium strong—2.9 per cent.; unspecified—1.8 per cent.

SOUTH AUSTRALIA (1,687,000 acres): Weak to very weak—41.9 per cent.; strong to medium strong—47 per cent.; unspecified—11.3 per cent.

WESTERN AUSTRALIA (3,162,000 acres): Weak to very weak—87.1 per cent.; strong to medium strong—7.1 per cent.; unspecified 5.8 per cent.

or very weak and only 2.5 per cent. medium strong. In 1952 the ten leading varieties accounted for 86.1 per cent. of the total acreage, made up of 47.9 per cent. weak and 38.2 per cent. medium strong to strong.

MACINDOE

There is no doubt that the name of Dr. S. L. Macindoe as well as that of Professor W. L. Waterhouse and Mr. Breakwell will long be associated with the varieties bred in this period in New South Wales.

On the overseas market, Australian wheat has been sought after because of its special value for blending with the high baking quality red wheats of North America. Good medium quality and a highly desirable white flour have made a special place for Australian wheat on the world's market.

For some years now, however, we have lost some of the advantage we previously held. Ever since the depression years there has been a higher proportion of white wheats on the world's market and, in recent years, dollar shortages have caused many countries to rely less on the red wheats of North America than previously. These two factors are emphasising the baking quality of white wheats to an extent not previously experienced.

There is no doubt that pre-war, the overseas market for Australian wheat was not interested in baking quality as such. All the arbitration on disputes in the corn exchanges of the United Kingdom were around the comparison of the sample with the f.a.q. standard, taking into consideration bushel weight, colour and impurities—baking quality did not enter into any of the arguments. These conventional markets will still continue to seek Australian white wheat for its outstanding properties for blending with high quality Canadian.

NEW MARKETS

Recent enquiries by the Australian Wheat Board, in most cases through personal contact, have shown that potential markets, in which baking quality factors are important, do exist in Africa and Southern Asia. To satisfy these markets, Wheat Board authorities consider that a minimum

of 10 per cent. protein content is necessary. Many of these markets are still buying Canadian and United States wheat, and the only way to interest them is to produce wheat capable of being milled and baked without the need for blending.

It is significant to note that the Australian Wheat Board is able to interest some of these markets in Queensland wheat because of its better baking quality. The Board also finds that some markets react favourably to South Australian wheats. This points to the fact that Australia has no opportunity of meeting and developing these potential markets by the simple expedient of keeping certain regional supplies in separate and distinct parcels.



Quadrat

SCIENTIFIC BASIS

Obviously, if any marketing reform is contemplated, it must take into consideration the true scientific basis on which baking quality is determined, namely, on the quantity and quality of the protein in the grain.

In spite of the fact that methods such as the Pelshenke test are simple and can be conducted on small quantities of grain, they do require elaborate organisation for sampling and testing which makes them complicated as a measure for commercial wheat. On the other hand, all the scientific evidence indicates that the quality of the protein is varietal and, provided there is a high level of actual protein in the grain, the combination assures high baking quality.

Sufficient is known in Australia of the protein characteristics of all commercially-grown varieties to make it comparatively simple to classify them according to their strength. Medium strong to strong varieties could well be segregated into an Australian strong wheat class, the minimum standard of which could be established at somewhere about 11 per cent. protein content. This would enable the production of flour of approximately 10 per cent. protein, and, by medium of the varietal classification, would guarantee the strength of the gluten for bread making.

This would automatically enable the miller in Australia to purchase Australian strong wheat for home consumption and for the production of export flour. In nearly all countries where flour is imported for bread making a standard of 10 per cent. protein is specified. It would also provide a standard high quality wheat class which would gain respect and status on discriminating markets which are known to exist.

CONCLUSIONS

1. One-quarter of the Australian wheat crop to-day is produced from varieties in the strong to medium strong class.



Gabo

Generally speaking, these wheats are marketed on their protein content only and, in so far as they are drawn from regions which concentrate on medium strong to strong varieties, this principle is quite sound. It can, however, lead to serious limitations where both strong and weak varieties are grown in regions of reasonable soil fertility.

2. If the Australian producer of high quality wheat is to be rewarded for quality, it is necessary to think in terms of separating the highest quality lines from the standard f.a.q.

3. This can be done without prejudice to the value of the Australian f.a.q. on the conventional market, where high baking quality is not an essential.

4. The retention of the f.a.q. for conventional trading purposes appears to be desirable.

5. To meet new and potential markets for white wheats of high baking quality, Aus-

tralia should establish a strong white class as distinct from f.a.q.

6. The establishment of an Australian strong white class might well be considered on a basis of varietal classification similar to that used in Canada and Argentine, plus the adoption of a minimum protein level, which for the purposes of argument is suggested at about 11 per cent.

7. The successful maintenance of a permanent standard class of Australia strong white will depend on the general soil fertility levels being raised in some regions and maintained in others.

