OVERSEAS TESTS OF THE MILLING AND BAKING QUALITIES OF GARNET WHEAT

TOGETHER WITH TESTS BY

THE STATE TESTING MILL, MINNEAPOLIS, MINN.
THE PILLSBURY FLOUR MILLS, MINNEAPOLIS, MINN.
THE TRENT INSTITUTE, ONTARIO AGRICULTURE COLLEGE, GUELPH, Ont.

BY

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CEREAL DIVISION
DOMINION EXPERIMENTAL FARMS

DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
BULLETIN No. 134—NEW SERIES

Published by direction of the Hon. W. R. Motherwell, Minister of Agriculture,
Ottawa, March, 1930

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Dominion of Canada
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Tests of the Milling and Baking Qualities of Garnet Wheat

FOREWORD

Garnet wheat, an early-maturing variety of hard red spring wheat produced and developed by the Cereal Division of the Experimental Farms Branch, Dominion Department of Agriculture, Ottawa, was first made available to Canadian farmers for testing in field areas in the spring of 1926. In 1927 the department published a bulletin in which an attempt was made to submit an unbiased statement of the field performance as well as of the milling and baking qualities of this wheat compared with Marquis and other varieties investigated up to that time.[1] The general conclusions as to the relative merits of Garnet as submitted in the above bulletin (page 74) were as follows:—

"From the data now available we may conclude that Garnet is a variety which merits consideration especially in those districts where the conditions are inimical to the proper development of Marquis. It is generally agreed that it is preferable to produce a well-developed Garnet sample than a poorly developed or unsound sample of Marquis. For reasons given below, however, we cannot recommend Garnet as a substitute for Marquis in districts where the latter variety may be depended upon to thrive successfully, although even in these districts it may often be profitable to the farmer to allow the former variety to occupy a part of the area devoted to wheat.

"From the standpoint of milling and baking qualities, Garnet, undoubtedly, does not rank as high as Marquis, all things considered, although it seems entitled to rank among the good milling wheats. The chief point regarding which Garnet is open to criticism is in the colour of flour. This without doubt is more creamy than Marquis. Since, however, bleaching and maturing processes have become so highly developed and are becoming so generally practised, the objection to the colour of Garnet would appear to be appreciably minimized."

In connection with the above summary, attention is drawn to the chief differences which exist between Garnet and Marquis, in respect of certain points which have a bearing on milling and baking qualities. Thus, it was shown that under conditions which are favourable to the proper development of the kernel of Garnet, this is inclined to excel the kernel of Marquis in weight per measured bushel. On the other hand, where conditions are unfavourable, the kernel of the former variety is inclined to be "lean," and thus not so desirable from a milling standpoint. It was shown, however, that the kernel of Garnet is definitely inclined to be more vitreous, and that it appears to hold its colour better than Marquis, particularly in districts where the latter variety is inclined to produce starchy or "piebald" kernels.

In "flour yield" it was shown that Garnet appeared to equal Marquis, even when the weight per measured bushel was slightly less than Marquis. In "crude protein" this was found to be somewhat lower as a rule in Garnet than in Marquis, although the colour of the grain would lead one to think otherwise. As regards "absorption" and "bread yield," it was found that Marquis is inclined to excel Garnet to some extent. In "elasticity of dough," Marquis again was considered somewhat superior to Garnet, whereas in "stability of dough" the latter variety appeared to have the advantage. In loaf volume and in texture of crumb, Garnet was considered approximately equal to Marquis, while in crust colour and general appearance of loaf, Garnet was considered to be superior.

[1] *Garnet Wheat* by L. H. Newman and A. G. O. Whiteside, Central Experimental Farm, Ottawa, Bulletin No. 83, New Series, 1927.

From the foregoing it will be noted that Garnet was recognized to be somewhat different in milling and baking qualities from Marquis, but it was felt that these differences were not sufficiently great to warrant the withholding of the former variety from trial by farmers in field areas. Especially was this the case in view of the fact that a wheat possessing the desirable agronomic characteristics of Garnet would likely prove of immense value in those districts where an early-maturing, high-yielding variety is practically imperative.

Since its introduction Garnet has spread rapidly, especially throughout those districts where early maturity is of prime importance. Undoubtedly Garnet matures early (from seven to ten days ahead of Marquis on the average) and at the same time is entitled to be classed as a relatively high-yielding wheat. Its desirable agronomic characters have meant much already to innumerable growers who formerly had found wheat raising a relatively risky and disappointing undertaking owing to the frequent damages suffered from late summer frosts. It would appear, therefore, that Garnet wheat is likely to occupy a place of considerable importance in certain areas throughout northwestern Canada, at least until such time as a better variety comes along to take its place. In view, however, of the differences which exist between Garnet and our present Manitoba Northerns, as pointed out in the above bulletin, together with the fact that Canadian millers not only discount Garnet on account of colour of flour, but find that this variety requires somewhat different treatment in connection with the preparation for milling, the question as to how this wheat may be handled to best advantage for all concerned becomes one of prime importance. To be specific, the question now to be settled may be stated as follows: *Should Garnet be allowed to go into our highest grades of Manitoba Northern wheat without restriction of any kind, or would it be preferable to set up at least one or two separate grades for the accommodation of this variety or continue to handle it as at present?*. In order to obtain further information in connection with all aspects of this important question, the Dominion Department of Agriculture decided to ship several thousand bushels of Garnet wheat to Great Britain and the Continent in order that both milling and baking tests might be made on a large scale. It was realized that the situation in the Old Country with regard to the manufacture of flour is quite different, generally speaking, from that which obtains in Canada, in view of the fact that wheats from different countries are available for blending prior to milling, the wheat from each country contributing certain distinctive characteristics to the blend.

It was also decided to forward a shipment of 250 bushels of Garnet and 250 bushels of Manitoba of the same grade to the State Testing Mill at Minneapolis, in order to obtain further information regarding the relative milling behaviour of Garnet and of Garnet mixed with ordinary Manitoba Northern, when ground together under Northern American conditions.

The writer desires at this point to express his personal appreciation, as well as that of the Dominion Department of Agriculture, of the splendid cooperation of all who assisted in connection with the above investigation. To the Canadian Wheat Pool, which did such excellent work in assembling and transporting the grain, and to those who gave their time so freely in investigating its qualities, we are deeply grateful. We are also indebted to Dr. F. J. Birchard, of the Dominion Department of Trade and Commerce, who followed the overseas investigations throughout, and who rendered valuable assistance in connection therewith.

PART I

OVERSEAS TESTS OF GARNET WHEAT

The overseas shipment of Garnet wheat above referred to consisted of 6,700 bushels. This went forward in the spring of 1929 to certain points in Great Britain and on the Continent, where milling and baking tests were to be made, where possible, on a commercial scale. The shipment was under the personal supervision of Mr. L. H. Newman, Dominion Cerealist, while Dr. F. J. Birchard, representing the Department of Trade and Commerce, also followed in person the details of the work performed at a number of the different centres.

In order that the wheat going forward should be as representative of the variety as possible, care was taken in the selection of the localities in which the said grain was produced. As a result one car was obtained from near De Winton, Alta.; one from near Scott, Sask.; one from near Wilkie, Sask.; one from near Southey, Sask., and two from the Shoal Lake district of Manitoba. The actual securing of the wheat was accomplised by the Canadian Wheat Pool, which organization had the different cars thoroughly mixed together at Fort William under the direct supervision of a departmental official, after which the wheat was put up in specially stencilled sacks, so that its identity might be retained.

Samples were taken from each of the above cars as well as from the sacks containing a mixture of the cars when these were thrown together. These samples were grown at the Experimental Farm at Ottawa, in order that there might be absolute proof that the genuine article had gone forward. It might be stated here that these tests showed that the wheat secured in each district consisted of a very pure lot of Garnet, and the shipment truly represented the average quality of this variety.

In the following list are submitted the names of those who investigated this wheat, namely:—

Dr. E. A. Humphries, manager, Coxes Lock Mills, Weybridge, England.
Dr. D. W. Kent-Jones, Woodlands Ltd., Dover, England, co-operating with G. W. Chitty & Company.
The Research Association of British and Irish Millers, St. Albans, England, under the supervision of the director, Dr. E. A. Fisher.
The Associated Flour Mills, Deptford Bridge (London), England.
Jos. Rank & Company, London, England.
Spillers, Limited, London, England.
Scottish Co-operative Wholesale Society, Edinburgh and Glasgow, Scotland.
Grands Moulins de Corbeil, Corbeil, France.
Georg Plange Company, Soest, Germany.
Georg Plange Company, Düsseldorf, Germany.
Georg Plange Company, Hamburg, Germany.
Hefftsche Kunstmühle, Cologne-Mülheim, Germany.
Kolpinhaus Bäckerei, Cologne, Germany.
Holsatia Mills, Keil, Germany.
De Maas Mills, Rotterdam, Holland.
Van Stolks' Commission, Rotterdam, Holland.
Research Institute of Cereal Chemistry, Frankfürt, Germany.
The T. Bienert Flour Mills, Dresden, Germany.

Institute of Milling and Grain Research, Berlin, Germany, under the direction of Dr. Karl Mohs.
The Baking Institute of Grain Research, Berlin, Germany.

The Garnet assembled at Fort William, and which was used in connection with these tests, was graded officially as No. 2^0. The presence of an odd green kernel was largely responsible for its not being entitled to receive grade No. 1, had such a grade otherwise been permissible.

Those investigating this wheat were asked to secure a sufficient quantity of ordinary Manitoba of the same grade, namely, No. 2^0, in order that a fair comparison might be made. In some cases, unfortunately, it was not easy to obtain this grade and as a result a lower grade of wheat was used. In three cases, for instance, a No. 4 wheat, containing a considerable percentage of frosted kernels, was used. In these cases, obviously, some allowance will have to be made in interpreting the results.

In order that the investigation might be as thorough as possible and that no essential information might be overlooked, a series of questions, both for the miller and for the baker, were prepared and forwarded to each investigator. The questions asked are submitted below as follows:—

QUESTIONS ASKED THE MILLERS

(1) Does the presence of a substantial proportion (say 50 per cent) of Garnet wheat in ordinary "Manitoba" of the same commercial grade offer any serious difficulty from the milling standpoint, especially as regards conditioning and separation of mill products?
(2) How does a mixture such as the above compare in flour yield with that obtained from (*a*) pure Garnet and with (*b*) Manitobas unmixed with Garnet?
(3) How do the above three lots of wheat compare in regard to their behaviour toward bleaching and maturing agents?
(4) Does the colour of the flour from Garnet add to or detract from its value in the trade to which you cater or is it of no particular importance?
(5) Would there be any advantage to the trade if Garnet were offered in a relatively pure state, that is, unmixed with any substantial proportion of ordinary Manitobas such as are now handled?
(6) How do the above three lots of wheat (*a*) pure Garnet, (*b*) ordinary "Manitobas" of the same grade not containing Garnet, and (*c*) a mixture of equal proportions of (*a* and *b*) compare in value for blending with non-Canadian wheats?
(7) Viewing the whole question broadly and having in mind the fact that the proportion of low grade wheat produced in Canada each year undoubtedly would be reduced substantially should Garnet be grown extensively in districts where Marquis is likely to suffer from frost or where it produces a distinctly softer grain than does the former variety, would you consider it advisable to encourage the production of Garnet in any part of Canada?

QUESTIONS ASKED THE BAKER

I. How does the flour made from pure Garnet wheat compare with that from ordinary "Manitobas" and with a 50-50 mixture of the first and second in the following points:—
    (1) Absorption and bread yield.
    (2) Resiliency of dough.
    (3) Ductility of dough.
    (4) Fermentation tolerance.

(5) Loaf volume.
(6) Crumb texture.
(7) Crumb colour.
(8) Crust-shape, break, shred, bloom, etc.
(9) Flavour.

II. How do the above three flours compare as to—
(*a*) value for blending with weaker flours.
(*b*) value for reducing the "stubborness" of very strong flours.
(*c*) value for general use in so far as concerns the trade to which you cater.

III. Does the colour of the flour from Garnet add to or detract from its value in the trade to which you cater, or is it of no particular importance?

IV. Would there be any advantage to the trade if Garnet were offered in a relatively pure state, that is, unmixed with any substantial proportion of ordinary Manitobas such as are now handled?

SUMMARY OF REPLIES TO QUESTIONS ASKED

I. *Dr. A. E. Humphries, Coxes Lock Mills, Weybridge, Surrey, England:*

(*a*) This investigator did not find it necessary to make any difference in the conditioning of Garnet prior to milling, neither did he experience any difficulty in milling a mixture of Garnet and Manitoba No. 2.

(*b*) Using the electrified air (nitrogen peroxide) method he found that Garnet "takes the bleach" as well as flour made from Canadian standard spring wheat.

(*c*) *Colour of Flour.*—He does not consider this especially objectionable. Personally he prefers the slightly creamy colour of the unbleached flour of Garnet, but realizes that he is in a small minority of buyers of flour and bread in England.

(*d*) *Gluten.*—He favoured the appearance of the dried gluten of Manitoba 2, although he considered the gluten of Garnet to be more stable.

(*e*) *Proving Gas.*—In all cases Garnet seemed to yield more gas than the Manitoba 2 Northern.

(*f*) *General Opinion of Garnet.*—He considers Garnet a good wheat of its kind, but different from the present Manitobas.

(*g*) *Opinion re Method of Handling.*—He advises that Garnet be made available in a relatively pure state, at least until such time as may be necessary to give the English millers an opportunity to thoroughly investigate its quality. He believes it safe to say that its real merits will be ascertained and its commercial value paid within a season or two.

II. *Dr. D. W. Kent-Jones, Woodlands, Ltd., Dover, England:*

(*a*) *Condition and Milling.*—He does not believe that Garnet will offer any special difficulties under this heading, either when milled alone or in combination with other hard wheats such as the present Manitobas.

(*b*) *Bleaching of the Flour.*—He found this to be accomplished quite easily.

(c) *Colour of Flour.*—Since bleaching is generally practised in England he does not consider the yellowness of Garnet a great drawback here.

(d) *Flour Yield.*—This he found to be unusually high in Garnet.

(e) *Absorption.*—He found that Manitoba 2° had a tendency toward higher water absorption and therefore higher bread yield.

(f) *Gluten.*—Garnet stiff and stable but lacks the elastic 'spring' of Manitoba 2°. He points out, however, that the flour of Garnet improves much more rapidly with age than does the latter.

(g) *Gas Producing Power.*—Garnet was found to be higher than Manitoba 2°.

(h) *Crust Colour.*—He considered Garnet superior to the Manitoba 2° in this respect.

(i) *Value for Blending with Weaker Wheats.*—He thinks 'Manitobas' will probably be the more useful wheat here, generally speaking.

(j) *General Opinion of Garnet.*—He considers Garnet to be an excellent wheat, although differing in some essential particulars from the present Manitobas. He believes the market will rapidly appreciate its merits and that there may be times when Garnet may even command the higher price.

(k) *Opinion* re *Method of Handling.*—He thinks it would be unwise at the present to mix Garnet into ordinary Manitobas. He advised the writer verbally that it would probably be sufficient if only the top one or two grades of Garnet were marketed separately. Otherwise he fears that Garnet might often be blamed for difficulties with which it may have had no connection.

III. Dr. E. A. Fisher, Director of Research, Institute, British and Irish Millers' Association, St. Albans, Eng.:

(a) *Conditioning and Milling.*—This investigator found Garnet an excellent milling wheat either by itself or in mixtures, but apparently more or less sensitive to differences in conditioning and in milling technique.

(b) *Colour of Flour.*—He considered the colour of Garnet to be inferior to the Manitoba No. 2° with which it was compared.

(c) *Flour Yield.*—This was found particularly high in Garnet.

(d) *Gas Production.*—Garnet inferior to Manitoba No. 2.

(e) *Fermentation Tolerance.*—Garnet not so satisfactory as Manitoba 2.

(f) *Dough Stability.*—Garnet was equal to Manitoba in this.

(g) *Crust and General Appearance.*—Garnet was equal to Manitobas.

(h) *Value for Blending with Weaker Wheats.*—In the present test Garnet did not prove as satisfactory as did the Manitoba No. 2 with which it was compared.

(i) *Opinion* re *Method of Handling.*—He says "it would certainly be desirable to keep Garnet separate from ordinary Manitobas for a few years until European millers have become familiar with its peculiarities and have learned how to deal with them in commercial milling practice". He is of the opinion that the conflicting opinions regarding the relative merits of Garnet may be due to the sensitiveness of this variety of wheat and flour to conditioning and storage.

IV. Associated London Flour Millers Limited, London, E.C. 3, England:

(a) *Conditioning and Milling.*—This concern states that Garnet would appear to require tempering at a little higher moisture content and to need a little more intensive "mellowing" than would ordinary Manitoba. Garnet milled quite satisfactorily, however, either alone or in blends with the Manitoba.

(b) *Colour of Flour.*—The colour of Garnet flour would be a drawback they state where customers stipulate that their flours must be unbleached. In the present test, however, Garnet was superior in colour to the Manitoba No. 3 with which it was compared.

(c) *Gluten Quality.*—This, as expressed by the elasticity figure, shows Garnet to be definitely superior to No. 3 Manitoba of the present crop (1928).

(d) *Ductility.*—The " firmness figure " shows that Garnet gives a much tougher and less ductile dough than No. 3 Manitoba, which goes to discount the higher elasticity.

(e) *Gas Retaining Power.*—This was relatively low in Garnet compared with the high " firmness " figure; the gas-making capacity, however, was high.

(f) *Maltose Figure.*—This was abnormally high in Garnet, which situation was believed to explain the particularly pleasant flavour of the bread.

(g) *Flavour of Bread.*—This was distinctly in favour of Garnet. This factor considered a decided asset.

(h) *Water Absorption.*—This was somewhat less in Garnet.

(i) *Volume of Loaf.*—Here again Garnet was somewhat inferior to Manitoba 3.

(j) *General Strength.*—" Garnet has not the high elastic strength that used to be possessed by Manitobas ".

(k) *General Opinion of Garnet.*—" There is no doubt but that good use can be made of this wheat in London, provided it can be bought separately as Garnet wheat ". As such, he says, it has a distinct value of its own, but if mixed with Manitobas, it will not only lose its own distinctive value, but it will tend to greatly lower the distinctive value of the Manitoba wheat.

(l) *Opinion* re *Method of Handling.*—From the above it will be quite clear that this investigator favours the separate grading of Garnet, or at least the giving of one or two high grades for this variety. He believes that if Garnet be graded separately, that farmers need not fear having to sell it at a heavy discount as compared with Manitobas, though he does not think they would get the same price for it as they would for the present No. 1°. On the other hand, he believes the price would depend somewhat on the proportion of Garnet wheat coming forward.

V. *Jos. Rank, Ltd., London, England:*

(*a*) *Conditioning and Milling.*—No difficulty was experienced here. Garnet milled freely and only very slight adjustments to the mill had to be made.

(*b*) *Colour of Flour.*—" The flour made from Garnet is somewhat yellow, but this was found to improve appreciably with age".

(*c*) *Volume of Loaf.*—Comparatively little difference was found between the loaves of Garnet and those of Manitobas and mixtures of same, especially when flour a month old was used.

(*d*) *Value of Garnet for Blending with Weaker Wheats.*—In tests made of mixtures of varying proportions of Garnet with varying proportions of Baril (from Argentine), it was found that Baril when baked alone produced a loaf of rather better volume than in the case of the loaves containing a proportion of Garnet. Where more than 40 per cent of Garnet was included with the Baril a definite depreciation in the quality of the loaf was observed.

In mixtures of Garnet with Rosafé, another Argentine wheat, the outstanding loaf was one consisting of 20 per cent Garnet and 80 per cent Rosafé. Mixtures containing 40 per cent or more Garent very materially reduced both the volume and the quality of the loaf in every respect. No tests were made of mixtures of Garnet with really weak wheat, the Argentines not being so classed.

Further tests were made of mixtures of Garnet and Australian wheat, Australian being rather on the weak side. Here Garnet was not found to have any ' lifting properties ' to distinguish it, it being noted that the loaves containing a mixture of Garnet were only slightly larger than they would have any ' lifting properties ' to distinguish it, it being noted that the loaves

(*e*) *Opinion re Method of Marketing Garnet.*—This investigator obviously favours the separate grading of Garnet, but does not actually say so in his report.

VI. *Spillers, Limited, London, England:*

(*a*) *Milling Qualities.*—No remarks were made here as the flour was not milled by this firm but obtained from the Co-operative Wholesale Society Mills, the best being confined to a comparison of Garnet with Manitoba No. 2° in the bakery.

(*b*) *Colour of Flour.*—The colour of the Garnet flour was considered to be slightly inferior to that of the Manitoba No. 2, it being of a dullish gray cast.

c) *Colour of Crust.*—In this case the colour of the crust of Garnet was considered superior to that of the Manitoba No. 2.

(*d*) *Value of Garnet for Blending with Weaker Wheats.*—In tests made of a mixture of 30 per cent straight run flour from Garnet with 70 per cent of a white wheat mixture composed of Australian and a soft white Pacific, it was found that Garnet gave slightly better results than did the flour from ordinary No. 2 Manitoba. This was considered to be due to the better gluten quality of the Garnet.

(*e*) *General Opinion of Garnet.*—In these tests there was found to be very little to choose between the two wheats studied.

(*f*) *Opinion re Method of Handling.*—They suggest that for the time being Garnet be handled separately from the present Manitobas. While they do not say so in their report, their conversation led the author to conclude that they would be interested particularly in seeing one or two high grades of Garnet provided for.

VII. *Scottish Co-operative Wholesale Society, Edinburgh and Glasgow, Scotland:*

In this case Garnet grading No. 2 Northern was compared with Manitoba No. 4. The latter was said to be a purer type of Manitoba than any of the higher grades then in stock, but was badly frosted. Under these circumstances the results obtained from the two wheats can hardly be compared, although on some points information of distinct value was obtained.

(*a*) *Conditioning and Milling.*—On the basis of these tests Garnet was believed to require special preparation (conditioning) for milling on account of its hard nature.

(*b*) *Bleaching Properties.*—In this test Garnet did not respond so quickly to maturing agents as did the Manitoba No. 4, with which it was compared.

(*c*) *Colour of Flour.*—In the case of Garnet, the colour of flour was considered to be inferior to a degree sufficient to detract from the value of the latter in the trade catered to by this firm.

(*d*) *Gluten Quality.*—This firm states that "the quality of the gluten of Garnet is reminiscent of that of the durums, being hard and stable but lacking in "elastic pull". It is not such as to encourage confidence in the flour for bread making. Possibly this character could be modified, however, if the flour were more mellowed in preparation".

(*e*) *Gas Retention.*—This was found to be relatively low in Garnet.

(*f*) *Volume of Loaf.*—The volume of the loaves made from Garnet and Garnet mixtures were appreciably lower than those in which Manitoba 4 was used. It is not possible however to make a fair comparison between these wheats in respect of loaf volume on account of the fact that different grades were used.

(*g*) *Opinion* re *Method of Handling Garnet.*—This firm decidedly favours the separate grading of this variety.

VIII. *Grands Moulins de Corbeil, Corbeil, France:*

(*a*) *Milling and Conditioning.*—No apparent difficulty was experienced here.

(*b*) *Colour of Flour.*—The flour of Garnet was more yellow than in Manitoba 2 and this was reflected in the crumb, although the latter was rather more "brilliant" than in the case of the other variety.

(*c*) In yield of flour Garnet was somewhat superior to the Manitoba 2.

(*d*) *General Opinion of Garnet.*—In view of the different results obtained from flour obtained from different millings no definite conclusions could be drawn as to how Garnet should be rated. In some cases loaves from the Manitoba 2 were superior to those made from Garnet, while in other cases the reverse seemed to be the case.

IX. *Georg Plange Co., Soest, Germany:*

In these tests Manitoba 3 rather than Manitoba 2 was used for comparison with Garnet, the latter not being available. It was believed, however, that there was not enough difference between Manitoba No. 2 and No. 3 of the 1928 crop to affect the results.

(*a*) *Conditioning and Milling.*—Mixtures containing Manitoba 3 milled rather better than did those containing mixtures of the same proportion of Garnet except where the Garnet did not exceed 15 per cent.

(*b*) *Colour of Flour.*—The flour of Garnet was observed to be more yellow than that made from Manitoba 3, but no criticism was offered.

(*c*) *Gluten Quality.*—No important differences were detected between the glutens of the two wheats.

(*d*) *General Opinions Regarding Garnet.*—This concern is of the opinion as a result of these tests, "that the presence of Garnet in Manitobas may tend toward a general improvement of the latter, providing the percentage of Garnet is not over 50 per cent".

(*e*) *Opinion* re *Method of Handling Garnet.*—These people stated verbally that they would prefer to see Garnet handled separately in order that they might do the blending themselves and thus be assured that there would not be more Garnet in any mixture than these tests would seem to indicate should be there.

X. *Georg Plange Co., Düsseldorf, Germany:*

Dr. Litzendorf, the chemist for this firm, states in his report that the present investigation must be discounted to some extent in view of the fact that a Manitoba No. 4 instead of a No. 2 had to be used. The No. 4 contained numerous frozen kernels and therefore represented an abnormal condition. The results obtained with Garnet by this concern therefore, as

in the case of those obtained by the Scottish Co-operative Society, can hardly be compared with those obtained from the Manitoba No. 4, although in some points they are of value. Dr. Litzendorf states that the present test would seem to enable the following conclusions to be made, namely, that Garnet produces a very good baking flour, with high water absorption, and that in combination or blends with German wheat it gives very good results. He expresses the hope that Garnet and the present Manitobas will not come on the market in mixed condition, otherwise the uniformity of Canadian wheat which has enjoyed such an enviable reputation, would become impaired.

XI. *Hefftsche Kunstmühle, Cologne-Mülheim, Germany:*

(*a*) *Conditioning and Milling.*—As the wheat used in this test was ground on a small experimental mill, it was not possible to make any deductions of value on these matters.

(*b*) *Colour of Flour.*—In these particular tests the colour of the flour did not seem to be a factor of importance.

(*c*) *General Opinion of Garnet.*—Garnet taken by itself was believed to have the ability to give a good normal baked product if handled with care, but was not thought to be able to withstand the test of blending with weak gluten wheats. It was found that more wheat of inferior quality could be mixed in with the Manitoba 2 Northern than with the Garnet. Actually it was found that 30 per cent of Manitoba No. 2 Northern, would give about the same results in a blend as would 50 per cent of Garnet. Dr. Fritch, who conducted these tests, was very positive in his statement that the utmost care should be taken to safeguard the quality of the gluten of Canadian wheat, otherwise the latter might have to yield to the wheat of South America. The labour laws of Germany require a "quick rise", hence the need for strong flour in their blend. Wheat flour, furthermore, he pointed out, is often mixed with rye flour, in which case it is imperative that a quantity of very strong flour be used.

(*d*) *Opinion* re *Method of Handling Garnet.*—Obviously this concern is strongly in favour of the separate grading of Garnet.

XII. *Tests made at the Kolpinghaus Bäckerei, Cologne, Germany:*

This test was conducted in co-operation with those made by the Hefftsche Künstmuhle and is recorded by the latter as their test No. 5.

The general conclusions arrived at by the baker conducting the test at this well-known bakery and baking school, were that Garnet would probably not be as satisfactory as would the present Manitobas for mixing with weak German wheat.

XIII. *Tests by the Holsatia Mill, Keil, Germany:*

(*a*) *Milling Qualities.*—Mixtures of Garnet with ordinary Manitoba No. 2 did not present any serious difficulties.

(*b*) *Colour of Flour.*—Garnet produced a flour which was somewhat darker than that obtained from the Manitoba 2, but these differences practically disappeared when the flour was mixed with that made from German wheat.

(*c*) *Value for Blending with Weaker Wheats.*—In this respect Garnet appeared to be rather superior to Manitoba No. 2.

(*d*) *Absorption.*—In this case Garnet was slightly superior to Manitoba No. 2.

(*e*) *Strength.*—" The dough made from Garnet wheat flour showed good strength and stability in fermentation". "The working condition of this flour in these tests was superior to Manitoba 2".

(*f*) *Opinion* re *Handling of Garnet.*—This concern verbally expressed the opinion that they would prefer to have Garnet wheat put on the market in a pure condition in order that they might blend to suit themselves.

XIV. *Tests made by the De Maas Mill, Rotterdam, Holland:*

In these tests Garnet was compared with Manitoba No. 4, the latter containing an appreciable percentage of frosted kernels. As in the other two cases mentioned, where the latter grade of wheat was used, it is hardly possible to make a fair comparison between the behaviour of Garnet or Garnet mixtures and Manitoba 4 or Manitoba 4 mixtures.

(*a*) *Milling Qualities.*—No decided objections were offered by this firm *re* the milling qualities of Garnet.

(*b*) *Colour of Flour.*—The colour of the flour of Garnet was described as "decidedly yellow". Since a fairly white flour and white bread are demanded in Holland, generally speaking, this firm expressed the opinion that it might not be advisable to risk more than 30 per cent of Garnet in their mixture.

(*c*) *Gluten Quality.*—This was believed to be poor in the case of Garnet.

(*d*) *Opinion* re *Handling of Garnet.*—They would prefer to have it handled separate from the present Manitobas.

XV. *Tests by Van Stolks' Commission, Rotterdam, Holland:*

(*a*) *Milling Qualities.*—Garnet required more power in the milling process but the bran was thin and light and separated readily.

(*b*) *Yield of Flour.*—This was unusually high in the case of Garnet.

(*c*) *Colour of Flour.*—This was found to be " strongly yellow " in the case of Garnet, but also was found to bleach relatively well.

(*d*) *Quality of Gluten.*—This was found to be very hard and strong in Garnet but with good elasticity, although not ductile.

(*e*) *Quality of Dough.*—In this test the dough could not stand any very strong working, especially in the case of dough made from untreated flour, as it broke easily. It was found, however, to be able to stand fairly long fermentation without noticeably influencing its behaviour.

(*f*) *General Opinion of Garnet.*—In these tests Garnet behaved much like a mixture of Manitoba and durum.

(*g*) *Opinion* re *Method of Handling Garnet.*—Obviously these people would prefer to see Garnet graded separately as far as practicable.

XVI. *Tests by the Research Institute of Cereal Chemistry, Frankfürt, Germany:*

In these tests only very small samples were available and as a result Dr. Von E. Berliner, Director of the Institute, does not consider that his baking tests are absolutely reliable. On the other hand, he has come to the general conclusion that Garnet wheat flour from a technical point of view, does not appear to be quite equal to that of a good Manitoba flour.

XVII. *Tests made by the T. Bienert Flour Mills, Dresden, Germany:*

(*a*) *Milling Qualities.*—Garnet wheat was not found to offer any difficulties whatever in connection with the milling.

(*b*) *Colour of Flour.*—These people do not consider that any objection to the colour of Garnet flour is justified in Germany.

(*c*) *Value of Garnet for Blending with Weaker Wheats.*—The results of tests conducted by the Bienert Mills were considered to indicate that Garnet was rather superior to the Manitoba No. 2 for blending with the weaker German wheat.

(*d*) *Absorption.*—Here again Garnet was considered at least the equal of Manitoba 2.

(*e*) *Volume of Loaf.*—Garnet was found to be the equal of Manitoba 2 in this case also.

(*f*) *Bleaching Qualities.*—Garnet was found to possess extraordinary bleaching qualities. No criticism whatever was offered on this point.

(*g*) *Opinion Regarding the Method of Handling.*—Dr. Burghart, Chief Chemist, who conducted these tests, states that he can see no ground why Garnet wheat grading No. 2 should be kept separate from the present Manitoba No. 2 Northern, in view of the similarity of the two wheats in all essential particulars.

XVIII. *Tests made by the Milling Institute of Grain Research, Berlin, Germany:*

(*a*) *Conditioning and Milling.*—The hardness of Garnet was believed to make a special preparatory treatment necessary and this, they say, presupposes special knowledge which the German industry would have to acquire.

The Director, Dr. K. Mohs, concludes that Garnet wheat when specially handled and treated to allow for its special characteristics, would have milling qualities and flour yields which would correspond very closely with those of Manitoba No. 2 Northern.

XIX. *Results of Tests made by the Baking Institute of Grain Research, Berlin, Germany:*

In these tests different grades of flour made from German wheat, Garnet wheat, and from Manitoba wheat were compared, as were different combinations of the three. As a result of these tests the following general conclusions were arrived at:—

(*a*) *Value for Blending with Weaker Wheats.*—Garnet when used alone did not prove as useful for this purpose as did Manitoba when used alone, but when equal proportions of the two were blended with the German wheat, the same results were obtained as were realized when 50 per cent Manitoba and 50 per cent German were used.

(*b*) *Quality of Gluten.*—The gluten of Garnet was found to be more stable than was that of Manitoba, on account of which the dough of the former exhibited greater resistance to fermentation, although it was lower in elasticity.

(*c*) *Volume of Loaf.*—From the above it naturally follows that the volume of the loaf of Garnet is inclined to be a little lower than is that of Manitoba.

(*d*) *Texture.*—Garnet was considered rather superior in this.

(*e*) *General Opinion of Garnet.*—Thought to be a wheat which may become of distinct value, but experience in the use of it must first be acquired. When this experience has been gained, Garnet, it was thought, would practically be equal to Manitoba, but at present hardly considered to be the exact equivalent of the latter.

General Summary of Results Obtained From Overseas Tests

The question as to whether or not Garnet wheat, or mixtures containing varying proportions of Garnet, offers any serious difficulties from the milling standpoint, especially as concerns the matter of conditioning and the separation of milled products, seems to have been answered fairly definitely. While practically all investigators have expressed the opinion that the above wheat or mixtures containing same, might have to be " conditioned " a little differently than would our present Manitobas, yet this fact does not seem to be of serious moment. On the other hand, a number of investigators spoke with considerable enthusiasm regarding the good milling qualities of Garnet, either when milled alone or in mixtures. It should be kept in mind however, that both in Great Britain and on the Continent, wheat is usually milled at a higher percentage moisture content than is the case in Canada, which fact may account for the relatively good milling behaviour of this variety in the Old Country tests.

The answers to question No. 2 regarding the flour yield of Garnet and Garnet mixtures as submitted, coincide very closely with the findings of those who have investigated this wheat in Canada. Practically all of these tests indicate that the yield of flour in the case of Garnet seems to be rather above the average.

The question (No. 3) as to the attitude of Garnet and Garnet mixtures towards bleaching and maturing agents, seems to have been quite definitely answered. While it would appear that Garnet may not respond quite so quickly nor quite to the same extent to these agents as does the present " Manitoba " wheat in most cases, yet the flour seems to have been bleached sufficiently for most trades without undue difficulty.

Question No. 4 regarding flour colour, implies that there may be a difference between districts as regards the demand for a pure white bread. The present investigation has confirmed this implication. It has revealed the significant fact that each milling centre caters pretty generally to a specific trade. For instance, the large mills in Scotland cater to a trade which appears to demand a relatively white bread, whereas in most other parts of Great Britain as well as on the Continent, the same degree of whiteness does not seem to be insisted upon. In Scotland, furthermore, a much larger percentage of Canadian wheat is used in the blends than is employed in the other centres where these tests were conducted. This means that there is little chance for any undesired colour being offset by the better colour of other wheats employed, although modern bleaching practices undoubtedly would be of assistance.

In England and on the Continent the colour of the flour made from Canadian wheat appears to be of relatively little importance since " colour " is looked for through other wheats used in the blends, and through bleaching which is commonly practised.

In regard to question No. 5, as to whether or not there would be any advantage to the trade if Garnet were offered in a relatively pure state, it seems to be almost the unanimous opinion of European and British investigators that it would be advisable to handle this variety separately for a time at least. It has been suggested that one or two high grades might be sufficient to accommodate the best of this variety and at the same time to permit the millers to gain a more intimate knowledge of the peculiarities of this new wheat.

The general attitude of practically all of those who investigated this wheat in England and on the Continent during the past season, seems to have been pretty well expressed in the words of Dr. Kent-Jones, whose concluding statement is repeated below as follows:—

" Garnet wheat both in milling and in baking has certain pronounced characteristics. Millers will always be faced with the fact that Garnet will give stability to their blends but not quite the spring and elasticity which is normally

given by Manitobas. Millers make their blends remembering all the characteristics of the wheat. There may, therefore, be times when the stability of the Garnet variety will be desired, while there may be times when the blend generally is stable enough and then the stability of the Garnet with its tendency to lack of spring may be a drawback. Since English and European millers are *par excellence,* blenders of wheat, they require to know the exact properties of the wheats they use. I therefore recommend that Garnet wheat should be placed upon the market as a separate variety, and although in the first instance, its price might be slightly lower than the corresponding Manitoba, I am inclined to think the market would rapidly appreciate its merits and there may be times when the Garnet may command the higher price. The wheat market rapidly adjusts itself to price and thus wheats which are in demand soon appreciate in value. For myself I look forward to the time when Garnet wheat is on the market and when we shall have another variety to assist in making our blends."

Another investigator is even more emphatic when he says, "There is no doubt in my mind that we can make very good use of this wheat in London, providing we are able to buy it separately as Garnet wheat. In fact, it has a distinct value of its own, but if mixed with Manitobas it will not only lose its own distinctive value but it will tend to greatly lower the distinctive value of the Manitoba wheats. If your farmers can send forward Garnet wheat of as good a quality as this particular shipment, I do not think they need fear having to sell it at a great discount as compared with Manitobas."

With regard to the question (No. 6) as to how Garnet compares with ordinary Manitobas for blending with non-Canadian wheat, this is one which obviously could not be answered very definitely in an investigation which had to restrict itself to the crop of a single year. There was some evidence, however, to show that there might be times when by reason of some peculiarity in the season prevailing in certain wheat-producing countries, wheat of the characteristics of Garnet might actually be of greater value for blending purposes than would our present Manitobas. Similarly, there might be times when the latter wheat might be worth a little more for blending purposes. It was also shown that a mixture of Garnet and of Manitobas in fairly definite proportions might, under certain circumstances, produce better results than if either of these two wheats were used alone in the blend.

While the questions asked specifically of the bakers have been fairly well answered already, yet there are a number of points raised which are worthy of special consideration. Thus, the questions of absorption and bread yield, are points of importance. The findings of practically all of those participating in the present investigation, are closely in agreement with those recorded in the bulletin already referred to ("Garnet Wheat"—Newman and Whitside) in which publication (page 76) the following conclusions are submitted: "Generally speaking, the flour of Marquis absorbs a little more water than does that of Garnet, and consequently, is inclined to produce a little higher bread yield." Since ordinary Manitobas at the present time consist largely of Marquis, it may be safe to assume that the tendency is for the former to absorb a little more water than is absorbed by Garnet.

With regard to "resiliency" and "ductility" of dough, it seems quite clear that Garnet gives a less ductile dough than do the Manitobas of the same grade. Generally speaking, the Garnet is stiff and stable, but appears to lack that spring which characterizes the ordinary Manitobas. While the greater stability of Garnet is considered to be a distinct advantage at times, yet this lack of spring is regarded as a drawback.

In the Old Country bread flavour is considered a factor of considerable importance and it is interesting to note that in three or four cases Garnet was considered to have a more agreeable flavour than that possessed by the ordinary Manitobas. Whether or not this is sufficient to be of any commercial importance, remains to be seen.

SUMMARY OF RESULTS OBTAINED IN TESTS MADE BY THE STATE TESTING MILL OF MINNEAPOLIS, THE PILLSBURY FLOUR MILLS, MINNEAPOLIS, AND THE TRENT INSTITUTE AT GUELPH

(*a*) *Results at State Testing Mill*

Two hundred and fifty bushels of Garnet grading No. 2 and 250 bushels of Manitoba No. 2°, were used in this test which was designed to determine, if possible, the comparative milling qualities of the two wheats, and also to determine whether the milling properties of the Manitoba Northern wheat were influenced by the admixture of 50 per cent of Garnet wheat. The Garnet wheat used in this test was taken from the same lot as that used in the overseas tests above referred to. Part of each of the two lots of wheat was first ground separately followed by a grinding of a mixture of 50 per cent of each wheat.

The results of the test conducted by this Institution seem to be in fairly close agreement with those obtained by the majority of the overseas investigators. They indicate that Garnet wheat, or mixtures of wheat containing a proportion of this variety, seem to require a little different treatment in "conditioning" or "tempering." As in the case of the Old Country tests, it is not shown in this case that this conditioning process involves any very serious difficulty.

In commenting upon the tests made at the State Testing Mill, Dr. Sherwood draws attention to the fact that it is possible to secure different types of wheat of the same variety which show as great a variance in milling properties as was exhibited by Garnet and the No. 2 Northern in the present test.

(*b*) *Test by the Pillsbury Mills, Minneapolis*

In some independent tests reported by this firm, the presence of 50 per cent Garnet in the grades 1 Northern, 2 Northern and 3 Northern, seems to have reduced the quality of the flour to some extent in the case of grades 1 and 2 Northern, although in the case of the 3 Northern the mixture containing Garnet seemed to be superior to the former, especially in the case of colour.

As only 60 bushels of each grade were ground, it was not possible to make any comments of value regarding the relative milling qualities of the various mixtures.

(*c*) *Results at the Trent Institute, O.A.C., Guelph, Ont.*

Baking tests were conducted at this institution with flour made from Garnet, from Manitoba No. 2° and from a 50-50 mixture of the two. This flour was forwarded at the request of the Department, from the State Testing Mill, Minneapolis, and was taken from the flour ground from the wheat reported above.

In these tests, six commercial sized batches were baked. These consisted of a batch of No. 2° straight flour unbleached and bleached; Garnet wheat flour unbleached and bleached and a mixture of 50-50 No. 2° and Garnet flour unbleached and bleached.

As a result of these tests this investigator concludes that Garnet wheat flour would not prove very satisfactory for commercial bread making when used alone, but that it has its merits and advantages when blended with Manitoba Northern. He expresses the opinion that a proper blend, say 50-50, of Garnet and of Manitoba Northern flour, would react to the improvement of the flour from Manitobas.

PART II

DETAILED REPORTS OF INVESTIGATORS

GARNET TRIALS, JULY TO AUGUST, 1929, BY DR. A. E. HUMPHRIES, WEYBRIDGE, ENGLAND

1. About two years ago I received from the Dominion Cerealist 280 pounds of flour made from Marquis wheat and 280 pounds of flour made from Garnet wheat. Both wheats had been grown in 1926 at one and the same place and the flours had been made in Canada. It follows that the flours I then tested had acquired the improvements in quality due to ageing, and I may at once say that I propose to test at intervals the flours recently made here from No. 2 Northern Manitoba and Garnet to see whether the differences on various points of quality remain constant as the flours acquire age or whether such differences become smaller. There is already some evidence that as time passes Garnet flour improves more than the flour made from No. 2 Northern Manitoba.

2. Two years ago I summarized my findings as to the respective merits of the Marquis and Garnet flours as follows:—

"I have in my time made many tests for the Indian Government. In that country only a small proportion of the crop is exported, and I have always strongly insisted on the desirability of paying attention to the requirements of the Indian producers, millers, and consumers in preference to those of persons buying and selling the small proportion of the crop exported. The point of principle must be stated differently in the case of Canada, if only because so large a proportion of the crop is exported and because it must be in the interests of the Canadian producer to grow varieties of the highest possible quality. Even so I should unhesitatingly recommend Canadian producers to grow those varieties which give them the best commercial return provided that the differences in quality are not large.....The differences between Marquis and Garnet are small except in respect of the colour of the flour and bread. There the difference is substantially in favour of the Marquis and if at any time or in any country the bleaching of flour is prohibited this difference would assume substantial commercial importance.....Seeing that the bleaching of flour is so generally practiced in all important countries where these two varieties are likely to be used, I am of the opinion that Garnet, inasmuch as it seems to favour the interests of the producer, can be recommended, at any rate in those parts of the Dominions where its virtues will be appreciated by the producer".

3. I understand that in the interval the position has changed. Garnet has proved to be highly desirable in certain environments, and large quantities are likely to be produced in Canada. This means that the question, ought the production of Garnet to be encouraged or discouraged, has been answered in its favour, and the point now is this: Is it "equal to Marquis" and can it be mixed without restrictions of any kind into the standard grades of Canadian spring wheats?

4. I understand that for the present series of tests Garnet has been grown at several places, representing several differing environments, and that the various bulks have been collected at one centre and mixed together. I have been puzzled by the conflicting opinions expressed concerning this wheat and have been wondering whether it varies greatly in quality according to environment and season to a greater extent than Marquis. However, that may be, the precautions taken to obtain a true average sample of the variety are a very satisfactory point in the present series of tests.

5. My firm received about 800 bushels from this bulk of Garnet. We were told that it had been graded No. 2 Northern Manitoba; we therefore based our comparisons upon a satisfactory lot of No. 2 Northern bought in an ordinary

commercial way. Both wheats appeared to be excellent and in good condition. A measured bushel of each weighed No. 2 Northern 65½ pounds; Garnet 65 pounds, but both wheats had been passed through a Warehouse Receiving Separator before the weighings were made. Their respective water contents on arrival were No. 2 Northern Manitoba, 11·85 per cent; Garnet, 13·39 per cent.

6. *Conditioning* (Tempering).—I had noted the objection to Garnet made by Canadian millers, that it ought to be tempered differently from standard Canadian spring wheat. Therefore I made a series of conditioning trials on a laboratory scale before the commercial tests were begun. Variations in methods of conditioning depend on the factors of time, temperature and water content. To avoid unnecessary complications, and to ascertain, not the ideal method in each case, but the essential point as to whether the two wheats required materially differing treatments, I kept the time constant at 48 hours and the temperature approximately constant, using cold water and keeping the wheats in bags in a room at summer temperatures. The water content of the No. 2 Northern Manitoba was raised by the addition of water from 11·85 per cent and the Garnet from 13·39 per cent to the following figures. At the end of 48 hours in each case each lot was milled on a small experimental milling plant, and the water content of each flour was ascertained.

—	No. 2 Northern Manitoba No. 2		Garnet	
	Wheat	Flour	Wheat	Flour
	%	%	%	%
Sample A	14·8	13·80	14·8	13·50
Sample B	16·3	14·01	16·1	14·06
Sample C	17·4	14·67	17·6	14·33
Sample D	18·4	14·41	18·7	15·01

At Weybridge the humidity of the atmosphere equals about 14 per cent water in flour. More than twenty years ago I found that a very large proportion of the water in wheat exceeding 14 per cent was lost during milling, so the water figures of these flours provide no surprise to me. They mean, however, that high conditioning on these lines should not materially affect the dough characteristics or the bread but it may most materially affect the milling operations. This is what we found as a result of many baking trials on varying processes of bread making; the merits or demerits of the "conditioning" had to be measured by the effects on the actual milling. There we found material differences. As the percentage of water was raised the quality of the work done on 4 breaks worsened in the case of No. 2 Northern Manitoba but did not worsen in the case of Garnet. As an indication of this result, the percentage of bran went up with each increase of water in the No. 2 Northern Manitoba until the 4 breaks would not " clean " its bran whereas the percentage of bran remained practically constant in each case of the Garnet wheat and was quite commercially clean even at the highest water figures. But on the " reductions " side of the milling operations the results were quite different. There at each stage of the No. 2 Northern Manitoba trials the work was excellent, whereas the Garnet products began to flake as the water content reached the maximum. In view of these results we decided that we should condition both wheats alike for the commercial tests and attempted to do so. But although we made adjustments of the commercial conditioning methods used, designed also to compensate for the difference in natural water content, we found on testing the commercially conditioned wheat that the No. 2 Northern Manitoba contained 16·6 per cent water

and the Garnet 17·7 per cent. We debated whether we should make further tests so as to secure practical uniformity in water content between the wheats, but knowing that nature would reduce the difference during milling we proceeded with the trials. Finally we found that the flour from the No. 2 Northern Manitoba contained 16·8 per cent water and the Garnet 16·4 per cent. These figures are above the normal of our flours, but we used such water contents because, for a few hours, we were using a commercial plant clothed for the milling of softer wheats, and we knew from experience gained in our cool climate, that with such flours neither the dough nor the bread would suffer. Under these conditions both wheats behaved satisfactorily in the commercial milling.

7. *Milling.*—On July 23 we milled the following grists on our commercial plant:—

Test 1—⅓ No. 2 Northern Manitoba, ⅓ R.Fe., ⅓ Austr.
2—⅓ Garnet, ⅓ R.Fe., ⅓ Austr.
3—100 per cent Garnet—Bleached.
4—100 per cent Garnet—Not bleached.
5—100 per cent No. 2 Northern Manitoba—Not bleached.
6—100 per cent No. 2 Northern Manitoba—Bleached.

Each trial was made easily and well without mishap. For such short periods, the margin of error as to extractions obtained renders it undesirable to give specific figures, but as some indication of the grade of the straight run flours I may say that we obtained from 73 to 74 per cent from the No. 2 Northern and rather more from the Garnet. This bleaching was done by the electrified air (nitrogen peroxide) method and the treatment measured by voltage, amperes and volume of air used was the same in each case of bleaching.

8. *Glutens.*—In my opinion the glutens extracted by washing on a good method, give, in the hands of a skilled operative, information which the Kjeldahl method cannot give. As averages of several washings we got the following figures:—

	Wet Gluten	Dry Gluten
No. 2 Northern Manitoba	38·9%	12½%
Garnet	35·8	12¼%

which indicates that the former carries more water than the latter. Furthermore, there is a very noticeable difference in the appearance of the dried glutens in favour, on the whole, of the No. 2 Northern Manitoba. But the Garnet gluten appears to possess more stability than the No. 2 Northern Manitoba.

9. *Baking Methods.*—We were not asked to ascertain the ideal method for making bread from each flour, although for our own information and as an interesting technical problem, we shall in the near future do so. For present purposes we were asked and have sought to ascertain, how each of these flours behaved in, or responded to, typical English methods of making bread, with a view to determining whether Garnet could be graded by standard Canadian methods and be mixed, without limits of admixture, into the standard grades. Of course I am well aware that there is no fixed and general method of making bread applicable to the whole of England. Nevertheless I have proceeded on the basis that Straight Dough methods predominate, that is to say, that all the ingredients of the dough are mixed together at the beginning of the breadmaking process. Practices as to the length of fermentation, proportion of yeast, and temperature of dough differ, but as a result of many years' experience I have

standardized straight dough methods under five heads, originally established for work done in collaboration with Cambridge University and the National Institute of Agricultural Botany.

—	E.T.I.	E.T. 2	E.T. 3	E.T. 4	E.T. 5
Distillers yeast	1½%	1%	0·75%	0·5%	0·5%
Temperature of dough	80° F.	80° F.	80° F.	80° F.	85° F.
Time from start to oven	3 hrs.	4 hrs.	6 hrs.	8 hrs.	8 hrs.

We have subjected all the flours specified in paragraph 7 and some other blends, to this series of tests, omitting E.T. 1 in a few cases.

10. Volume of loaf although useful in appraising the quality of flours of the same type, is of itself useless as a correct index of general quality when flours of widely differing nature or type are compared. A critical study of our present figures shows this conclusively. Equally conclusively it shows that the volume of loaf, when such breadmaking processes are used, is not increased in proportion to an increase in protein content when a minimum necessary proportion of protein is passed. Nevertheless, I have had the volume of loaf ascertained in each trial made. For this purpose the loaf is measured by displacement of wheat from a box. In addition we have awarded marks, as the most convenient and simple form of expressing the skilled operator's opinion on various points of dough and bread quality. In preparing the summary of our results we group the sub-divisions of absorption, resilience, ductility, firmness, " liveliness " and freedom from stickiness into the overhead designation of " dough marks", and we group the subdivisions of external quality, crust, colour of crumb, texture and " soaking " into the overhead designation of " bread marks". The name of most of these subdivisions indicates of itself the point of quality in question, but it may be desirable to say that the term " absorption", so used, does not directly indicate the quantity of water which a given flour will take but the facility with which it absorbs the water used. In an indirect way it does indicate the major point, for high marks give an indication that it is possible to increase the water used if for any reason the baker should at any time attach predominant importance to yield of bread per unit of flour used. The term " liveliness " is closely associated with the evolution of gas in panary fermentation, for it connotes during and after moulding the response of the dough towards satisfactory development. The term " external quality " indicates the impression made on the observer by the external appearance of the uncut loaf. The term " soaking " connotes the extent to which the interior of the loaf is thoroughly baked; a point of importance when unsound or frosted wheat is tested. In our laboratory work we still bake the bread in tins, but are inclined to adopt the " cob " form of loaf, and in our tests made on a small commercial scale we make " cottage " loaves almost entirely. By preliminary trials we found it advantageous to use 0·05 per cent of a very highly diastatic malt extract and this we used for all the trials recorded in the next paragraph.

The following table gives in summarized form the average results of many tests of each flour and certain blends of flour:—

—	Proving Gas	Volume of loaf (2 lbs.)	Dough Marks	Bread Marks
	(c.c.)	(c.c)		
No. 2 Northern Manitoba—				
Unbleached 100%	45	3,105 av.	76	72
Bleached 100%	43	3,130 3,117	76	75
Garnet unbleached 100%	50	2,915 av.	73	70
Bleached 100%	51	2,825 2,870	72	71
⅓ No. 2 Northern Manitoba, ⅓ R. Fe., ⅓ Austr	46	3,365	75½	79
⅓ Garnet, ⅓ R. Fe., ⅓ Austr	48	3,255	75½	77½
50% No. 2 Northern Manitoba flour and 50% Av. English flour	37	2,825	76½	67½
50% Garnet flour and 50% Av. English flour	44	2,825	74	66
50% No. 2 Northern Manitoba flour and 50% Australian flour	39	2,850	75	72½
50% Garnet flour and 50% Australian flour	45	2,775	74½	70

Proving Gas.—The figures represent the number of c.c. gas given off by a given weight of dough in a certain time. All that need be said now is that in every case this quantity of gas evolved was sufficient for the thorough inflation of the dough, but I may add that Garnet seems to yield more gas than the No. 2 Northern Manitoba. This characteristic may be of value when these wheats are mixed with others, *e.g.* some Plates, deficient in gas yielding capacity.

Volume of Loaf.—There is a substantial margin of error in such work, which is not entirely obviated by taking the average of several trials. The differences in the cases of the blends are not significant except that they are in the same direction as those shown in the 100 per cent trials. There the differences in volume is 247 c.c. which is significant. As an indication of the accuracy of the operator's work, it is most gratifying, at any rate to me, that the difference in volume of loaf between the two wheats in the preliminary conditioning trials, an entirely separate piece of work, was 261 c.c. in favour of the No. 2 Northern Manitoba. I commend to the notice of those who believe in the value of high protein, the whole set of figures earned by the blends, compared with those earned by the 100 per cent trials. "Strength", however, defined, has to be appraised by reference to the processes of bread manufacture used. The results obtained by these typical English methods do not support the views of those who belief unqualifiedly in the technical or commercial value of high protein wheats.

12. *Summary.*—These trials dispose, in my opinion, of some of the criticisms levelled at Garnet. For example, I find it unnecessary to make any difference in the conditioning (tempering) of the No. 2 Northern Manitoba or the Garnet. Again, I was told by a miller of the highest standing that Garnet flour would not "take the bleach" as well as flour made from Canadian standard spring wheats. Using the electrified air (nitrogen peroxide) method I find that it does. Personally, I prefer the slightly yellow (creamy) colour of unbleached flour and the bread made from it, but I am in a small minority of buyers of flour and bread in this country, for an over-whelming majority of them want really white flour and bread. Ordinary commercial bleaching does whiten Garnet flour but it also whitens, very fully to the same extent, the flour from the No. 2 Northern Manitoba, so that in the 100 per cent trials there is a substantial difference between the two, bleached as well as unbleached. This difference is of course dimished with diminishing proportions of Garnet in the grist, and I expect to find cases of blending in which the yellowness of Garnet may be advantageous. But I cannot overlook the fact that many buyers of Canadian spring wheat, not only in

Canada, use 100 per cent of it, so I think, on balance of considerations, that it would be advantageous to market Garnet separately. Absolutely it is a very good wheat of its kind, relatively it is not of the same quality as Marquis. Their relative merits can be better ascertained as time passes. We shall see how seasonal variations affect both varieties and whether Garnet has special virtues or faults when used in many varying blends. English millers will gradually ascertain them if Garnet can be obtained in quantity regularly, and it is safe to say that its real merits will be ascertained and its commercial value paid, within a season or two. The grower will then be in a position to choose, on a definite and clearly ascertained basis, the variety he will sow.

August 29, 1929. (Signed) A. E. Humphries.

REPORT ON THE MILLING OF GARNET WHEAT AND THE BAKING PROPERTIES OF THE FLOUR MADE THEREFROM—BY DR. D. W. KENT-JONES, WOODLANDS, LTD., DOVER, ENGLAND

Introduction

Since the visit of Mr. L. H. Newman, the Dominion Cerealist, I think the European millers appreciate the desirability of growing the Garnet wheat variety in Canada and the importance of its ripening seven to fourteen days earlier than the Marquis variety. The full facts of the case, the attitude of the Canadian millers, etc., have been placed before me and this report is based on observations extending over several weeks and on investigations carried out in the mill, laboratory and bakehouse.

In the first place I received 300 bushels of Garnet wheat from the Canadian Co-operative Wheat Producers, Ltd., and also 300 bushels of a corresponding grade of Manitoba, which was in fact No. 2. Later, an additional 160 bushels of Garnet wheat were sent me from the Grands Moulins de Corbeil for further experiments.

Scope of Investigation

Milling experiments on a commercial scale in a 20-sack mill were undertaken with:—

I. All Garnet.
II. All No. 2 Manitoba (for comparison).
III. A mixture of equal parts Garnet and No. 2 Manitoba.
IV. A commercial mixture containing 50 per cent Garnet and 50 per cent Barusso Plate.
V. A commercial mixture containing 50 per cent No. 2 Manitoba and 50 per cent Barusso Plate (for comparison).

On the arrival of the additional Garnet wheat from the Grands Moulins de Corbeil, a further grinding on all Garnet wheat was carried out in which the moisture content of the wheat on the mill was deliberately made higher. The results will be reported from:—

I. The miller's standpoint.
II. The baker's standpoint.
III. The chemist's standpoint.

I personally do not believe in small experimental grindings on a quasi-laboratory scale even though these are very carefully carried out. All the grindings were carried out in the mills of Messrs. G. W. Chitty & Co., Ltd., Dover. This mill is on the same premises as my own firm—Messrs. Woodlands Ltd.—and my staff and I have free access to the mill at all times.

First Milling Experiment

The usual procedure in the mill of Messrs. G. W. Chitty & Co., Ltd., is that the wheats, after dry cleaning, are damped with two, three or four per cent of water or whatever amount they require and are then allowed to remain in bins from eight to twenty-four hours according to the type of wheat and the position in which the mill finds itself. The various wheats making the blend are usually damped independently, but they are later mixed together and then washed, whizzed and conditioned. The conditioning consists in passing the wheat through a Simon Conditioner in which the wheat passes over hot radiators and, in order further to keep the wheat warm at this temperature, it then passes to a cylindrical, lagged bin before cooling. Under these circumstnaces the wheat is kept hot—usually about 105° to 110° F.—for about an hour. It is then cooled and goes to a grinding bin where it may stay about eight hours before it actually goes on the mill. In these experiments the Garnet wheat was damped with approximately 3 per cent of water, the same as the No. 2 Manitoba; the Barusso was damped with 2 per cent of water. The first three wheats, namely, the Garnet, the No. 2 Manitoba, and the 50 per cent mixture of each, were milled on Tuesday, July 16, and the last two, namely, the mixture of 50 per cent Garnet and Plate and the mixture of 50 per cent No. 2 Manitoba and Plate, were milled on July 17. All the Garnet, all the Manitoba and the Plate were damped and conditioned independently so that for the mixture it was merely a matter of taking some of the wheat ready for grinding of one kind and mixing it with another. This was done in order not to lose the small quantities of wheats being used. This means that the mixtures IV and V, milled on July 17, had stood conditioned twenty-four hours before grinding; whereas the Garnet and the Manitoba, used on July 16, had only stood, after conditioning, a matter of eight hours. Table I gives the moistures of the various wheats estimated in a water-oven at 98° C., the procedure I usually adopt.

TABLE I

—	Original moisture	Same wheats (damped 3% Garnet and Manitoba, 2% Barusso)	Wheats after conditioning and standing
	%	%	%
Garnet	12·82	14·50	15·86
No. 2 Manitoba	11·38	14·60	16·34
Mixture 50% Garnet, 50% No. 2 Man.)	12·10	14·55	15·87
Mixture (50% Garnet, 50% Barusso)	12·05	13·80	15·14
Mixture (50% No. 2 Man., 50% Barusso)	11·35	13·85	14·94
Barusso	11·32	13·10	.....

It was a little unfortunate that the Garnet wheat should have gone on the mill with slightly less moisture than the No. 2 Manitoba as the intention was to do the reverse. In view of this, a further experiment was made with the Garnet wheat received from the Grands Moulins de Corbeil, when the Garnet was deliberately damped to a greater extent. This grinding will be referred to later and separately.

Milling Observations

The Garnet wheat, which was the first sample milled, certainly broke up on the mill somewhat after the nature of Durum, the Semolina being sharp and hard and the grind being quite distinct from ordinary Manitoba. It was a pity that the moisture content of the Garnet was on the low side, but actually the

moisture contents of these experimental samples were higher than the ordinary grists at the time, as just at that period the weather became exceptionally hot and all the moistures were lower, due to evaporation. English and European millers generally, however, should not encounter any great difficulty in milling Garnet wheat as they are used to dealing with wheats of all kinds and conditions and of varying degrees of hardness. Even with the mixtures containing 50 per cent of Barusso Plate, the difference between the Garnet mixture and the Manitoba mixture was noticeable, the same general remarks applying. Attempts were made to estimate the yields, but it is obvious that with these small grindings and with the different breaking down of the wheats, with their consequent different sweeping-out actions in the mill, precise information cannot be obtained. Nevertheless, the results have been checked up as carefully as possible against the total amount of wheat used and there is ample evidence of the higher yielding quality of Garnet wheat against the corresponding grade of Manitoba. These results are given in table II.

TABLE II

Wheat	Flour	Sharps	Bran
	%	%	%
Garnet	76·7	20·6	2·7
No. 2 Manitoba	75·0	22·0	3·0
Mixture (50% Garnet, 50% No. 2 Manitoba)	75·6	21·0	3·4
Mixture (50% Garnet, 50% Barusso)	74·8	22·2	3·0
Mixture (50% No. 2 Manitoba, 50% Barusso)	74·3	21·8	3·9

Table III gives the moisture contents of the various products.

TABLE III

—	Wheat going on on mill	"SR"	Bran	Sharps
	%	%	%	%
Garnet	15·86	14·41	15·34	14·42
No. 2 Manitoba	16·34	14·22	16·38	14·97
Mixture (50% Garnet, 50% No. 2 Manitoba)	15·87	14·44	15·70	14·67
Mixture (50% Garnet, 50% Barusso Plate)	15·14	13·78	15·02	14·38
Mixture (50% No. 2 Manitoba, 50% Barusso Plate)	14·94	13·82	14·88	14·06

It is interesting to note that in spite of the fact that the Garnet yielded so well and was better in this respect than the No. 2 Manitoba, the Sharps in all cases were rather whiter than the corresponding grinds of Manitoba, although the Coarse Semolina in all cases contained more offal. It was thought, therefore, that the ash contents of the wheat, flour, bran, sharps and of the coarse semolina from the five grinds (reduced to 13½ per cent moisture basis) might be of interest and these are given in table IV.

TABLE IV

—	Wheat	Flour	Bran	Sharps	Semolina (coarse)
	%	%	%	%	%
Garnet	1·34	0·49	5·30	4·19	0·90
No. 2 Manitoba	1·45	0·48	5·67	4·50	0·78
Mixture (50% Garnet, 50% No. 2 Manitoba)	1·45	0·47	5·58	4·40	0·87
Mixture (50% Garnet, 50% Barusso Plate)	1·56	0·48	5·59	4·43	0·84
Mixture (50% No. 2 Manitoba, 50% Barusso Plate)	1·59	0·48	5·57	4·62	0·86

The ash contents of the straight-run flours are very similar, but it is significant that the ash content of the Garnet Semolina is distinctly higher than that of the Manitoba.

On the arrival of the further 160 bushels of Garnet from the Grands Moulins de Corbeil, the additional grinding referred to previously was carried out. The wheat was deliberately damped with 5 per cent of moisture instead of 3 per cent (3%) as in the previous case and table V gives the moisture contents of the wheat in its various stages of preparation for the mill and of the products therefrom.

TABLE V

	Moisture %
Original wheat	13·25
After damping and standing (16 to 17 hours)	16·50
Going to Conditioner (after washing and whizzing)	19·70
After conditioning	18·70
Going on Mill (after cooling and standing in bin)	17·90
Bran	17·44
Sharps	16·88
Semolina (coarse)	16·96
Straight-run flour	15·93

Table VI shows the ash contents (calculated to 13·5% moisture basis) of the various products.

TABLE VI

	Ash %
Straight-run flour	0·47
Patent flour	0·40
Bran	4·73
Sharps	3·74
Semolina (coarse)	0·77

With respect to this grinding, the wheat itself did not seem too damp and again it broke up in the mill after the fashion of the previous experiment with the Garnet wheat. It was perhaps rather more normal in this respect than the original grinding with Garnet as might be expected, but the additional moisture did not entirely make it like a normal Manitoba wheat in its method of breaking up on the mill. It would appear, therefore, that however conditioned, the hard characteristics of Garnet will persist to some extent. It should be stated that all the grindings referred to contained approximately 18-quarters of wheat and, therefore, occupied in their milling rather more than an hour. As previously stated it is a little difficult under these circumstances to estimate the yield very accurately, but the following figures were obtained for this particular grinding:—

	%
Flour	73·9
Sharps	20·9
Bran	5·2

In spite of the heavy damping the high yielding value of the Garnet wheat was again confirmed.

With respect to the special questions asked of the miller it may, therefore, be stated that Garnet wheat will not offer any serious difficulty from the milling standpoint as regards conditioning and separation of mill products, although it is different from ordinary Manitoba. In flour yield the Garnet is probably better than Manitoba and as will be seen later the colour of the flour from Garnet is more yellow. In view of the fact that bleaching is generally practised by English and European millers the yellowness of the Garnet should not be a great drawback. The consideration of whether Garnet should be offered in a pure state or not will be left till later in this report. It should be emphasized

that although Garnet is distinct from ordinary Manitoba it is also greatly superior in value for blending than the non-Canadian wheats and should be utilized as the strong component of a blend for carrying the other weaker wheats.

Chemical Examination

The chemical analysis of the various flours obtained was undertaken by the methods I normally employ and which are given in the 1927 edition of my book "Modern Cereal Chemistry." The moistures mentioned are lower than those given elsewhere in this report, but it should be remembered that the samples had been standing in a warm laboratory. The other estimations are based on the flours as they then were and are not corrected for moisture.

With respect to the bleach figures, the average figure of 9·0 does not show particular yellowness, but undoubtedly it would be difficult to obtain unbleached flours in the mill owing to the fact that in the short run it was impossible to remove all the oxides of nitrogen from the worms. It is unfortunate, therefore, that the real yellowness of Garnet flour cannot be given, but it is also of interest to note how easily it is bleached. More normal results of the yellowness of the unbleached flour and the significance of the increased yellowness of the Garnet can be seen from the mixtures with Plate. The mixture of 50 per cent Garnet and 50 per cent Plate gives an unbleached figure, on the scale I adopt, of 12·5, while the corresponding mixture with No. 2 Manitoba gives the figure of 11·0. The latter mixture is, therefore, not so heavily coloured and in both these instances the majority of the bleaching gas had been removed from the worms. It is also significant to notice that corresponding amounts of bleaching agents leave the flour slightly yellower when the Garnet is in the mixture.

The point was mentioned as to the fat content of straight-run flours from Garnet and Manitoba wheats. These were, therefore, estimated in the manner advocated by Herd and given in "Modern Cereal Chemistry," p. 346, and were found to be as follows:—

	%
Straight-run flour (Garnet)	1.30
Straight-run flour (No. 2 Manitoba)	1.46

The figures are calculated to a 13½ per cent moisture basis. It would appear from this that the Garnet does not contain as much fat as ordinary Manitoba, but it would be unwise to draw any conclusion from such a slight difference on a single sample.

Baking Results

Baking tests were carried out on the straight-run flours (and also incidentally on some patent flours) from the five grindings mentioned and later from the additional grinding of Garnet wheat. In conformity with my general views no attempt was made to measure loaf volume, but, besides the usual cottage loaves I make for such special tests, tin loaves were also made. I base, however, my report more upon the cottage loaf for reasons which I have advanced in various publications from time to time. The following water absorptions were required:—

TABLE VII

—	Cottage (quarts)	Tin (quarts)
Garnet	60	62
Manitoba	61	64
Mixture (50% Garnet, 50% Manitoba No. 2)	61	63
Mixture (50% Garnet, 50% Barusso Plate)	60	62
Mixture (50% No. 2 Manitoba, 50% Barusso Plate)	60	62

The doughs all had similar consistencies and it will be seen, therefore, that as regards the first five grindings the No. 2 Manitoba had a tendency towards higher water absorption and, therefore, bigger bread yield than the Garnet.

The next observation is in the behaviour of the doughs during fermentation and handling. There is no doubt that there is a distinct difference in the dough behaviour of Garnet and ordinary Manitoba. Generally speaking, the Garnet is stiff and stable but lacks that spring and generosity one normally associates with Manitoba. The fact that it has a greater stability than ordinary Manitoba may at times be of great assistance but at the same time the fact that it is not quite so springy and elastic as Manitoba is a distinct drawback. Generally speaking, there is a tendency, although a slight one, for the loaf volume in the Garnet to be rather smaller than the corresponding Manitoba, while the texture of the Garnet is generally not quite so pleasing as with the Manitoba. As far as crust colour is concerned Garnet, with a higher sugar content, naturally takes the fire of the oven better. This is another distinctive feature which must be borne in mind by the English miller in making his blend. Other things being equal, if his blend has a low sugar content, he will prefer Garnet but if it already has a high, or even a tendency towards a too high sugar content, he will obviously prefer the ordinary Manitoba. Photographs of the loaves made are appended and it will be seen that generally speaking the Manitoba is rather better than the corresponding Garnet.

As regards blending with other weaker wheats, it is difficult to give an opinion without knowing the characteristics of the other wheats. As has already been pointed out, there may be occasions when the Garnet is preferable to the Manitoba, but generally speaking the Manitoba is probably rather the more useful flour.

The grinding of the second sample of Garnet at the high moisture content was carried out about a month later than the earlier samples and when, therefore, the baking tests on this were made, baking tests on the earlier samples were repeated. The grinding with the higher moisture of the Garnet wheat resulted in the flour having a low water absorption and did away to a great extent with some of the stiffness and tendency to "Deadness" noted previously. The fact, however, that the flour milled under these conditions would only take 59 quarts per sack for cottage bread is unfortunate and it will be seen that, in order to get more normal milling and to do away with certain characteristics previously noted in the Garnet, further drawbacks appeared. With a lower water absorption, however, the Garnet ground with the high moisture behaved very satisfactorily and was more like ordinary Manitoba. It should be borne in mind that the high water absorption of Manitoba is, however, one of the reasons of its popularity with English and European millers. As has been stated, when the new baking tests were carried out, baking tests were repeated with the pure Garnet and pure Manitoba, which had now a month's age. It is interesting and important to note that the month's age had been of extreme benefit to the Garnet which was now in baking behaviour, both in the dough and in the bread, almost indistinguishable from the Manitoba. The fact that it improves so rapidly in storage so as to make it equivalent to ordinary Manitoba was unexpected and should not be lost sight of.

It was thought that, in long sponge systems such as are usually employed in Scotland, the Garnet flour would prove to be quite as suitable as the Manitoba. For the setting of these sponges, a flour with a strong and stable gluten is necessary and the fact that the Garnet had a greater stability than the Manitoba suggested that it would be particularly suitable for this class of work.

Sixteen hour sponges were made with the month-old Manitoba flour, the month-old Garnet flour and the Garnet flour that was milled on the 14th inst. The aged Garnet was equal in all respects to the Manitoba and, although the sponge from the freshly milled Garnet was "through" a trifle sooner than the

others, owing to its lower water absorbing capacity, it was, in every way, as good as a freshly and similarly milled sample of No. 2 Manitoba would have been.

General Observations

It will be seen from the above report that Garnet, both in milling and in baking, has certain pronounced characteristics. It is intended to be used as an alternative to the ordinary Manitoba. English millers use Australian and Plate wheats as "sack filling wheats", *i.e.* they do not require much assistance from the stronger wheats but are not strong enough to carry weaker ones in the blend. Although in physical appearance the above two wheats are very distinct, they have similar strengths and are similar in other characteristics such as normally they are low in diastatic value. In blends some millers use one and some prefer the other but they are nevertheless distinctive wheats. I should go as far as to say that in many respects Garnet and Manitoba show similar ditinctive features. It does not seem to me probable or advisable that the Garnet wheat should be milled with such a high moisture content as was given it in the final experiment. Millers will always, therefore, be faced with the fact that Garnet will give stability to their blend but not quite the spring and the elasticity which is normally given by Manitoba. Millers make their blends remembering all the characteristics of the wheat. There may, therefore, be times when the stability of the Garnet variety will be desired while there may be times when the blend generally is stable enough (such as when Indian wheat is cheap) and then the stability of the Garnet with its tendency to lack spring will be a drawback.

I cannot help coming to the conclusion that in view of these differences it would be unwise to mix Garnet into ordinary Manitoba. Remembering that the English and European millers are par excellence blenders of wheats they require to know the exact properties of the wheats they use. I, therefore, recommend that Garnet wheat should be placed upon the market as a separate variety and, although in the first instance, its price might be slightly lower than the corresponding Manitoba, I am inclined to think the market will rapidly appreciate its merits and there may be times when the Garnet may command the higher price. The wheat market rapidly adjusts itself to price and thus wheats which are in demand soon appreciate in value. I am not unmindful that storage improved the Garnet flour so much as to make it practically indistinguishable from ordinary Manitoba and this fact has weighed much in my mind and makes me wonder at times whether I have been correct in emphasizing the differences as noted betwen the two varieties of wheat. Knowing, however, that these differences do exist, particularly during and soon after milling, I cannot help thinking it would be a wise policy for the Dominion Government not to allow the Garnet to be mixed in with the ordinary Manitoba. Everything that goes wrong in a mixture will be put down to Garnet. The Garnet wheat would be unjustly blamed for this thing and the other thing. The reputation of Manitoba wheat must not be imperilled even though the criticisms raised may be based upon imaginary or exaggerated defects. For myself I look forward to the time when Garnet wheat is on the market and when we shall have another variety of wheat to assist us in making our blends.

I cannot close this report without thanking Mr. C. W. Chitty who has assisted me throughout and whose milling experience and general business experience of the milling trade has been of such great assistance. I am also indebted to Mr. W. S. Thompson, the Mill Manager of Messrs. C. W. Chitty & Co., Ltd., under whose direction the wheats were milled and who took such a great personal interest during the whole investigation.

(Signed) D. W. Kent-Jones.

August 15, 1929.

Note.—The baking tests employed in all the above experiments were carried out by the method reported in "Modern Cereal Chemistry", 1927, page 174.

K-J.

FLOUR.
MARK OR DESCRIPTION: I. Garnet.

July 19th, 1929.
Lab. No. F. 110.

Firm: MESSRS. G. W. CHITTY & CO., LTD.

Analysis	%	Remarks
Moisture (loss in water-oven at 100° C.)	13·02	Of no significance owing to changes on standing.
Gluten (dried)	12·11	Good quality and quantity.
Ash	0·49	Satisfactory for straight run.
Nitrogen	2·05	Good but slightly lower than No. 2 Manitoba.
Protein N% x 5·7	11·69	" "
Hydrogen Ion Conc. in terms pH. 10% Extract	6·35	Normal.
H. Ion Conc. in terms pH. after addition 10 c.c. N/100 Lactic Acid per 100 c.c. Extract	5·10	"
Buffer Value (differ. between above x 10)	12·5	"
Gas Producing Power in per cent maltose after 1 hour's incubation at 27°C. If over 1·50%, gassing power satisfactory. If over 2·3% danger of stickiness in crumb	1·95	Satisfactory. Showing more sugar than ordinary Manitoba (see No. 2 Manitoba).
Colour {Grade Fig. (alcohol)	9·0	
Colour {Bleach Fig. (petrol)	.....	Unbleached 9·0 Bleached ½-oz. Novadelox 4·5.

FLOUR.
MARK OR DESCRIPTION: II. No. 2 Manitoba

July 19, 1929.
Lab. No. F. 111.

Firm: MESSRS. G. W. CHITTY & CO., LTD.

Analysis	%	Remarks
Moisture (loss in water-oven at 100°C.)	12·88	Of no significance owing to changes on standing.
Gluten (dried)	13·13	Good quality and quantity.
Ash	0·48	Satisfactory.
Nitrogen	2·09	Good, slightly higher than Garnet.
Protein N% x 5·7	11·91	" "
Hydrogen Ion Conc. in terms pH. 10% Extract	6·35	Normal.
H. Ion Conc. in terms pH. after addition 10 c.c. N/100 Lactic Acid per 100 c.c. Extract	5·00	"
Buffer Value (diff. between above x 10)	13·5	"
Gas Producing Power in per cent maltose after 1 hour's incubation at 27° C. If over 1·50%, gassing power satisfactory. If over 2·3%, danger of stickiness in crumb	1·62	Satisfactory but definitely lower than Garnet.
Colour {Grand Fig. (alcohol)	9·0	Normal and satisfactory.
Colour {Bleach Fig. (petrol)	.....	Same as Garnet. Unbleached 9·0. Bleached ½-oz. Novadelox 4·5.

FLOUR — July 19, 1929.

MARK OR DESCRIPTION: III MIXTURE {50% GARNET. {50% No. 2 MANITOBA. — Lab. No. F. 112.

FIRM: MESSRS G. W. CHITTY & Co., LTD.

Analysis	%	Remarks
Moisture (loss in water-oven at 100°C.)	13·20	Of no significance owing to changes on standing.
Gluten (dried)	12 05	Good quality and quantity.
Ash	0·47	Satisfactory.
Nitrogen	2·08	Satisfactory and normal.
Protein N% x 5·7	11·86	" "
Hydrogen Ion Conc. in terms pH 10% Extract	6·30	Normal.
H. Ion Conc. in terms pH. after addition 10 c.c. N/100 Lantic Acid per 100 c.c. Extract	4·95	"
Buffer Value (diff. between above x 10)	13·5	"
Gas Producing Power in per cent maltose after 1 hour's incubation at 27° C. If over 1·50%, gassing power satisfactory. If over 2·3%, danger of stickiness in crumb	1·67	Satisfactory.
Colour {Grade Fig. (alcohol)	9·0	Normal and satisfactory.
Colour {Bleach Fig. (petrol)	.....	Unbleached 9·0. Bleached Alsop 6·5· Bleached ½ oz. Novadelox 4·5.

FLOUR. — July 19, 1929.

MARK OR DESCRIPTION: IV MIXTURE, 50% GARNET, 50% PLATE — Lab. No. F. 113.

FIRM: MESSRS G. W. CHITTY & Co., LTD.

Analysis	%	Remarks
Moisture (loss in water-oven at 100° C.)	12·90	Of no significance owing to changes on standing.
Gluten (dried)	13·48	Good quality and quantity.
Ash	0·48	Satisfactory.
Nitrogen	2·10	Very good.
Protein N% x 5·7	11·97	"
Hydrogen Ion Conc. in terms pH. 10% Extract	6·30	Normal.
H. Ion Conc. in terms pH. after addition 10 c.c. N/100 Lactic Acid per 100 c.c. Extract	4·95	"
Buffer Value (diff. between above x 10)	13·5	"
Gas Producing Power in per cent maltose after 1 hour's incubation at 27° C. If over 1·50%, gassing power satisfactory. If over 2·3% danger of stickiness in crumb	1·65	Satisfactory and higher than corresponding mixture with No. 2 Manitoba.
Colour {Grade Fig. (alcohol)	9·0	Normal and satisfactory.
Colour {Bleach Fig. (petrol)	.....	Unbleached 12·5 (a more normal result). Bleached Alsop 7·0: Bleached ½-oz. Novadelox 6·0.

FLOUR. July 19, 1929.

MARK OR DESCRIPTION: V. MIXTURE (50% No. 2 MANITOBA, 50% PLATE). Lab. No. F. 114.

FIRM: MESSRS G. W. CHITTY & CO., LTD.

Analysis	%	Remarks
Moisture (loss in water-oven at 100° C.)	13·02	Of no significance owing to changes on standing.
Gluten (dried)	13·57	Good quality and quantity.
Ash	0·48	Satisfactory.
Nitrogen	2·11	Good.
Protein N% x 5·7	12·03	"
Hydrogen Ion Conc. in terms pH. 10% Extract	6·30	Normal.
H. Ion Conc. in terms pH. after addition 10 c.c. N/100 Lactic Acid per 100 c.c. Extract	4·95	"
Buffer Value (diff. between above x 10)	13·5	"
Gas Producing Power in per cent maltose after 1 hour's incubation at 27° C. If over 1·50%, gassing power satisfactory. If over 2·3%, danger of stickiness in crumb	1·53	Satisfactory but lower than corresponding Garnet mixture.
Colour {Grade Fig. (alcohol)	9·0	Normal and satisfactory.
Colour {Bleach Fig. (petrol)	.....	Unbleached 11·0 (lower than corresponding Garnet Mixture: Bleached Alsop 6·0; Bleached ½-oz. Novadelox 4·5.

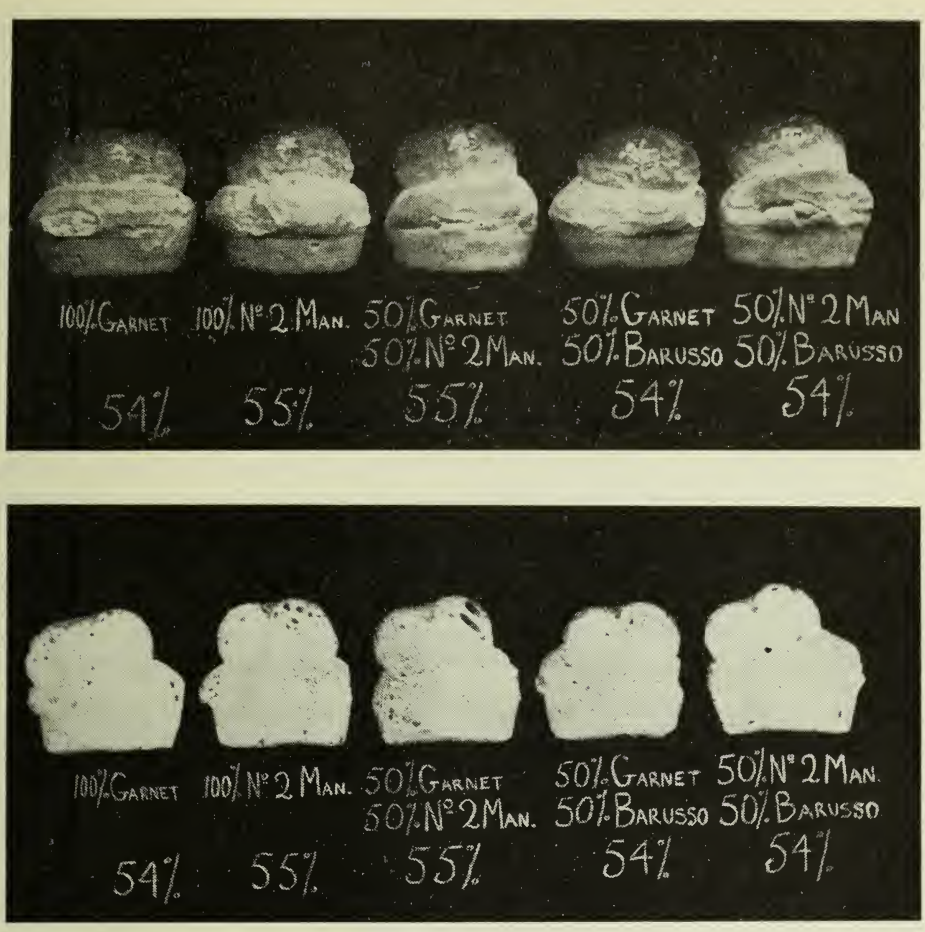
FLOUR. August 14, 1929.

MARK OR DESCRIPTION: GARNET (x Grands Moulins de Corbeil). Lab. No. F. 118.

FIRM: MESSRS G. W. CHITTY & CO., LTD.

Analysis	%	Remarks
Moisture (loss in water-over at 100° C.)	15·93	Of no significance owing to changes on standing.
Gluten (dried)	12·04	Good quality and quantity.
Ash	0·46	Very good dur to milling at higher moisture content.
Nitrogen	2·01	Slightly lower than original Garnet but practically within experimental error particularly when sampling error is considered. (Also allowing for moisture.)
Protein N% x 5·7	11·46	
Hydrogen Ion Conc. in terms pH. 10% Extract	6·25	Lower than previous grinding due to low ash content.
H. Ion Conc. in terms pH. after addition 10 c.c. N/100 Lactic Acid per 100 c.c. Extract	4·85	" "
Buffer Value (diff. between above x 10)	14·0	Higher difference as usual with low ash.
Gas Producing Power in per cent maltose after 1 hour's incubation at 27° C. If over 1·50%, gassing power satisfactory. If over 2·3%, danger of stickiness in crumb	1·88	Satisfactorily high figure and similar to previous grinding. Good sugar content.
Colour {Grade Fig. (alcohol)	9·0	Normal.
Colour {Bleach Fig. (petrol)	.....	Unbleached 9·0 (some gas still in worms).

(Signed) D. W. Kent-Jones.



Loaves made by Woodlands' Ltd.

A REPORT ON THE CHEMICAL CHARACTERISTICS AND MILLING AND BAKING QUALITITES OF GARNET WHEAT (1928 CROP)— BY RESEARCH INSTITUTE, ST. ALBANS, ENGLAND

Summary

Two commercially milled samples of Garnet flour, one sample milled on a Tattersall one-sack plant and one sample milled on the Research Association's model mill (four samples in all, milled from the same lot of wheat), have been examined and compared with commercially milled No. 2N. Manitoba flour.

The Garnet flour was closely similar to the Manitoba in chemical characters, in water absorption of dough, in dough stability and in general outside appearance of loaf. It was definitely inferior in colour (which was yellowish, rather than creamy), in dough "body," in gas-producing capacity, and in all loaf crumb characters. Moreover, the four Garnet samples differed in many respects from one another, indicating that this wheat is relatively sensitive to differences in conditioning and/or milling techniques. There were also indications that the flour was of inferior quality.

Garnet was also inferior to Manitoba in its ability to carry weaker flours. The blends of Garnet with 20 per cent and with 40 per cent of poor-quality English flour were inferior to the corresponding Manitoba-English blends. These inferiorities were more marked in some characters than in others, and varied also in the different samples. They were, however, quite definite and sufficient to justify the grading of this lot of Garnet as distinctly inferior to Marquis.

The milling character of the wheat appears to be excellent. The bran is thin and easily separated (although rather brittle) and the flour yield is high.

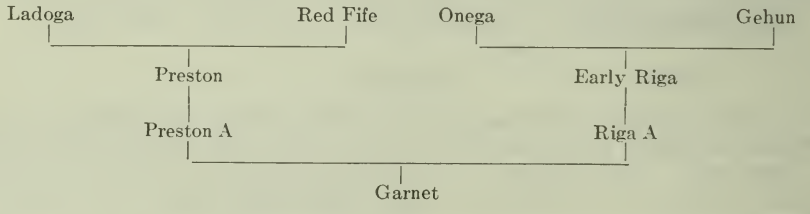
It is suggested that until European millers have become familiar with the peculiarities of this wheat and have learnt how to deal with them in commercial practice, it would be preferable to grade Garnet wheat separately rather than to include it (as the equivalent of Marquis) in the standard Canadian grades.

Introduction

Garnet wheat is a comparatively new variety, produced in Canada, which has the advantage of ripening a week or ten days earlier than the well-known variety Marquis. It produces about as good yields in the field as Marquis and numerous preliminary tests have indicated that its quality is at least comparable with that of Marquis. Its early ripening not only enables it to escape many of the early frosts that cause damage to Marquis in the more northerly parts of Canada, but may make it possible to grow this wheat in those northerly regions of Canada where, owing to early frosts, Marquis cannot be grown profitably at all.

There is no doubt that in a few years Garnet wheat will be grown widely in Canada and will probably become the predominant variety in the more northerly wheat regions. An important economic question that arises—important alike to the Canadian grower and to the English miller—is whether Garnet wheat shall be graded separately from Marquis or whether it shall be included in the ordinary grades. If Garnet is substantially identical with Marquis in milling and baking quality it will be a matter of indifference to the English miller whether, say, No. 1 N. Manitoba wheat contains 60 per cent Marquis or 60 per cent Garnet wheat. If, however, there are material differences in quality between the two wheats it would be greatly to the miller's advantage if the two varieties were graded separately.

The pedigree of Garnet is of interest and is indicated in the following scheme:—



Ladoga was an early-maturing variety obtained from the Lake Ladoga region of Northern Russia, about 600 miles north (by latitude) of Winnipeg. It was, however, of very poor quality, producing a loaf of yellow crumb and coarse open texture.

The cross between Ladoga and Red Fife made in 1888 and called Preston possessed the earliness of ripening of Ladoga but was still of relatively poor quality. From this cross a pure line selection, called Preston A, was obtained.

Onega was also a Russian wheat obtained in 1888 near Archangel, one of

the most northerly wheat-growing districts of Russia. Gehun came from the Himalayan mountains of India at an elevation of about 11,000 feet. Both varieties were early but relatively unproductive. These were crossed in 1891, producing Early Riga, one of the earliest ripening wheats known. This cross gave a flour of high protein content and good quality, but was unproductive in the field. From this cross a pure line selection—Riga M—was obtained.

These two pure line selections—Preston A and Riga M—were crossed in 1905 and produced Garnet, a variety which possessed the earliness of its immediate progenitors, with the high quality of Riga, and was also satisfactorily productive in the field. It was not until 1923, however, that Garnet wheat was given serious consideration as a possible rival to Marquis in certain areas on account of its earliness.

Garnet seed wheat was first released to Canadian farmers in 1926, in which year approximately 12,900 acres were sown—largely as an experiment.

The great amount of work carried out in Canada up to and including 1926 has been described in an official publication.* It may be of interest to summarize briefly the main conclusions recorded concerning the character of this wheat:—

Garnet is equal to Marquis in weight per bushel and where the supply of moisture is ample Garnet may excel Marquis in this character. At the same time the Garnet kernel is smaller than the Marquis and where conditions are not favourable for full development of the kernel this is inclined to be lean.

The bran is very thin so that Garnet is at least equal to Marquis and frequently excels it in flour yield.

Garnet produces a more vitreous kernel than Marquis and appears to hold its colour better under moist conditions. This difference is particularly evident in districts where Marquis produces starchy or "piebald" kernels.

The colour of Garnet flour is yellower than is that of Marquis.

The crude protein content is generally somewhat lower than that of Marquis.

Generally speaking the water absorption of Garnet dough is a little lower than that of Marquis; the dough is also of poorer spring and elasticity. In experimental and commercial test bakes the Garnet doughs resisted fermentation slightly better than Marquis and the loaf was of slightly greater volume. Crumb colour is appreciably and crumb texture slightly inferior to Marquis.

Milling Results

This year a considerable bulk of Garnet wheat has been distributed for testing purposes to a number of millers in Great Britain and Western Europe. A small sub-sample has been examined in these laboratories.

The wheat (2 bushels) was a good sound sample and resembled No. 1 N. Manitoba in appearance. The kernels appeared to be rather smaller and more brittle than Manitoba.

The moisture content at intake was 13·13 per cent. The wheat was dry cleaned but not washed. The amount of screenings removed on the model cleaning plant was 1·17 per cent. The wheat was given one moistening with cold water on July 3, a second moistening on the 4th, another on the 8th and a fourth and last on the 9th. The moisture content of the 1st break feed was 16·66 per cent. Breaking was carried out on July 10 and the milling completed on the 11th, 12th and 13th.

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*Dominion of Canada, Department of Agriculture. Bul. 83 (new series): Garnet Wheat. By L. H. Newman & A. G. O Whiteside (1927).

8731—3½

The wheat milled excellently both during breakings and reductions and dressing was free. The flour yield was 72·5 per cent of 1st break feed, or 74·1 per cent expressed as percentage of total products.

The moisture contents of the various fractions were: 1st break feed 16·66 per cent, bran 16·53 per cent, semolina offal 14·38 per cent, dunst offal and plansifter residues (mixed) 13·66 per cent, flour 14·90 per cent. It will be noticed that appreciable drying out of reduction stocks occurred during the somewhat protracted milling. This would tend to reduce the apparent flour yield.

The flour was kept in store for seven weeks after which analytical and baking tests were carried out.

ANALYTICAL RESULTS

Garnet Wheat: Moisture, 13·13%; total nitrogen, 2·15%; protein = N x 5·7 = 12·26%.

Flours	Garnet .	No. 2 Northern Manitoba
	%	%
Moisture	14·44	14·89
Ash	0·521	0·429
Total nitrogen (N)	1·97	2·01
Total phosphorus (P_2O_5)	0·224	0·219
Soluble extract	4·80	5·56
Soluble nitrogen	0·236	0·248
Soluble phosphorus	0·062	0·059
Protein = N x 5·7	11·23	11·45
Dry gluten by washing out	13·40	13·60
Maltose figure	1·50	1·60
Total or titratable acidity	0·54	0·48
pH	6·12	5·93
Buffer value	0·62	0·64

The Garnet and No. 2 Manitoba were closely similar in chemical composition except in ash content which was materially higher in the model-milled Garnet than in the commercially milled Manitoba.

Both glutens washed out well. The Garnet did not break up during washing but was rather soft, fairly springy but had little extensibility and tore easily. It toughened somewhat towards the end of the washing but remained " short." Colour was good, skin rather rough and stability in oven excellent. (Note. " Short " glutens, like " short " doughs, are often of good apparent stability. A really good gluten, or dough, should possess good stability and good elasticity).

The Manitoba gluten was fairly tough and did not break up during washing. It appeared to be rather softer than is usual with high grade Manitoba. It was coherent but had little extensibility, although superior to Garnet in this respect. Colour was good, skin rather rough, stability in oven very good. On the whole it was distinctly superior to the Garnet gluten.

Gas Production

Gas production of both Garnet and No. 2 Manitoba flours was tested, using in each case 2 per cent and ½ per cent of yeast.

For each test the following amounts of material were used: 50 gms. of flour, 1 gm. (— 2 per cent of weight of flour) *or* 0·25 gm.) (— ½ per cent) of yeast, 0·625 gm. (= 1¼ per cent) of salt, 30 ccs. water. Temperature of fermentation 80° F.

—	Garnet Flour		No. 2 N. Manitoba	
	2% yeast	½% yeast	2% yeast	½% yeast
	ccs.		ccs.	
1sr hour	30	.....	31	.....
2nd hour	72	22	78	18
3rd hour	83	24	89	22
4th hour	106	34	106	33
5th hour	71	46	108	49
6th hour	34	59	82	68
7th hour	24	.....	.....	68
8th hour	16	75	36	70
Total gas in 24 hours	516	499	840	.....

Garnet was inferior to Manitoba in gas production.

With Garnet and 2 per cent yeast rate of gas production increased steadily up to the 4th hour after which it decreased rapidly. With Manitoba gas production increased up to the 5th hour after which it decreased relatively slowly.

With most commercial flours of moderately good " strength " in this country the best loaf should be thrown (with 2 per cent yeast) at about $3\frac{1}{4}$ hours but really good Canadian and American " strong " flours might throw their best loaves at 4 or $4\frac{3}{4}$ or, in exceptional cases, even at $5\frac{1}{2}$ hours. Moreover, after the best loaf has been thrown and deterioration has set in the rate at which deterioration progresses is of interest as it is one indication of the fermentation tolerance of the flour. In testing a new flour it is desirable to bake loaves at intervals in order to " bracket " the best loaf and so obtain information concerning the flour's fermentation tolerance. For this purpose it is essential that gas production be maintained at a high rate for, if possible, some hours beyond the time at which the best loaf is thrown.

It is apparent from the figures given above that while the Manitoba flour was quite satisfactory in this respect, the Garnet was not. No true comparison between the two flours could be made until the rate of gas production in the Garnet flour was increased in the 5th and subsequent hours sufficiently to produce a proper inflation of the doughs at final proof. This increase was brought about by adding to the flours 0·1 per cent of a highly diastatic malt extract and 0·05 per cent of ammonium phosphate. The relatively very large increases in rate of gas production resulting from this addition are evident from the figures given below and were sufficient to ensure adequate dough inflation for some time after the optimum fermentation time.

—	Garnet Flour		Manitoba Flour	
	With 0·1% malt extract and 0·05% ammonium phosphate			
	2% yeast	½% yeast	2% yeast	½% yeast
	ccs.		ccs.	
1st hour	47	.....	41	.....
2nd hour	79	23	84	25
3rd hour	102	30	102	30
4th hour	122	49	121	48
5th hour	137	62	127	60
6th hour	93	71	117	69
7th hour	50	83	90	81
8th hour	37	89	53	87
Total gas in 24 hours	983	882	1,099	1,045

The importance of adjusting rate of gas production in testing for quality was shown in the following way:

A series of loaves were baked from Garnet and Manitoba flours, at ¾-hourly intervals, using 2 per cent yeast and no addition of malt extract. The 4-hour Garnet and Manitoba loaves were closely similar in volume, the 4¾-hour Manitoba was larger and the 4¾-hour Garnet very small and stodgy.

On rebaking with the addition of malt extract and ammonium phosphate, the 4-hour Garnet and Manitoba loaves were again similar in volume, and similar also to the corresponding loaves baked without malt extract. The 4¾-hour Manitoba also was little changed, but the 4¾-hour Garnet loaf, instead of being small and stodgy, was larger than the 4-hour loaf and was in fact the best Garnet loaf of the series.

Baking Tests

In the following tests, unless otherwise stated, the baking formula used was 2 per cent yeast, 1¼ per cent salt, 0·1 per cent malt extract and 0·05 per cent ammonium phosphate, absorption 16 gallons liquor per sack,* fermentation temperature 800° F. Separate doughs were made at ¾-hour intervals, so that all doughs went to the oven together.

X. No. 2 Manitoba flour.
Y. Garnet flour.
Z. 50-50 Garnet-Manitoba mixture.

In each series doughs were scaled at 1¾, 2½, 3¼, 4, 4¾ and 5½ hours, then each was given ¾-hour final proof. Tinned loaves were made.

Corresponding doughs of the three series were closely similar in stability, but the Manitoba doughs were the best in "body." The Z loaves were intermediate between X and Y.

The best loaf of each series was thrown at 4¾ hours (i.e. scaled at 4 hours). The 5¼-hour loaves were still good but distinctly inferior to the 4¾ loaves; the 5½-hour Garnet dough and loaf had deteriorated more than the 5¼-hour Manitoba.

The best loaves of X, Y and Z series resembled each other closely in outside appearance and volume. The Manitoba was slightly more open in grain and softer in crumb, of lighter crumb colour and markedly better bloom or brightness.

This series of tests indicated that Garnet when baked alone was inferior to Manitoba in dough "body" and in crumb colour, spring and grain. It did not "stand up" so well as the Manitoba to slight over-fermentation as indicated by the comparative inferiority of the 5½-hour Garnet loaf. Garnet was equal to Manitoba in dough stability and in loaf crust and general outside appearance. Loaf volumes were not determined: the corresponding loaves of the three series were of approximately similar volume.

Two further series were baked, using the same baking formula, in order to ascertain the effect on Garnet and Manitoba flours of blending with a very poor, weak (biscuit-making) English flour. Cob loaves were made and the two series were baked at different fermentation periods (including final proof) of 4¾ and 5½ hours. All loaves, however, went to the oven together; i.e. series A were made ¾-hour later than series B, so that all A loaves were "thrown" at 4¾ hours and all B loaves at 5½ hours.

The blends were as follows:—

A1. No. 2 N. Manitoba alone.
A2. Garnet alone.
A3. 50-50 Garnet-Manitoba mixture.
A4. 80 per cent Manitoba-20 per cent very poor English.

*This absorption was found by trial and was the same for both Garnet and Manitoba flours.

A5. 80 per cent Garnet-20 per cent very poor English.
A6. 60 per cent Manitoba-40 per cent very poor English.
A7. 60 per cent Garnet-40 per cent very poor English.

In both series Garnet was equal to Manitoba in dough stability but inferior in " body " or toughness of dough. In A series A4 was a better bodied dough and made a better loaf (in oven spring and most crumb characters) than A5. That is, the English reduced oven spring and made the grain closer and the crumb more cheesy and rough and of poorer spring. These effects were slight in A4, more pronounced in A6. A5 was inferior to A4 but slightly better than A6. A7 was markedly inferior to A6 in all characters.

All the loaves of the B series were over-fermented, the Manitoba slightly, the Garnet markedly. This difference was even more apparent in the blends, B7 being very markedly inferior to B6 and to A7.

Comparison of Garnet Flours Made in Different Mills

Along with the A series were baked two loaves (one with 16 gallons and one with $16\frac{3}{4}$ gallons absorption) made from a sample of Garnet flour which had been milled commercially from the same bulk of Garnet wheat of which our Garnet wheat was a sub-sample. This flour, labelled B, was quite definitely different in quality from our model milled sample. It was markedly yellower in colour and of higher absorption in the dough, the optimum absorption being $16\frac{3}{4}$ gallons as compared with 16 gallons for the model milled flour. Moreover, apart from colour, this sample, B, gave a loaf better in all characters than that obtained from our sample—a loaf which (again apart from colour) more closely resembled the Manitoba loaf.

It appeared therefore that Garnet wheat is quite definitely sensitive to differences in conditioning and milling technique, or at any rate, sensitive to the difference between commercial hot conditioning and milling technique on the one hand and laboratory cold conditioning and model milling on the other.

It seemed desirable to ascertain whether the quality of Garnet flour is affected by differences in commercial milling techniques. Some samples of Garnet flour were obtained made from the same bulk of wheat but in three different mills. Samples B (already referred to) and C were made on commercial plants, full commercial extractions being obtained, and sample D was made on a Tattersall one-sack plant, the extraction being about 60 per cent.

The analytical results of these three samples, together with those for the Research Association's sample (RA), are given below.

	Sample			
	R.A.	B.	C.	D.
	%	%	%	%
Moisture	14·44	15·32	15·43	14·78
Ash	0·521	0·473	0·470	0·554
Total Nitrogen (N)	1·97	1·95	1·97	1·75
Total Phosphorous (P_2O_5)	0·224	0·219	.....	.....
Soluble extract	4·80	6·59	5·46	.....
Soluble nitrogen	0·236	0·375	.....	.....
Soluble phosphorus	0·062	0·054	.....	.....
Protein = N x 5·7	11·23	11·11	11·23	9·97
Dry gluten by washing out	13·40	12·05	12·23	11·23
Maltose figure	1·50	2·30	1·60	1·90
Total or tireatable acidity	0·54	0·72	0·64	0·46
pH	6·12	5·57	5·52	6·28
Buffer value	0·62	0·50	0·48	0·57

The dates of manufacture and of analysis of the four flours were as follows:—

—	R.A.	B.	C.	D.
Date of manufacture	July 10	July 23	July 16	Aug. 23
Date of analysis	Sept. 5	Sept. 9	Sept. 9	Sept. 9

Sample B had markedly deteriorated during storage, as indicated by the high soluble extract, maltose figure, total acidity and low pH value. This deterioration was most evident in the washed out gluten which was low in quantity and comparatively poor in quality. The gluten showed a marked tendence to break up during washing, showed very poor cohesion and no extensibility. It tore easily, its skin was rough, colour reddish brown. Like most "short" gluten, it stood up well in the oven.

Sample C also showed signs of deterioration. Its pH value was the lowest (most acid) of the four, its total acidity intermediate between B and RA and its gluten low in amount. (Note.—The total nitrogen was substantially the same in B, C and RA.) The gluten was of much better quality than B being rather more resilient and coherent and of better colour, but of rather putty-like feel. Skin was rough and stability good.

Sample D although of low extraction was of high ash content; the low total nitrogen was therefore surprising. There were no signs of deterioration in this sample (or in RA). The gluten however was relatively low in amount and was the toughest and most clay-like of the set. It stood up best of all in the oven. Colour was similar to C. All four glutens were however inferior in colour and in all other characters (except stability) to Manitoba.

Gas Production Figures, using 2 per cent yeast, for all four samples were as follows:—

GARNET FLOURS

—	Sample R.A.		Sample B.		Sample C.		Sample D.	
	Alone	+M.E.*	Alone	+M.E.*	Alone	+M.E.*	Alone	+M.E.*
	ccs.	ccs.	ccs.	ccs.	ccs.	ccs.	ccs.	ccs.
1st hour	30	47	31	50	35	36	34	40
2nd hour	72	79	67	67	78	83	79	76
3rd hour	83	102	71	82	96	96	82	86
4th hour	106	122	95	101	106	105	98	105
5th hour	71	137	116	120	92	150	117	133
6th hour	34	93	120	134	58	142	87	135
7th hour	24	50	83	126	37	68	43	107
8th hour	16	37	54	82	29	45	29	84
Total gas in 24 hrs.	516	983	910	1,135	771	1,031	809	1,189

*0·1% malt extract and 0·05% ammonium phosphate.

The high gas production of B was due probably to deterioration. Sample C compared satisfactorily with the model milled RA sample. All were greatly benefited by malt extract and ammonium phosphate.

Baking Tests Y, A and B series were repeated with all four samples of flour. The results need not be described in detail but may be summarized as follows:—

Colour (of flour and loaf): RA (best), C.B. (most yellow), D (poorest); all inferior to Manitoba.

Absorption: 16 gallons per sack for RA, C and D, and 16¾ gallons for B; C, B and D were similar in "body" of dough, being superior to RA in this respect. All four were similar in stability.

All threw their best loaves at 4¾ hours (to oven, using 2 per cent yeast). C "stood up" to over-fermentation rather better than the other samples and also "carried" 20 per cent and 40 per cent of English flour with less deterioration. The C-English blends were easily the best of the blends in oven-spring.

On the whole C resembled the Manitoba most closely of the four Garnet samples, although it was distinctly inferior to Manitoba. B was inferior to C although, owing to the variable degree to which these two samples had apparently deteriorated during storage, it is not possible to say to what extent they differed when freshly milled. The RA sample was inferior to B (excepting colour) and the D sample was the least satisfactory in all characters except dough "body."

Neither the Manitoba nor the RA Garnet showed signs of deterioration during storage. The deterioration of B and C is a point worthy of further investigation. If it represents a general characteristic of Garnet it is a serious defect.

The tests described above indicate that this year's Garnet flour is distinctly inferior to the sample of No. 2 N. Manitoba flour used as a reference flour not only in colour but in all dough characters (except stability) and in loaf crumb characters. Moreover the quality of the flour is affected by differences in conditioning and milling technique, and there are indications that the keeping quality of the flour is not altogether satisfactory. It is possible that this apparent sensitiveness of Garnet wheat and flour to conditioning and storage may account to some extent for the somewhat conflicting opinions that have been expressed concerning the value of this wheat. Certainly it would be desirable to keep this wheat out of the standard grades (as the equivalent of Marquis) for a few years until European millers have become familiar with its peculiarities and have learned how to deal with them in commercial milling practice.

(Signed) E. A. Fisher,
Director of Research.

September, 1929.

GARNET TESTS BY ASSOCIATED LONDON FLOUR MILLERS, LTD.

Haddon House, 66a Fenchurch St.,
London, E.C. 3, August 16, 1929.

Mr. L. H. Newman,
Canada House,
Trafalgar Square, S.W. 1.

Re Garnet Wheat Ex ss. Beaverhill

Dear Mr. Newman,—I am sending you herewith a summary of our Laboratory tests of the above wheat, together with full particulars of the various tests as carried out in the Laboratory.

This wheat proved very satisfactory with regard to the actual operation of grinding. The untreated flour from it was of an exceptionally strong yellow colour, which is distinctly against it with regard to the customers who stipulate that their flour shall be unbleached and untreated.

There is no doubt in my mind that we can make very good use of this wheat in London, provided we are able to buy it separately as "Garnet wheat". As such, it has a distinct value of its own, but if mixed with Manitobas it will not only lose its own distinctive value but it will tend to greatly lower the distinctive value of the Manitoba wheat—in fact it will practically nullify it.

If your farmers can send forward Garnet wheat of as good a quality as this particular shipment, I do not think they need fear having to sell it at a heavy discount as compared with Manitobas, though no doubt they would not get the price of No. 1's for it. This, however, would somewhat depend on the proportion of Garnet wheat grown. If a very heavy percentage were produced it would probably have to be sold at a discount.

We shall be very interested to see how this matter develops but we do sincerely hope that this wheat will not be passed for grading with Manitobas.

Yours very sincerely,

(Signed) O. E. Robinson,
Director.

ASSOCIATED LONDON FLOUR MILLERS LIMITED

The Laboratory,
Deptford Bridge Mills,
London, S.E. 8, July 22, 1929.

Report on Garnet Wheat, Ex. ss. Beaverhill Received June 28, 1929

SUMMARY

The general conclusion is that this "Garnet" wheat has different strength characters from, say, No. 3 N. Man. in spite of its prepossessing appearance—there is still a deep-rooted idea that a hard, red, translucent wheat is a strong one—it has not the high elastic strength which used to be the great feature of high grade Manitoba wheats and for which such wheats were so highly valued.

Its excellent milling qualities, and the pleasant flavour of the bread it makes, are points decidedly in its favour, and for which it will be esteemed when its properties are more widely known.

Assuming this sample of "Garnet" wheat to be fairly representative, it seem certain that it would be inadvisable to include "Garnet" wheat in the ordinary grades of Manitoba wheat; to do so would be detrimental to the reputation of both.

It would be much better policy to grow and market it as an entirely separate grade, when it would reap the benefits of the valuable properties which it possesses.

(Signed) A. G. Simpson,
Chemist.

ASSOCIATED LONDON FLOUR MILLERS LIMITED, CENTRAL LABORATORY

July 22, 1929.

Report on Garnet Wheat Ex. ss. Beaverhill Received June 28

Notes

GENERAL CONDITION AS RECEIVED

A longer-grained type of wheat than average Manitoba wheats as received here.

Practically free from extraneous matter; an occasional skin-frosted, sprouted and immature grain was found, also a minute proportion of what were apparently Durum wheat grains.

Moisture Content: 13·6 per cent (110° C — $4\frac{3}{4}$ hours).

Hardness or Toughness.—Laboratory tests showed that this wheat was distinctly harder than average No. 3 N. Man. of the current crop, *i.e.* would require to be tempered to a higher moisture content and would stand, and require, a more intensive mellowing process than No. 3. Manitoba, which will take about 18·0 per cent moisture on the 1st. Break-rolls. Actually, this Garnet wheat was brought up to 19·2 per cent moisture and milled with remarkable freedom at that figure, in the commercial tests.

Protein Content (Wheat): 14·88 per cent. This is practically the same as the average protein content of the No. 3 Manitoba wheats (14·92 per cent) received by Associated Mills during the past 2 months.

LABORATORY STRENGTH TESTS

Three lots of this wheat all damped to 18·0 per cent moisture but otherwise conditioned in somewhat different ways were milled on the Laboratory Mill: all milled quite easily; the three lots of flour obtained were mixed for laboratory tests.

The following figures show the results of laboratory strength tests on this flour as compared with those for the average of No. 3 Manitoba wheat received during June-July 1927; 1928 and 1929.

The figures are merely comparative and are chiefly intended to show the differences in the working properties of the doughs. The methods by which they are obtained have been worked out in this laboratory and have not been published.

——	Elasticity	Firmness	Stability	Gas retaining capacity
No. 3 Manitoba—1927	106	62	70	102
No. 3 Manitoba—1928	76	69	79	97
No. 3 Manitoba—1929	71	88	83	111
Garnet	84	152	90	96

Although this Garnet wheat would certainly grade higher than No. 3 Manitoba on general appearance and condition, yet the figures for No. 3 Manitoba only are given for comparison because—

(1) No samples of grades higher than No. 3 have been received in this laboratory during the present crop season.

(2) Strength is not necessarily higher the higher the grade.

Variations in climatic conditions during growth and other considerations also affect strength and will affect various grades unequally, which may in part account for the remarkable variations in strength figures in No. 3 Manitobas in the 3 years—1927-9.

It is therefore difficult to say how far Garnet wheat would compare with No. 1 N. Manitoba wheat in different seasons.

As regards the figures themselves:—

The *elasticity figure* is probably the best expression in the present state of our knowledge of the "gluten-Quality" factor. It shows Garnet to be definitely superior to No. 3 Manitoba of the present crop (1928).

The *firmness figure* shows that Garnet gives a much tougher and less ductile dough than No. 3 Manitobas which goes to discount the higher elasticity.

The *stability figure* shows the tendency of the dough to soften during the fermentation process; the difference between the two flours under consideration is hardly significant.

The *gas retaining capacity* will be self-explanatory. It is relatively low in Garnet, corresponding to the high firmness figure and incidentally to the relatively low bread-volume given by the Garnet flour.

The figures therefore show the Garnet flour to have abnormal strength figures as compared with average No. 3 Manitoba for the last 3 years.

DIASTATIC CAPACITY

The "Maltose figure" (Kent-Jones "Modern Cereal Chemistry" 1927) was abnormaly high, *i.e.*—

Garnet	3·64
No. 3 Manitoba (fair average)	2·69
No. 4 Manitoba (fair average)	3·24
No. 5 Manitoba (fair average)	2·77

This is no doubt correlated with the particularly pleasant, sweetish flavour of the bread.

The gas making capacity was also high, gas evolution being well maintained throughout fermentation.

Twenty grams of flour fermented with 11 cc's. of a suspension containing 1·8 per cent yeast and 1·8 per cent salt at 27° C.

GAS EVOLUTION

—	4th Hour	7th Hour
	ccs.	ccs.
Garnet	32·0	40
No. 3 Manitoba	34·5	38
No. 4 Manitoba	37·0	42
No. 5 Manitoba	37·0	43

LARORATORY BAKING TESTS

Baking Test Method

300 cc's water.

50 cc's yeast suspension containing 10 grams yeast = 1·4 per cent of flour.

50 cc's salt solution containing 9 grams salt = 1·28 per cent of flour.

700 grams of flour are weighed out and of this enough is added to the 400 cc's liquor to obtain a dough of as near as possible standard consistency, the temperature of the flour and liquor being so regulated as to give a dough temperature of 80° F. which is maintained throughout fermentation.

1st cut back after	2 hours from start.
2nd cut back after	3 " "
Dough scaled off (2 lb. 4 oz.) after	3¼ " "
Proof for	¾ hour "
Total for fermentation	4 hours.
Time in oven	¾ hour.

The dough is proved up and baked in circular pans about 7 inches in diameter and 1¾ inches deep.

Water absorption is calculated in pounds water for a sack (280 pounds) flour.

Notes are taken of the behaviour during fermentation. The volume of the bread is measured by displacement. The bread is cut vertically through the

centre, the vertical height through the centre divided by the maximum diameter giving a rough measure of its shape, while the vertical height gives a measure of the "oven spring".

Colour, texture and outside appearance are assessed arbitrarily.

TESTS ON LABORATORY MILLED FLOURS

The Garnet wheat flour already mentioned and flour similarly milled from the No. 3 Manitoba wheat which happened to be in stock at the time were baked side by side.

The water absorption figure was high, and practically the same, in each.

The Garnet flour gave rather better elasticity 'body' and firmness and stability in the dough than the No. 3 Manitoba; it also gave a loaf of distinctly worse volume and shape—in fact a poor loaf.

—	Garnet	No. 3 Manitoba	Stand: for S. R. Flours
	c.c's.	c.c's.	c.c's.
Volume	2,350	2,600	3,000
Shape	60	64	75
	ins.	ins.	ins.
Height	4·3	4·7	5·5

The Garnet loaf was decidedly yellower and rather clearer in the crumb than that from the No. 3 Manitobas and the texture more even.

The flour was excellent, distinctly sweet and appetizing.

TESTS ON COMMERCIALLY MILLED FLOURS

Two mixtures were milled on the Commercial Mill.

A . . . . . { 50 per cent Garnet
35 per cent Plate Wheat
15 per cent Australian } Soft Mix

B . . . . . { 50 No. 3 Man.
35 per cent Plate Wheat
15 per cent Australian } Soft Mix

The same three grades were sacked off in each case:—

(1) Top, 60 per cent.
(2) Straight run.
(3) Bottom, 40 per cent.

BAKING TEST REPORT

—	A1	B1	A2	B2	A3	B3
Water absorption	154·5	155	156	158·8	160·3	162·3
Elasticity	+	....	+	....	....	....
"Body" and firm	....	+	....	....	....	+
Stab. in Proof	....	+	....	+	....	....
Volume	2,900	3,100	2,850	3,050	2,750	2,900
Shape	71	80	68	74	72	72
Height	5·2	5·8	5·0	5·5	5·2	5·3
Colour	+	....	+	....	+	....
Texture	+	....	+	....	....	+
Crust	+	....	....	+	....	....

Comparing the three pairs of flours, the preference in any particular property is given to the one marked +; where no mark is entered, there is no difference.

The general conclusion is that the flours from the Garnet mixture give a somewhat more elastic dough, but with reduced Water Absorption, ' body ', firmness and stability in the dough.

The bread from the Garnet mixture flours is appreciably smaller in volume and has rather worse shape and oven spring.

Colour, texture, crust character and flavour are rather better in the flours from the Garnet mixture.

The reduced Water Absorption and softer working character of the doughs from the Garnet mixture may be due to the higher moisture content of the conditioned Garnet wheat.

(Signed) Associated London Flour Millers Ltd.,
A. G. Simpson, *Chemist.*

TESTS BY JOSEPH RANK, LTD., LONDON

Silverton Laboratories, July 12, 1929.

W. H. Raylor, Esq.,
Mgr. Jos. Rank, Limited,
London.

Re Test of Garnet Wheat

Dear Sir,—This wheat was conditioned to give a moisture content of between 16½ per cent to 17 per cent of moisture. Actually, it came on to the Mill at 16·64 per cent (vide Hay's report 8/7/29—5 grams test for 5 hours in electric oven). It milled freely and broke up very short on the breaks, but, despite this fact, the quantity of bran powder made by the break rolls was surprisingly small. Very few readjustments to the setting of the machines had to be made. The first and second break rolls were eased off and only slight adjustments made to the setting of the head end reductions. The purifier stocks were very clean and in an ideal condition for purification. The percentage of extraction can be computed to be about equal to No. 2 Man.

The behaviour of the flour in the baking process was rather disappointing. The baker found that at first the dough was inclined to be sticky. It improved in the later stages, however, but the " oven spring " was slight.

Yours truly,

(Signed) Joseph Rank, Limited,
per S. Jones.

TEST OF BREAD, JULY 18, 1929

Mixture of	20	per cent	Garnet —80	per cent of Baril.
	40	"	" —60	"
	60	"	" —40	"
	80	"	" —20	"

In this group the colour values were:—

1—40	per cent	Garnet—	60	Baril.
2—20	"	—80	"	
3—60	"	—40	"	
4—80	"	—20	"	

There was very little difference, so little as to be inappreciable, in the size of any of the loaves. The Baril flour, when tested alone, produced a loaf of rather better than fair volume, but all the loaves mixed with the Garnet showed

slightly less volume in the loaf than the Baril alone. The colour of the Baril alone was particularly good, the only loaf that compared with it was the 40 per cent Garnet and 60 per cent Baril mixture. The textures of the loaves were in all cases a little closer than the Baril, with a little more silky character, but so far as the strength factor was concerned as shown by the size of the loaves, while the density of the crumb was increased a little and in that also it was slightly tougher, in each case the loaves were perfectly aerated and showed no signs of being gluten bound. The loaves were all decreased in size by the admixture of Garnet. The proportion of Garnet in each case of increase beyond the 40 per cent showed a definite depreciation in the quality of the loaf.

Trial of Rosafé and Garnet

The Rosafé flour produced a typical Rosafé loaf, very open texture, big volume and high colour. Silky bright sheen, long spores. The mixtures were as above, viz. 20 per cent Rosafé—80 per cent Garnet, 40 per cent Rosafé—60 per cent Garnet, 60 per cent Rosafé—40 per cent Garnet, 80 per cent Rosafé—20 per cent Garnet.

The outstanding loaf among the four tests was the 20 per cent Garnet and 80 per cent Rosafé, but although the colour of this loaf was equal to the Rosafé alone, with the exception that it was slightly creamier in colour, the admixture of 40 per cent Garnet, and increased quantities very materially reduced both the volume and quality of the loaf in every respect.

The same characteristics obtained briefly as with the Baril, viz. that the crumb was much closer, and the addition of the increased quantity of Garnet made the texture less silky and the size of the loaves were decreasd almost proportionately to the quantity of Garnet introduced.

In this test there was no appearance from the section of the loaves of any lack of thorough aeration, the spores of the bread were very small, the texture was even and regular, but very close.

The loaf with only the 20 per cent of Garnet in was scarcely the colour of our ordinary commercial loaves, while the volume of the Rosafé alone was slightly greater.

In both tests straight grade flour was used.

Test of "Garnet" Wheat Mixed with "Australian"

Top 50 per cent.—First Test. Four Garnet—Six Australian.
2. Six Garnet—Four Australian.
3. Two Garnet—Eight Australian.

The size of the loaves is small and rather flat. The greater volume of the three being the four Garnet and six Australian. Six Garnet and four Australian is distinctly less in volume, two Garnet and eight Australian comparatively small, dumpy loaf.

Straight Grade.—An almost inappreciable difference in size between the three comparative combinations, same as the preceding one. The loaves are comparatively small, and would be accounted as dumpy and unsatisfactory from a commercial point of view.

Fifty Per Cent Bottom.—Four Garnet—Six Australian, makes the best combination for size, but there is very little difference in the size of the three loaves, which are relatively small for commercial bread.

Texture.—The texture of the two parts Garnet and eight Australian is by far and away the best of the 50 per cent loaves. The six Garnet and four Australian has not opened out freely, but in texture it is as open as four Garnet and six Australian.

Texture Straigt Run.—The best texture of these three loaves is the two of Garnet and eight Australian—the four Garnet and six Australian is quite a fair texture, but a little lift in the loaf—the six Garnet and four Australian is disposed to be at once close in texture and at the same time rather holey at the top of the loaf.

Top 50 Per Cent.—Best texture four Garnet and six Australian.
2. Six Garnet—four Australian.
3. Two Garnet—eight Australian.

In all cases the colour value is practically determined by the amount of Australian in, that is, the larger quantity of Australian in all cases gives the highest colour value of the combinations. As this Australian wheat is rather on the weak side, the question of the possibility of the Garnet being gluten bound when baked alone is removed—the loaves are all a little larger with the Garnet baked alone, and the texture of the bread with the combination of four Garnet and six Australian is very materially altered. There are, however, apparently no lifting properties in the Garnet to distinguish it, at any rate, as the loaves are only slightly larger than they would have been approximately if made from the Australian wheat alone.

Flavour is very unsatisfactory and poor.

July 18, 1929. (Signed) W. H. Raylor.

LATER TESTS BY JOSEPH RANK LIMITED, LONDON

L. H. Newman, Esq.,
c/o the Canadian Building,
Trafalgar Square, S.W.1.

Dear Sir,—I had the Garnet flour baked again yesterday, and have the loaves before me.

The colour value of the flour is undoubtedly improved with the month's age, the divide of 50 per cent of the top now having lost a good deal of its particularly yellow character, which also applies in a slightly less degree to the 50 per cent Straight Run, 100 per cent.

These flours again have been baked by us on the ordinary straight dough process, about 4 to 4½ hours.

So far as the size is concerned, there appears to be comparatively little difference in the volume of the loaves from the test made when the flour was manufactured, but I enclose you herewith a diagram of the size of the loaves for your guidance.

There is certainly one feature about these loaves which is more noticeable than when we tried them immediately after milling, viz., the toughness, or to use another word that perhaps would more correctly define what I mean, the "resiliency" of the crumb. In this respect the bread, although not of the same volume, is more resilient than another loaf made from No. 2 Manitoba's, which I have before me. The No. 2 Manitoba's is made from a Straight Grade flour, and when compared with the 100 per cent Garnet is a little better colour and a shade or two whiter, but the texture is not so good as the Garnet.

August 22, 1929.

Yours truly,

(Signed) W. H. Raylor.

GARNET TESTS BY SPILLERS LIMITED, LONDON

Mr. L. H. Newman,
c/o Canadian Building,
Trafalgar Square, London, S.W.1.

Dear Sir,—With reference to our interviews when you were in this country, we have received the samples of flour from the Co-operative Wholesale representing Straight Run from "Garnet" and No. 2 Northern Manitoba wheats, as also sample of the "Garnet" wheat, for which we are very much obliged, and have been interested in making our trials.

We enclose herewith the report as received from our Laboratory, which we think deals with all features from an analytical point of view, and in comparing these tests one would, we think, say that there is apparently very little to choose between the two. We may here say, however, that the No. 2 Northern Manitoba wheat was a sample representing an average of our own receipts, and can be taken to be a fair average of last year's crop.

In addition to the analytical report we had bakings of the two Straight Run flours, and here again there was but little difference.

The "Garnet wheat seems to produce a stiffer crumb and it would be a question to decide later whether in our blends this would have a greater carrying capacity, from a strength point of view, than the No. 2 Northern Manitoba.

The colour of the "Garnet" was slightly inferior, being of a dullish grey cast, but there was an improvement in the colour of the crust from our point of view, as it gave a redder hue.

We also conducted baking trials by blending 30 per cent of the Straight Run flour from "Garnet" wheat with a 70 per cent White Wheat mixture, composed of Australian and Soft White Pacific, as against No. 2 Northern Manitoba in the same proportions, which really confirmed the bakings as shown by the Straight Run flours from the wheats themselves.

If it is considered on your side that it is an advantage to grow "Garnet" wheat as against the usual grades of Northern Manitoba, we would suggest that for the time being these wheats should be sold and shipped separately, so that we may have the advantage of thoroughly testing the values in our blends, and that this would be more satisfactory to us than your shipping the "Garnet" wheat with your Northern Manitoba, the percentage of which would be variable and uncertain.

With kindest regards,

Yours faithfully,

September 9, 1929. (Signed) Walter Allen.

ANALYSIS OF WHEAT, SPILLERS LIMITED

To Walter Allen, Esq., 40 St. Mary Axe, E.C.3.

Type: Garnet Wheat

Admixture report		Analytical report		Remarks
Broken and small wheat	0 99	Moisture	12·48	
Oats	0·16	Wet gluten—Quantity	42·45%	
Barley	0 03	Quality		M-G.
Black seeds	0·10	Dry gluten	11·59%	
Other seeds and dirt	0·05	Strength fig.	64·0	
Knottings		Protein (N x 5·7)	12·21	
Chaff	0 01			
Admixture	1·37			
Clean wheat by difference	98 63			
Total	100·00			

General remarks on condition, smell, weevils, smut, etc.:—

	Per cent
Green	0·68
Frosted	2·23
Bran frosted	3·77
Sprouted	0·08

TYPE: MANITOBA 2 NORTHERN WHEAT

Admixture report	%	Analytical report	%	Remarks
Broken and small wheat	1·88	Moisture	12·22	
Oats	0·53	Wet gluten—Quantity	31·24	
Barley	0·31	Quality		Mod.
Black seeds	0·95	Dry gluten	11·16	
Other seeds and dirt	0·28	Strength fig.	56·0	
Knottings	0·02	Total protein (N x 5·7)	11·47	
Chaff	0·08			
Admixture	4·05			
Clean wheat by difference	95·95			
Total	100·00			

General remarks on condition, smell, weevils, smut, etc.:—

	Per cent
Green	0·09
Frosted	12·44

ANALYSIS OF FLOURS, SPILLERS, LIMITED

Samples marked—No. 2N. Manitoba and Garnet Flours (in cotton bags) ex C.W.S. *Silvertown.*

Received from—Walter Allen, Esq., Messrs. Spillers Ltd., 40 St. Mary Axe, E.C. 3.

Date received—2nd inst.

Laboratory Ref. No. ....958C.

—	"No. 2 N. Manitoba" Flour	"Garnet" Flour
Moisture	12·92	12·96
Wet gluten	30·94	29·52
Dry gluten	11·05	10·54
Gluten quality	M-G	G
Strength points	61·0	63·0
Total protein (N x 5·7)	11·28	11·30
Ash	0·46	0·46

The strength of the "Garnet" Flour is very slightly better than the No. 2N. Manitoba due to its better gluten quality.

There is a definite difference between the colours in the Pekar test, the "Garnet" sample being darker.

The ash contents are equal, indicating that they are freed from branny matters in the milling process to an equal extent.

The "Garnet" wheat is darker in colour than the No. 2N. Manitoba sample, the latter containing more yellow berries, and we are of opinion that this difference is mainly responsible for the difference in flour colour.

No. 2 Manitoba Flour sample is slightly softer to the feel.

(Sgd.) W. H. Stephenson,
Central Laboratory.

SCOTTISH CO-OPERATIVE WHOLESALE SOCIETY

Edinburgh September 4, 1929.

Mr. L. H. Newman, B.S.A.,
Dominion Cerealist,
Central Experimental Farm,
Ottawa, Canada.

Dear Sir,—Further to your visit here on 29th and 30th ult, enclosed herewith is categorical answers to the questions submitted regarding our experience of "Garnet" wheat.

I also enclose abridged copy of Dr. Sword's report, and also copy of Mr. Sproul's (our experimental baker) report, and trust these will be of some interest to you.

As stated to you verbally, we experimented with "Garnet" wheat against No. 4, primarily because we happened to have a sample of No. 4 Nor. on hand at the time, much above the average we have been receiving, and although badly frosted was a purer type of Manitoba wheat than any of the higher grades we had in stock.

The extraction obtained from Garnet wheat on one grade of flour only—Straight Run—is equal to 75 per cent.

Yours respectfully,

(Sgd.) W. Smith.

Report on Garnet Wheat Flour Bakery Tests

Scottish Co-operative Wholesale Society

This flour was first tested on July 26 by the long overnight quarter sponge method of fermentation. The baker's remarks on that date were "In the overnight stage there was a large increase in temperature from the time the quarter was made till it was taken the following morning. The increase in temperature was greater than what usually takes place with a Northern wheat flour. This indicated that Garnet wheat flour does not resist the action of yeast well. The dough was short and rotten, which points to the flour not being well adapted for the long overnight stage of breadmaking. In the succeeding stages the flour fermented rapidly. When handling the scaled pieces of dough at the moulding stage there was very little resistance to the hand, and the dough did not stretch well. The bread was low in volume and broken on the sides. There was little oven spring."

On the same date and for comparison purposes a batch was made from Flour which was milled from the No. 4 Northern wheat entirely. The baker's remarks anent this flour were "This flour in every stage fermented like a good ordinary spring patent. The resultant bread was entirely satisfactory. The loaf volumes from these two flours measured in the laboratory under the supervision of Dr. Sword were:—

Bread from No. 4 Northern wheat flour—2812 c..c.
Bread from Garnet wheat flour—2472 c.c.

The yields were—

No. 4 Northern—198·9 loaves per 280 pounds flour.
Garnet flour—197·1 loaves per 280 pounds flour.

A test was made on July 29 using 25 per cent of Garnet wheat flour and 75 per cent Northern. These percentages being used in each stage. The increase in temperature during the overnight stag was normal. In the succeeding stages it was necessary to shorten time, fermentation was proceeding so quickly. The bread was quite good, a little under a full volumed loaf. There were no broken sides or corners. The 25 per cent of Garnet wheat flour had a weakening effect on the No. 4 Northern. The loaf volume was 2732 cc's and the yield was 196·8 per 280 pounds flour.

Another test was made on July 30, using 50 per cent Garnet flour and 50 per cent No. 4 Northern Wheat Flour in each stage. The increase in temperature during the overnight stage was normal. In the succeeding stages fermentation proceeded quickly. Many of the loaves showed broken sides and corners such as we get from over-fermentation. Evidently this percentage of Garnet Flour had a weakening effect on the No. 4 Northern. The yield was 197·5 loaves per 280 pounds flour. The loaf volume was 2,650 c.c's.

On July 31, the 50 per cent Garnet and 50 per cent No. 4 Northern wheat flour was again tested. In this test the Garnet Wheat Flour was added to the last stage so as to give it the minimum time under the action of yeast. The results were similar to those when the 50 per cent was added at each stage, viz. broken sides and corners and low volume. The yield was 197·2 per 280 pounds flour. The loaf volume was 2,605 c.c's. One more test of Garnet Wheat Flour was made on the 15th August, 1929 by the short process (sponge and dough) using Garnet wheat flour entirely. Fermentation proceeded rapidly despite the fact that a reduced quantity of yeast was used. What was a six hours process from start to finish was completed in five hours twenty minutes. We had slightly better results by this method. There were no broken sides on the loaves and only a very few loaves showed broken corners. The colour of the bread was also better. The yield was 199 loaves per 280 pounds flour. The volume of the bread was still low. The loaf volume was 2,650. From the above tests we formed the following conclusions. That Garnet wheat flour could not take the place of ordinary Spring Patent. According to the percentage used it has a weakening effect on Northern Wheat Flour. Of itself it does not resist the action of yeast well, and is not suitable for either long or short processes for Scotch Batch bread.

M. Sproule, *(Experimental Baker).*

Analysis of Flours from Garnet and No. 4 Northern

Scottish Co-Operative Wholesale Society

The close agreement between the two flours in the results for moisture, ash, protein, granulation distribution, and diastatic activity shows that

(1) the two wheats are of a very similar constitution and fundamental character, and
(2) the miller has succeeded in according to them exactly similar treatment.

No objection can be raised against Garnet on account of its chemical composition, but some of its physical characteristics are not in its favour.

(1) Its colour is not attractive. Even when loose in the dry state, it was obvious that the flour had a dingy—yellow colour. Made up in a wet slide test it developed brown and darkened considerably on drying out. This defect in colour continued right into the baked loaf.

It might be suggested that this defect could be removed by bleaching. We are of opinion that it could not be removed by our bleaching plant, for as a matter of fact, the yellow petrol figure, which is an index of the bleaching effect, is not high. It is indeed equal to what is found on the average in our straight run spring flours, viz. 9·5. On the other hand, the figure for the No. 4 Northern, treated under the same conditions, was found to be 7·5 *i.e.* below the average showing that the bleach was working at its maximum efficiency. A stronger bleach would certainly remove the colour, but, even if it were convenient to introduce this, it would be likely to produce a sickly over-bleached appearance, rather than a pure lustrous white.

(2) The quality of the gluten is not such as would encourage confidence in the flour for bread-making. It is reminiscent of Durum, hard and stable, but lacking in elastic pull. Possibly, this character could be modified if the flour were more mellowed in preparation, but this would require to be tried out in practice. This conclusion would appear to have some support from the nature of the flour which to us felt harder and sharper to the touch than do our normal spring flours, although the actual size of the particles as shown by the granulation distribution is the same for both flours.

The nature of the gluten has also an unfavourable influence on the dough during fermentation. There is ample diastatic activity but the dough remains bound and does not expand nearly so well as the No. 4 Northern with which it was compared. When mixed with other flours in trial yeast doughs it had the invariable effect of reducing the gas retaining power as compared with a similar dough in which No. 4 Northern was substituted for the Garnet flour. This is often due to excess of proteolytic activity, but in this case the defect appears to be in the other direction, which would again indicate that further mellowing in the preparation of the wheat would be beneficial.

GENERAL CONCLUSIONS

We conclude, therefore, as far as the evidence of this one individual sample goes, that Garnet is a first grade quality wheat in general appearance and expected flour yield, but requiring special treatment in preparation and milling on account of its hard resistant nature.

When milled under the best conditions for milling ordinary Northern wheat, Garnet gives a flour which differs in its characteristics as a bread baking flour, from flour made from pure Northern wheats. It would require special treatment by the baker to produce good bread, and even with such treatment the resulting loaf is likely to be inferior in colour, volume and texture owing to its strong colour and to its lack of gas-retaining power resulting from the nature of its gluten, low proteolytic activity, and low viscosity of its dough.

Jas. Sword, M.A., B.Sc., Phd., A.I.C.
(Chemist).

Categorical Answers to Questions Asked of the Scottish Co-Operative Wholesale Society

Answers to Questions

No. 1.—Garnet wheat would require special conditioning as distinct from ordinary method of conditioning Manitoba wheats.

No. 2.—On account of the limited quantity of Garnet wheat available for experimental purposes, we were unable to blend it with other wheats, consequently, cannot answer this question.

No. 3—Flour produced from Garnet wheat does not respond to maturing agents so quickly nor to the same extent as do average Manitoba wheats.

No. 4.—The colour of flour produced from Garnet wheat, in our opinion, decidedly detracts from its value, with the trade for which we cater.

No. 5.—We are decidedly of opinion that Garnet wheat if grown and offered for sale in this market should be in a pure state, and not mixed with any ordinary Manitoba wheats.

No. 6.—Answer to No. 2 question is applicable to this also.

No. 7.—So far as our limited experience guides us, we do not consider it advisable to increase the production of Garnet wheat.

No. 8.—(*a*) Have no record of bushel weight.
(*b*) Yield of flour includes all flour produced, i.e. Straight Run Flour only.
(*c*) We have no hesitation in saying that the average quality of Canadian wheat delivered to us during the past few years compares very unfavourably with wheat supplied 15 to 20 years ago.

On the average the moisture content is much heavier, the variety of types included in particular grades is very much increased. The relative strength has deteriorated and the reliability of grades arriving here is most uncertain.

In other words, twenty years ago, Nos. 1, 2 and 3 Northern wheat could be relied upon to be equal to a certain standard of quality and purity. This is not so now, nothwithstanding the Inspection Certificates granted.

(Sgd.) W. Smith.

COMPARATIVE TEST OF ORDINARY MANITOBA 2 WHEAT AND GARNET—BY GRANDS MOULINS DE CORBEIL (NEAR PARIS) FRANCE

We first made a preliminary milling of 100 klg. of the above wheat in order to obtain a general idea of their relative characteristics.

A second test of 200 klg. was also made and this enabled us to arrive at more definite conclusions.

From the standpoint of yield Garnet, which graded No. 2, was superior to Manitoba No. 2 and seemed in fact, to compare more closely with Manitoba No. 1.

From the standpoint of colour of flour Garnet produced a flour which was clearly more yellow than that produced from the ordinary Manitobas. In colour Garnet would come midway between ordinary Manitoba and the durums.

When the loaves were baked we found not only this yellow colour but also, in a certain measure, did we find the characteristics of durum wheat, that is to say, Garnet fermented more rapidly and showed a rather quick reduction in the elasticity of the gluten the moment the loaves were placed in the oven and as a result a certain shrinking of the loaves during the process of baking. The crust has clearly, in a certain measure, the colour and the "hygrometic sensibility" that is characteristic of the wheat of North Africa.

RESULTS OBTAINED

Milling of 200 Klg.	Manitoba No. 2	Garnet No. 2
Percentage of white flour	63·7	64·325
Percentage of white flour	9·075	8·7

Characteristics of the flour—Garnet very yellow. Gluten not so good as in Man. 2.

BAKING TESTS

—	Manitoba No. 2		Garnet No. 2	
	Yield	Quality	Yield	Quality
	%		%	
July 17	137·7	Good.	139	Good, crumb yellow.
July 29	136·5	Very good.	139	Very good, crumb yellow.

July 30—75 per cent ordinary flour—25 per cent Garnet No. 2.
75 per cent ordinary flour—25 per cent Man. 2.
The yield in this case was practically the same (132·5 per cent and 132 per cent respectively). The difference in quality was also insignificant.

July 31—75 per cent superior flour from French wheat—25 per cent Garnet No. 2.
75 per cent superior flour from French wheat—25 per cent Man. 2.
The yield is practically the same (131·5 and 131 per cent). The influence of the addition of Canadian wheat is more marked than are the differences.

Aug. 1—85 per cent superior flour—15 per cent Garnet No. 2.
85 per cent superior flour—15 per cent Man. 2.
The yield is 130 per cent and 129·5 per cent respectively. The same result as above but the difference is at once less marked than with 25 per cent.

Aug. 2—85 per cent superior flour—15 per cent Garnet.
The bread was clearly more yellow but more brilliant.

Aug. 6—Man. 2 pure.—Garnet No. 2 pure (with yeast).
Bread better with yeast, the differences between the two remaining the same.

Aug. 7—80 per cent ordinary flour—20 per cent Garnet No. 2 } with
80 per cent flour—20 per cent Man. 2 } yeast.
The differences here were about the same although less marked.

Aug. 9—85 per cent superior flour—15 per cent Garnet } with
85 per cent superior flour—15 per cent Manitoba 2 } yeast.
The difference between the loaves always in favour of Manitoba 2.

(Signed) R. Perrot.

REMARKS BY AUTHOR

On August 12, I inspected the above loaves (made on August 9) but could find very little difference between the two lots as regards colour, texture or volume. I also examined loaves made (on August 9) from pure Garnet and from pure Manitoba 2, and here I found a distinct difference in favour of the latter.

On August 12, a special baking was made by the above concern in order that I might have an opportunity to examine freshly made loaves. In this case Garnet appeared to give rather better results than did Manitoba 2, which fact caused those in charge to admit that further trials must be made before it would be safe to attempt to give Garnet its proper rating.

TEST OF GARNET WHEAT MADE BY THE GEORG PLANGE MILL AT SOEST, GERMANY, JULY, 1929

Three mixtures were milled and baked at this mill in connection with an investigation of Garnet wheat. The composition of each of these mixtures, together with the results obtained from both milling and baking, are given in tabular form below.

It will be noted that Manitoba No. 3 was used rather than Manitoba 2 as none of the latter was available at the time. In any case, we have not noticed enough difference between Manitoba 2 and 3 this year to make us believe that No. 3 would not be suitable for use in this test.

The wheat was prepared for milling in accordance with our usual practice and then allowed to stand for 36 hours in the damping bin (netz-silo). Before tempering, the mixtures contained about 11·4 per cent water, but these left the damping bin carrying 17 per cent water. As regards behaviour during the milling process, certain differences were noted between the three mixtures. Thus the mixture containing 30 per cent Manitoba 3 milled better than the mixture containing 30 per cent Garnet. However, the mixture containing 15 per cent Garnet and 15 per cent Manitoba 3 milled well, resembling in this respect the mixture containing 30 per cent Manitoba 3 but no Garnet.

The semolinas in all cases separated and cleaned very readily.

The yield of flour was practically the same in all three mixtures, but in colour, the mixture containing 30 per cent Garnet was the yellowest.

A baking was made of each of the three mixtures both with and without Novadelox, the nature of the response to this treatment being indicated in the following tables.

Two types of loaves were baked, namely, (1) small bun-like loaves or rolls known in Germany as Brötchen, and (2) large pointed loaves weighing about two pounds each and extending in length to about 14 or 15 inches. A third baking was made of what is known as a "turm" or cylinder loaf. In this case 400 grs. of dough are baked in a cylinder standing about 10 inches in height and having a diameter of about 5 inches. The height the dough is able to rise above the top of the cylinder is accepted as a valuable indication of the degree of strength possessed by flour. The flour designated "Diamant" in the tables is the highest grade of flour made by this firm. The flour designated "Crystal" is their second grade flour which is sold at a lower price.

In making the three types of loaves in connection with baking tests a total of 1,500 grs. of flour is used for each test, that is, this quantity is divided so as to make a definite number of loaves of each type. If the absorption of water has been high there may be a "brötchen" or two over and above the standard number and the sum total of this "residue" is taken as a direct indication of the water absorbing ability of the dough under investigation and the final yield of bread.

For the above amount (1,500 grs.) of flour there is used 30 grs. of yeast and 20 grs. of salt.

WHEAT MIXTURES GROUND AND BAKED AT SOEST, GERMANY

Mixture	Milling Yield	Brand	Baking condition	Handling condition	Dough	Cylinder	Wet gluten
					grs.	c.m.*	%
No. I treated—							
30·0 per cent Manitoba 3	74·3 per cent flour	"Diamant"	1	Very good	2,640	198	
50·0 " Barusso	3·5 "						
10·0 " Bahia	4·5 "	"Crystal"	1	"	2,660	200	22·4
8·3 " Australian	8·7 " second middlings.						
1·7 " German	11·2 " bran.						
No. II Treated—							
15·0 per cent Manitoba 3	74·5 per cent flour	"Diamant"	1	Very good	2,660	197	
15·0 " Garnet	3·0 "						
10·0 " Bahia	4·7 "	"Crystal"	1	"	2,700	200	22·9
50·0 " Barusso	8·2 " second middlings.						
8·3 " Australian	12·0 " bran.						
1·7 " German.							
No. II untreated—							
15·0 per cent Manitoba 3	74·5 per cent flour	"Diamant"	1	Good	2,640	190	
15·0 " Garnet	3·0 "						
10·0 " Bahia	4·7 "	"Crystal"	1	"	2,660	185	22·3
50·0 " Barusso	8·3 " second middlings.						
8·3 " Australia	12·0 " bran.						
1·7 " German							
No. III treated—							
30·0 " Garnet	74·8 per cent flour	"Diamant"	1	(somewhat hard)	2,680	190	
10·0 " Bahia	3·8 "						
50·0 " Barusso	4·4 "	"Crystal"	1	Very good	2,730	193	22·8
8·3 " Australian	5·8 " second middlings.						
1·7 " German	11·4 " bran.						
No. III untreated—							
30·0 per cent Garnet	74·8 per cent flour	"Diamant"	2	Good	2,660	185	
10·0 " Bahia	3·0 "						
50·0 " Barusso	4·4 "	"Crystal"	2	(somewhat wet)	2,640	187	22·6
8·3 " Australian	8·8 " second middlings						
1·7 " German	11·4 " bran.						

*The figures in this column represent the height in Centimetres to which the dough has risen above the top of the cylinder.

As indicated in the foregoing table the dough of Garnet was a trifle wet when untreated with Novadelox, but in the treated mixture this "wetness" was not observed. As regards the general character of the glutens we could detect no important difference between these.

In conclusion, it may be said that the differences in actual value between the different mixtures was not great although we are of the opinion that it might be desirable to restrict the percentage of Garnet in Manitobas so that not more than 50 per cent of the latter would consist of the former variety.

We are also of the opinion, as a result of these tests, that the presence of Garnet in Manitobas may tend toward a general improvement of the latter, providing the percentage of Garnet is not over the figure mentioned above.

Signed at Soest, Germany, this 24th day of July, 1929.

(Signed) WILHELM PLANGE, *Manager.*

REPORT ON GARNET WHEAT INVESTIGATIONS, BY DR. W. LITZENDORFF, GEORG PLANGE CO., DÜSSELDORF, GERMANY

This investigation must be discounted to some extent in view of the that a No. II Northern was not available for comparison with Garnet which was given this grade. We had available for comparison only a No. IV which contained numerous frozen kernels and therefore represented an abnormal condition. It is possible, however, to say with safety that Garnet produces a very good baking flour with high water absorption. In combination or blend with German wheat, Garnet likewise gave very good results. It has not been proven, however, whether a mixture of Garnet with Manitoba gives better baking results than would either of these two wheats when baked separately. Manitoba No. IV is unsuitable for use in connection with this sort of test, since the frozen kernels which it contained gives it an unusually high diastatic power. We may assert, however, that Garnet is a valuable wheat and one which we would willingly purchase when it comes on the market. Further experience will be necessary, however, before it can be safely stated whether Garnet is worth as much as is Marquis. We hope, however, that Garnet and Marquis will not come on the market in mixed condition, otherwise it is quite certain that the uniformity of the Canadian wheat, which hitherto has enjoyed an enviable reputation, would become impaired.

(Signed) W. LITZENDORFF.

September, 1929.

Düsseldorf, September 26, 1929.

"CRYSTAL" FLOUR*—EXPERIMENTAL MILLING

Flour	Working of dough		Height of loaf in cyl.	Volume of rolls	
				5 large	10 small
Home grown, bright	Weak, moist	2	142	1,530	1,610
50 per cent Garnet / 50 per c. home grown, bright	Very good, strong	1	180	1,770	1,770
50 per cent Manitoba IV / 50 per c. home grown, bright	Good, comparatively moist.	1–2	165	1,680	1,660
50 per cent Manitoba IV / 50 per cent Garnet	Very good	1	179	1,700	1,680
Manitoba IV	Very good	1	182	1,820	1,770
Garnet	Very strong	1–2	174	1,720	1,640
Home grown	Weak, moist	3	139	1,600	1,670

(Signed) W. LITZENDORFF.

*This is the second highest grade of flour offered by this firm.—L.N.

Düsseldorf, September 27, 1929.

"DIAMANT" FLOUR*—EXPERIMENTAL MILLING

Flour	Working of dough		Height of bread in cylinder	Volume of Rolls	
				5 large	10 small
Home grown, bright	Short, moist	2	184	1,660	1,670
{50 per cent Garnet / 50 per c. home grown, bright}	Very good, strong	1	200	1,890	1,900
{50 per cent Manitoba IV / 50 per c. home grown, bright}	Good, comparatively moist.	1	199	1,940	1,870
50 per cent Garnet	Very good, first quality	1	190	1,990	1,920
Manitoba IV	Very good, first quality	1a	191	2,170	2,090
Garnet	Very good, strong	1-2	186	1,960	1,860
Home grown, bright	Short, moist	2	184	1,740	1,710

(Signed) W. Litzendorff.

*This is the highest grade of flour offered by this firm.—L.N.

Note of Author.—The Georg Plange Mill at Düsseldorf, at which point the investigation above reported by Dr. Litzendorff was conducted, is equipped with an excellent experimental mill capable of grinding three sacks of about 220 pounds each in two hours. This mill does excellent work and produces flour which compares quite favourably in general quality with that produced on the larger mills. It was on this experimental mill that the Garnet wheat used in the test above reported was ground.

REPORT OF GARNET WHEAT TEST MADE BY GEORG PLANGE, HAMBURG, GERMANY

Protein of Garnet—12·43 per cent.
Protein of Manitoba II—12·73 per cent.
The protein was determined on the 13·5 per cent basis.

—	Moisture	Relative baking volume	Absorption*
	%		
Manitoba II—Crop 1928	15·0	189	918
Garnet wheat,—Crop 1928	15·3	180	880
50 per cent Manitoba II, 50 per cent Bahia Blanca—Crop 1928	14·9	179	918
50 per cent Garnet wheat, 50 per cent Bahia Blanca—Crop 1928	15·0	189	900
50 per cent Manitoba II, 50 per cent German wheat—Crop 1928	14·6	180	895
50 per cent Garnet wheat, 50 per cent German wheat	14·8	185	865

*1,000 grs. flour containing 15 per cent moisture, was used along with 20 grs. salt and 35 grs. yeast.

(Sgd.) Georg Plange.

August 20, 1929.

TEST OF GARNET BY THE HEFFTSCHE KUNSTMÜHLE, COLOGNE—MULHEIM, GERMANY

On July 25, 1929, the Hefftsche Kunstmühle, Cologne-Mülheim, Germany, was visited by Dr. F. J. Birchard and L. H. Newman, the Chief Chemist (Dr. Eugene Fritsch) and Mr. Neusshart, Managing Director, being interviewed.

This concern operates eight different mills and ranks high in the milling industry in Germany. They have a small experimental mill at Crefeld, near Düsseldorf, in which they ground a small quantity of the 500 bushels of Garnet wheat which they had purchased from the Pool through the Getreide-Commission

at Düsseldorf. The remainder of the Garnet was ground along with other wheats, in the large mill of the above concern at Cologne-Mülheim. A part of the flour produced at Crefeld as above was sent to Dr. Fritsch for baking test in his laboratory, it having been agreed that the procedure in the larger test would be determined in part at least by the results obtained on the smaller scale.

These people devoted a great deal of time and thought to this test and were quite positive in their statements. Their full report is submittd below by Dr. Fritsch as follows: —

Report by the Hefftsche Kunstmühle

"For carrying out the experiments with Garnet wheat in the form desired, there were only 50 bushels available. This quantity was too small in itself to carry out the experiments on a relatively big flour mill. It would have been impossible to avoid the mixing of the products of the Garnet-milling with the remaining stock in the mill from a previous run. Therefore, the Garnet-milling was carried out on an experimental mill. This fact, however, seems to be of a minor importance, because attention had to be paid only to the fact that the different kinds of wheat were to be milled with the same moisture content, and to the same extraction".

Two tests were first carried out.

FIRST EXPERIMENTAL MILLING

(*a*)	15 per cent	Manitoba 2°	Extraction 55 per cent, moisture content 17·3 per cent, wet gluten 35·5 per cent, stable and resistant.
	30 "	Rosafe	
	20 "	Bahia	
	20 "	Australian	
	15 "	German	
(*b*)	15 per cent	Garnet	Extraction 55 per cent, moisture content 17·25 per cent, wet gluten 35 per cent, stable but somewhat more smeary.
	30 "	Rosafe	
	20 "	Bahia	
	20 "	Australian	
	15 "	German	
(*c*)	7·5 per cent	Manitoba 2°	Extraction 55 per cent, moisture content 17·3 per cent, gluten 35·3 per cent, stable but somewhat inferior to above.
	7·5 "	Garnet	
	30 "	Rosafe	
	20 "	Bahia	
	20 "	Australian	
	15 "	German	

The baking experiments were carried out exactly according to the daily baking tests conducted here and as far as it is possible the following results permit a reliable opinion of the flour.

Experiment 1 (a)

Rolls: Big, normal shape, well and evenly split.
Big loaves: Full, round shape, big volume.
Pan loaves: Normal, nicely rounded.

Experiment 1 (b)

Rolls: Small, well split.
Big loaves: Small, but smaller differences than in the rolls.
Pan loaves: Good volume and smooth surface.

Experiment 1 (c)

Rolls, Big loaves, Pan loaves: The baked products are between the results of 1 (*a*) and 1 (*b*).

To explain the data given above, we have to remember that we baked as usual three kinds of baked products. Rolls, Big loaves baked without pans on the bottom of the oven and Pan loaves baked in pans. We have to add further that in this part of Germany the rolls are always cut longitudinally in the middle. The dough of the margins must not stick together, but must fall apart during the baking process so that a hard crust is developed. The big loaves have to be very wide and high, but they must not run out and even the bottom has to rise somewhat rounded from the bottom of the oven. The Pan loaves must be big in volume and give a nicely rounded top.

Since we always use some German wheat, the following data might be of interest:—

Moisture content between 15 and 19 per cent.
Wet gluten between 23 and 25 per cent.

The wheat contains very often up to 3 per cent germinated kernels. The baking qualities of German wheat alone are as follows:—

Rolls: Small, very flat shape, most of them poorly split, crease not falling apart during the baking.
Big loaves: Very flat and run out.
Pan loaves: Average volume about 1,100 cc. with 400 grams dough (normal good flour gives 1,400 cc. with 400 grams of dough).

The flours milled in the experimental mill give always a smaller volume on account of the higher ash content but otherwise the same qualities as the flours milled on the big commercial mill.

SECOND EXPERIMENTAL MILLING

In this experiment the two kinds of wheat, Two Northern and Garnet, were milled separately and the two flours at the same extraction and with the same moisture content were compared with each other.

(*a*) Two Northern—Extraction 55 per cent, moisture content 17 per cent, wet gluten 39·5 per cent, very strong and very tight.

(*b*) Garnet—Flour yield 55 per cent, moisture content 17 per cent, wet gluten 38 per cent, as strong and as tight as above.

Baking experiments were carried out the same way as with the other flours and the following results were obtained:—

2*a* (Manitoba No. 2) Rolls—Not split on account of gluten being too strong; big volume. The fact that the rolls did not split in this case, is explained by the very strong gluten in the flour from the Two Northern. This wheat requires blending with a weaker variety.
(Manitoba No. 2) Big loaves—Very good and full volume.
(Manitoba No. 2) Pan loaves—Very good volume, but flat, top retained by strong gluten.

2*b* (Garnet) Rolls—Nicely split, almost normal product, but somewhat smaller than 2 (*a*).
(Garnet) Big loaves—Very good product but somewhat smaller than 2 (*a*).
(Garnet) Pan loaves—Smaller than 2 (*a*).

The experiments were then continued with the following mixtures:—

THIRD EXPERIMENTAL MILLING

(*a*) 50 per cent Manitoba 2° .. ..
17·5 per cent Rosafe.. .. ..
17·5 per cent Bahia.. .. .. ..
15·0 per cent German wheat. .
} Extraction 55 per cent, moisture content 17 per cent, wet gluten 35 per cent. Very strong.

(*b*) 50 per cent Garnet.. .. ..
17·5 per cent Rosafe.. .. ..
17·5 per cent Bahia.. .. ..
15·0 per cent German.. .. .. ..
} Extraction 55 per cent, moisture content 17 per cent, wet gluten 34·7 per cent, average quality.

The baking experiment carried out with the flours obtained gave the following results:—

(*a*) Rolls—Normal shape, but poorly split being too heavy.
Big loaves—Full shape but somewhat heavy.
Pan loaves—Normal volume, only slightly rounded.

(*b*) Rolls—Full normal shape, very well split.
Big loaves—Full shape.
Pan loaves—Somewhat smaller than " a ".

On examining the products of " b " no apparent differences were found, in the Big loaves or the Pan loaves, but the Rolls clearly showed that 50 per cent Manitoba 2° is too much in this mix while 50 per cent Garnet yielded a Flour of good baking quality. It is possible to mix more wheat of inferior quality with Manitoba 2° than with Garnet. In a wheat mixture 30 per cent Manitoba 2° is about equal to 50 per cent Garnet.

The following wheat blends were made for further experiments.

FOURTH EXPERIMENTAL MILLING

(*a*) Same as 3*a*.

(*b*) Same as 3*b*.

(*c*) 30 per cent Manitoba 2°.. ..
25 per cent Rosafe.. .. ..
25 per cent Bahia.. .. ..
20 per cent German.. .. ..
} Extraction 75 per cent, moisture content 17 per cent, wet gluten 34·7 per cent, stable.

(*b*) 30 per cent Garnet.. .. ..
25 per cent Rosafe.. .. ..
25 per cent Bahia.. .. ..
20 per cent German.. .. ..
} Extraction 75 per cent, moisture content 17 per cent, wet gluten 34·6 per cent, somewhat softer.

(*e*) 15 per cent Manitoba 2°.. ..
35 per cent Rosafe.. .. ..
35 per cent Bahia.. .. ..
15 per cent German.. .. ..
} Extraction 75 per cent, moisture content 17 per cent, wet gluten 34·2 per cent, stable.

(*f*) 15 per cent Garnet.. .. ..
35 per cent Rosafe.. .. ..
35 per cent Bahia.. .. ..
15 per cent German.. .. ..
} Extraction 75 per cent, moisture content 17 per cent, wet gluten 34 per cent, softer.

Results of the Baking Experiments

4 (*a*) Rolls—Full, round, only slightly split, gluten too strong.
Big loaves—Full, normal, rounded.
Pan loaves—Full, somewhat heavy, only slightly rounded.

4 (*b*) Rolls—Full, normal shape, very good split.
Big loaves—Full, similar to 4 (*a*).
Pan loaves—Full volume, somewhat smaller than 4 (*a*).

4 (*c*) Rolls—Full, nicely split, lighter than 4 (*a*) but guten still too strong.
Big loaves—Full, round, very even shape.
Pan loaves—Full, normal shape.

4 (*d*) Rolls.. .. ..
Big loaves.. .. ..
Pan loaves.. .. ..
} Same as 3 (*c*).

4 (*e*) Rolls—Normal, well split, shape like 4 (*c*).
Big loaves—Same as 4 (*c*).
Pan loaves—Same as 4 (*c*).

4 (*f*) Rolls—Quality inferior, did not split, gluten too weak, not enough strong wheat in the mixture.
Big loaves—Smaller than 4 (*e*).
Pan loaves—Smaller volume, very flat.

BAKING EXPERIMENT NO. 5

(See report of Mr. August Leutner).

BAKING EXPERIMENT NO. 6*a*

To determine the influence of the Garnet wheat and Manitoba 2° on minor or inferior baking wheat varieties, a second big experimental baking was made.

40 per cent Garnet.	40 per cent 2°.
60 per cent German (New crop).	60 per cent German (New crop).

The Garnet wheat was tempered for about twenty-four hours. The moisture content of the flours was 15 per cent. The straight flours milled to an extraction of 74 per cent, were first baked fresh milled (Experiment *a*) and then baked again after two weeks storage (Experiment *b*). The flours were bleached with the usual quantities of bromate and ammonium persulphate (1·5 ammonia and 1·0 bromate) and the doughs were mixed to the proper consistency in the usual way.

Garnet	Two Northern
Flour.....2,350 gms.	Flour.....2,350 gms.
Water.....1,500 cc.	Water.....1,500 cc.
Fermentation..... 60 mins.	Fermentation..... 60 mins.
Proof..... 20 mins.	Proof..... 20 mins.
Temperature of flour..... 23° C.	Temperature of flour..... 23° C.
Temperature of water..... 30° C.	Temperature of water..... 30° C.
Temperature of dough (average)..... 29° C.	Temperature of dough (average)..... 29° C.
Yeast.....0·025 on 1 kg. of flour..	Yeast.....0·025 on 1 kg. of flour.
Salt.....0·015	Salt.....0·015
Outside Temperature 25° C.	
During mixing the dough was found to have slower water binding abilities but towards the end showed the same stability as the dough from 2°.	The water binding ability was much quicker, otherwise there was no difference between this dough and the dough of the Garnet.

There were 60 rolls produced in the Dough Divider, the rolls cut in the middle after a short while, and after a 10 min. additional period put in the oven at 210° C.

Results

Rolls— Nice split, although called failures. 12 failures. 48 very nicely split rolls although all rolls were somewhat flat at the bottom.	Rolls— Nice split, full and round. 2 failures. 58 nicely split. The rolls were quite round, and had a nice rounded bottom.
2,400 grams of dough gave 60 rolls at 40 grams each.	2,400 grams of dough gave 60 rolls of 40 grams each.

The rest of the dough was punched once more and divided equally into pieces for pan loaves and big loaves. The doughs were, after additional proof, put in the oven at 210° C. and were allowed to bake for 25 minutes.

Pan Loaves	*Pan Loaves*
Volume 1,430 cc. The loaf was very evenly baked, but the top not so flat as that of 2°.	Volume 1,445 cc. Somewhat stronger and fuller, but flat top.

When cut, both pan loaves showed normal texture without failure.

Big Loaves	*Big Loaves*
Full round shape, bottom somewhat flat.	Somewhat fuller than the loaves from Garnet, but otherwise no noticeable difference.

Repetition of the experiments (6a), two weeks later.

EXPERIMENT (6*b*)

The moisture content of the flour was 14·3 per cent. The outside temperature during storage had been 20 to 30° C. abnormally high. Therefore a quick ageing of the flours was made possible, especially because they were stored in sacks of 50 pounds each.

GARNET	TWO NORTHERN
Flour.....2,350 gms. Water.....1,500 cc. Fermentation..... 60 min. Proof..... 20 min. Temperature of flour..... 23° C. Temperature of water..... 30° C. Temperature of dough (average)..... Yeast.....0·025 } on 1 kg. of flour. Salt.....0·015 }	Flour.....2,350 gms. Water.....1,500 cc. Fermentation..... 60 min. Proof..... 20 mins. Temperature of flour..... 23° C. Temperature of water..... 30° C. Temperature of dough (average)..... 29° C. Yeast.....0·025 Kg. } on 1 kg. of flour. Salt.....0·015 Kg. }

Outside Temperature 28° C.

On account of the high outside temperature and the quicker rise of the doughs, the mixing water was made somewhat cooler.

Judgment of the Doughs before Moulding

Somewhat softer at the beginning but soon becoming normal. At the end no difference from 2°.	At the beginning somewhat stiffer, but at the end no difference from Garnet.

After a fermentation of 60 min. the dough was put through the dividing machine and 60 rolls obtained which were handled the same way as in experiment (6a).

Rolls	*Rolls*
Nicely split. No failures, however, 14 pieces only slightly split.	Nicely split, only 2 poor shapes.

The rest of the dough was handled the same way as in Experiment (6a).

Pan Loaves	*Pan Loaves*
Volume 1,435 to 1,440 cc. The same difference as in Expt. (6a).	Volume 1,445 cc. normal product.
Big Loaves No essential differences. Bottom somewhat flatter.	*Big Loaves* No essential difference. Bottom somewhat rounded.

It has to be said that Garnet wheat, taken by itself, has the ability to give a good normal baked product if handled with care, but it is not able to withstand the test of blending with weak gluten wheats. I emphasize particularly that the demand here is for a strong wheat for blending purposes. All the big baking companies test very carefully all deliveries of flour, and if these flours are not up to standard they immediately claim on the mills. Undoubtedly the inferior qualities of Garnet Wheat Flour are improved with ageing, but this is only relative as the Manitoba 2° also improves with storage. From a technical baking point Garnet wheat will never be able to take the place of Manitoba 2° in Europe, because the requirements are for a strong wheat to blend in with the weak gluten wheats of Europe. As yet it is impossible by means of chemicals to make a weak gluten wheat into a good baking flour. Canadian wheats are known to be the strongest in gluten content and should the quality of this gluten be lowered Canadian wheats would have to yield to those of South America.

I should like to add, at the end of my statement, some facts which are of the most importance to the baker.

(1) Good yield in baked products (with weak doughs a strong rise).

(2) Quick rise.—The bakers are not allowed to start work before five o'clock in the morning, but at seven o'clock the first products have to be out in the shop ready to sell. It is just this requirement which makes it necessary to have strong gluten flours, which will stand hard treatment and respond readily to improvers.

(3) The rolls are mostly cut in the middle of the top and have to fall apart in good shape. In South Germany the rolls are pressed down, have to give a globular shape and have a fairly big volume. At the same time there is not so much attention paid to texture.

(4) Pan loaves are not very common in practice. The Big loaves have to bake in an oven rounded shape with a rounded base.

(5) Light colour is very desirable and greyish colours must be avoided.

(6) Wheat flour is very often mixed with rye flour and therefore has to have very strong gluten content. More especially because yeast is used and the consumers want big volumed loaves. Besides the flour of the big mills is very often used for mixing purposes, which means the small mills mix this flour into 100 per cent German wheat flour.

(Signed) Eugene Fritsch.

BAKING TEST OF GARNET WHEAT MADE AT KOLPINGHAUS BACKEREI, COLOGNE, GERMANY

In this test Garnet wheat grading No. 2 was compared with ordinary Manitoba wheat of the same grade. In the making up of doughs the following ingredients were used in the proportions indicated, namely, 3 klg. of flour, 2 lts. of water at 32° C., 80 gms. of yeast, 60 gms. of salt, and 40 gms. of " Lindomalt."

During the working of the dough it was quite noticeable that the dough from the ordinary Manitoba flour worked up dryer than did that made from Garnet. The fermentation of the dough in both cases was completed in a fermentation chamber at 32° C. The dough was kneaded three times at fifteen-minute intervals. After forty-five minutes the dough was cut into small pieces, weighing 50 gms. each, for the purpose of making small loaves (Brötchen). Both doughs felt quite strong and had a fine appearance, with the difference that the loaves from the Manitoba seemed the stronger. On the other hand, the loaves made from the Garnet flour appeared somewhat broader.

When the baking was completed, the loaf volume in each case was determined. In the case of Manitoba the volume of the loaf averaged 1,190 ccm.,

while the Garnet loaves average a volume of 1,215 ccm. The volume of the loaf in both cases, however, was below normal. This is explained by the fact that flour which has a specially strong gluten does not produce a loaf of maximum volume under normal treatment. This tendency to be "gluten-bound" was especially noticeable in the case of the Manitoba flour.

The crease, or slit, across the top of these small loaves and which is characteristic of the way they are made, did not turn back so well in the Manitoba loaves as it did in the case of the loaves made from Garnet.

The above data would seem to indicate that Garnet wheat when mixed with German wheat would not be as satisfactory as would the present Manitoba wheat when so mixed.

(Signed) Aug. Leutner.

TESTS BY HOLSATIA MILL, KIEL, GERMANY

In tests of Garnet wheat made by us at our mill (Holsatia) at Kiel, the following data were obtained and observations made:—

—	Garnet wheat	Manitoba II
	%	%
Weight	84·7	83·7
Water	13·80	13·10
Dry protein	14·92	14·55
Admixture	0·40	1·60
Germination at 20°	92·00	95·00
Germination at 40°	92·00	93·00
Protein of the 60% flour	14·09	14·47
Gluten of the 60% flour	35·60	37·80

Ground—

1. Pure Garnet wheat.
2. Pure Manitoba II.
3. Mixture of Garnet wheat and Manitoba II.

The water content of the flour as determined immediately after milling was 16 per cent. In the first test the Garnet produced a very dark flour, the bleaching of which was accomplished with considerable difficulty. In the second test made, the water content of the flour had increased to 17 per cent, but in this case the colour was more satisfactory.

The capacity for absorbing water was slightly greater in the case of Garnet wheat than it was in the case of Manitoba II.

Below are submitted the yields of dough in percentage of flour used in the case of the above two wheats:—

Garnet Wheat	*Manitoba II*
168·6 per cent of flour	167·3 per cent of flour
173·6 per cent of flour	172·4 per cent of flour

In volume of dough it was found that 1 gr. samples occupied from 3·5 to 3·6 c.c. in both cases.

The dough made from Garnet wheat flour showed good strength and stability in fermentation. The working condition of this flour in these tests was superior to Manitoba II.

Two baking tests were made with a mixture of Garnet and Plate wheats, and Manitoba II and Plate wheats, the results from which tests are submitted below:—

—	Garnet and Plate wheat	Manitoba No. 2 and Plate wheat
Yield of dough in per cent of flour used	174·5 to 174·3%	172·9 to 173·6%
Volume occupied by 1 gr. of dough	3·70 to 3·65 c.c.	3·64 to 3·56 c.c.

The formation of pores was a little irregular in the case of Manitoba II, but there was no significant difference between the two varieties in this respect.

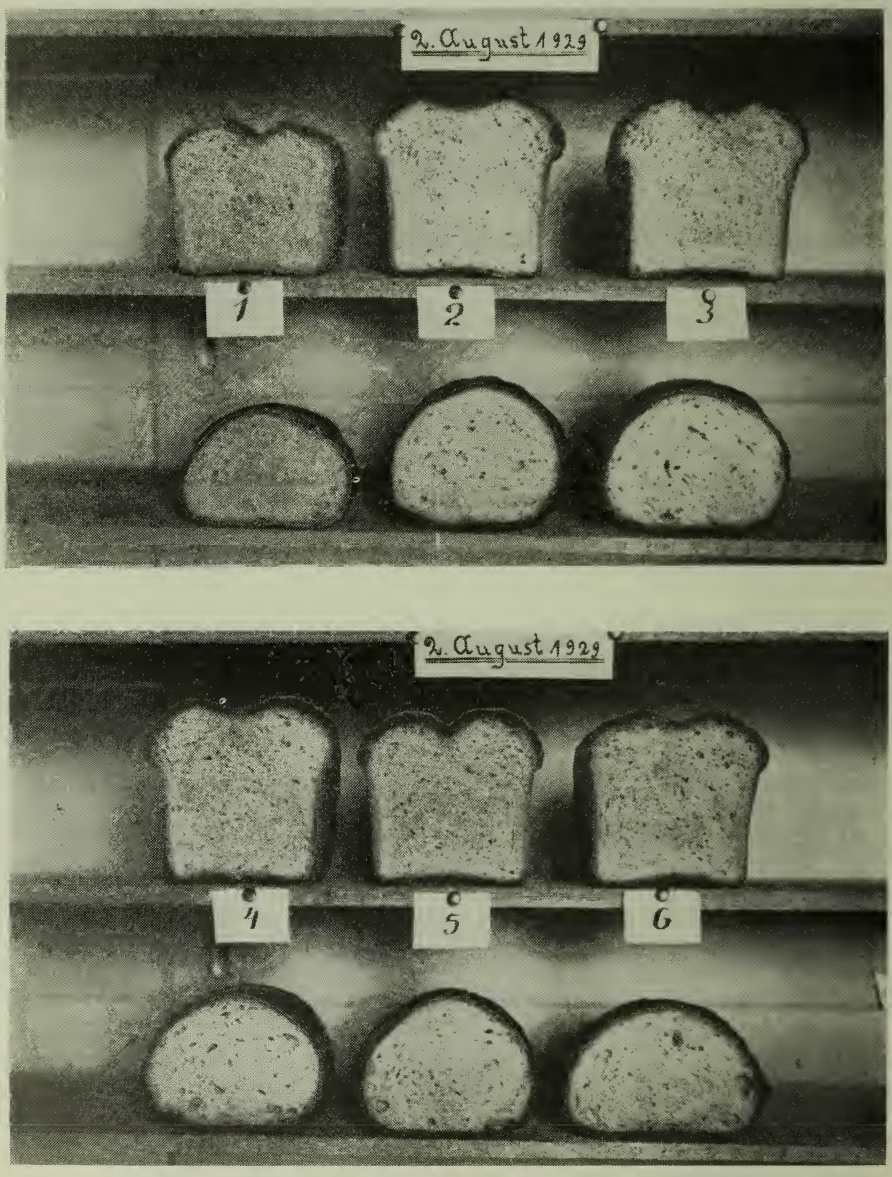
In further baking tests made with the above wheats, the following dough yields and specific volumes were obtained:—

—	Dough Yield	Specific Volume
	Per cent of flour	c.c.
Garnet wheat	174·0	4·11
Manitoba No. 2	173·7 to 173·3	3·80
Garnet/Plate wheat	174·0	4·01
Manitoba No. 2/Plate wheat	173·7	3·84

Baking Tests Made at Kiel on August 2, 1929

In view of the law recently enacted in Germany which requires that 40 per cent of the wheat mixtures ground in that country shall consist of German wheat, it was decided to compare the ability of Garnet with that of Manitoba II to provide strength to a mixture consisting of the above percentage of German wheat. Accordingly, mixtures were made up consisting of 60 per cent Garnet and 40 per cent German on the one hand, and 60 per cent Manitoba II and 40 per cent German on the other. The wheats were ground separately and the flours mixed in the above proportions. A mixture consisting of 50 per cent Garnet and 50 per cent Manitoba II was also prepared for baking tests.

In addition to the three mixtures indicated above, there was included in this test a baking of pure Garnet, pure Manitoba II, and pure German, the latter having been grown in Schleswig-Holstein. The accompanying photographs give some idea of the relative performance of the six lots:—



Loaves baked by Holsatia Mühle.

Composition: (1) 100 per cent German wheat. (2) 100 per cent Garnet wheat. (3) 100 per cent Manitoba 2 Northern. (4) 50 per cent Garnet and 50 per cent Manitoba 2 Northern. (5) 50 per cent Garnet and 50 per cent German. (6) 50 per cent Manitoba 2 Northern and 50 per cent German.

In these tests Garnet showed good water absorbing ability and satisfactory baking qualities. In comparison with Manitoba II the colour of Garnet is somewhat more yellow. On the other hand, Garnet shows a little greater water absorbing ability and better texture.

In the mixture consisting of Manitoba II and Garnet the colour of the bread more nearly approached that of pure Manitoba.

Loaves made from the mixture of Garnet and German wheat showed greater strength than did those made from the mixture consisting of Manitoba II and German wheat. In the case of these mixtures the colour differences practically disappeared.

Since Canadian wheats are used in Germany only in mixtures with other wheats, any difference in colour of flour will be of no significance. We believe, however, that the flour made from pure Manitoba II would be generally preferred to that made from pure Garnet in so far as colour is concerned.

Summing up our general conclusions as a result of our investigations of Garnet wheat it may be said:—

1. Mixtures of Garnet with ordinary Manitoba wheat of the same grade are unlikely to meet with serious difficulties in this country.
2. For mixing with other flours, the flour of Garnet wheat appears to be slightly superior to that from ordinary Manitoba wheat.
3. The colour of the flour made from pure Garnet wheat is not considered as satisfactory as is that from the flour made from Manitoba Northern wheat.
4. As a result of the darker or stronger pigment contents of Garnet the effects of bleaching by the processes at present employed are more favourable to Manitoba Northern than to Garnet.

HOLSATIA-MÜHLE G.m.b.H.

(Signed) M. Lebenbaum.

TEST BY DeMAAS MILL, ROTTERDAM, HOLLAND, JULY 5, 1929

The milling and baking trials with Garnet wheat carried out on the large commercial mill " DeMaas " indicate that Garnet wheat differs from the other varieties of Canadian wheat, first as regards the hardness of the kernel and consequently requiring a somewhat different treatment preparatory to milling, and secondly as regards the colour of the flour, which is decidedly yellow.

When the percentage of Garnet wheat in ordinary Manitoba grades does not exceed 15-20 per cent there would be no objection from the miller in Holland—higher percentages up to 50 would be objectionable—over 50 per cent we would consider quite unsuitable for the conditions prevailing in this country.

The yield of flour obtained from Garnet is satisfactory, and there is no decided objection to its milling properties even when present in mixtures with other Manitoba wheat, up to 50 per cent—though in our opinion it would be preferable to keep the Garnet separate. The chief objection is to the baking quality, on account of the colour of the flour and of the bread, the smaller loaf volume and poorer quality of the gluten. The milling characteristics are a secondary consideration.

In conclusion it is our opinion that it would be a decided mistake to include more than 25 per cent in the ordinary Manitoba grades; if higher percentages were present we would be compelled to substitute Kansas hard winter for a portion of our ordinary Manitoba. If graded separately we would not ordinarily be prepared to pay more than 5 cents per bushel under the price of the Manitoba IV with which it was compared.

(Signed) Van Düsseldorf.

TEST OF GARNET AT DE MAAS MILL, ROTTERDAM, HOLLAND

—	Garnet wheat	Manitoba No. 4 wheat
	13,700 Kg. used	25,000 Kg. used
Hectolitre weight	83·80	79·40
Water content	9·20%	10·00%
Ash content	1·45"	1·40"
Damaged kernels	0·55"	
Oats	0·30"	

Both wheats were prepared in exactly the same manner. The highest temperature reached by the water used was 44° C. while the temperature at the outlet of the conditioner was 20° C.

In the preparation of Garnet the per cent moisture was taken of the wheat in two hydrolysers and at three different points as follows:—

—	Per cent Moisture	
	Hydrolyser No. 3	Hydrolyser No. 4
Intake	18·94	18·8
Middle	17·80	17·6
Outlet	17·0	16·4

The wheat was ground on July 3, 1929, one day after cleaning, in the usual manner. The results obtained from this phase of the work are submitted below:—

—	Garnet	Manitoba No. 4
Weight of flour per H.L.	75·90	76·90
Water content of wheat	16·40	16·20
Ash content of flour	0·60	0·65
Water content of flour	14·80%	14·80%
Dry gluten	12·00"	12·50"
Wet gluten	37·00"	38·00"
Quality of gluten	Short, breaks on stretching	Good

The milling of Garnet required more power than did the Manitoba. This was especially true in the case of the smooth rolls. The grinding of the offal was easy. The Garnet semolina had the appearance of that of Durum as did also the flour, while the semolina of Manitoba was considerably whiter in colour. With both sorts, the offals were well cleaned.

For bleaching, the Garnet flour was not so good as the other flour as the former became grey.

The baking showed that Manitoba 4 gave a whiter colour. While Garnet gave a yellow colour, this however, was quite satisfactory.

As is shown below, we have made several baking tests using pure Garnet flour and mixtures of same with other flours.

In each case there were used 2 kilo of flour, 50 grs. of yeast and 40 grs. of salt, and the loaves were baked in tins.

Below are submitted data obtained from our bakings:—

Flour used	Treatment of flour	Weight of dough in grs.	Volume of loaf in c.c.	Remarks
Garnet	Unbleached	3300	3260	Vol. too low.
Manitoba No. 4	"	3300	3200	"
Garnet	Elect. bleached	3300	3260	"
Manitoba No. 4	"	3225	3200	"
Garnet	With milk	3375	3000	"
Manitoba No. 4	"	3375	3200	"
Garnet	With 120 grs. Am. pers.	3300	3340	"
Manitoba No. 4	" "	3000	3200	"
Manitoba No. 4 50% / Garnet 50%	" "	3300	3360	"
Garnet 30% / Rosafe 20% / Barusso 50%	" "	3300	3600	Good.
Manitoba No. 4 30% / Rosafe 20% / Barusso 50%	" "	3350	3700	"

In discussing the foregoing data with the DeMaas people, the miller pointed out that he believed the Garnet contained more fat than the Manitoba 4, which fact might explain why it baked better with water than with milk and which also might account for the grey colour of the Garnet flour.

It was explained that in Holland they want a white flour and white bread, generally speaking, and the DeMaas people, therefore, are of the opinion that it might not be advisable to risk more than 30 per cent of Garnet in their mixture.

When asked for their opinion as to how Garnet should be graded, they stated that they would like to see it graded separately as they could then use it with greater certainty and possibly to better advantage.

In Holland, the millers attach much importance to the gluten test. In the present test, Mr. Weidlich faulted the character of the Garnet gluten and stated that the loaf volume followed the latter. A study of his data, however, hardly supports this statement.

Mr. Van Dusseldorf stated that if Manitobas were found to contain a high per cent of Garnet it might be necessary to use more Kansas wheat and less Manitoba in the mixture. This statement is based on the belief that Kansas wheat lends itself better to the short period which is available for baking, since the present law does not allow the bakers to start operations before six a.m. while their bread must be ready for delivery by 8.30 or 9 a.m.

Mr. McGillivray, Canadian Trade Commissioner, Rotterdam, with whom this situation was discussed later, stated that Kansas wheat undoubtedly had grown in favour here since the hours of work had come to be restricted.

Discussing the matter of price, Mr. Van Dusseldorf told Dr. Birchard on the occasion of the latter's first visit, that he would buy Garnet if kept separate, at five cents per bushel under ordinary Manitoba 2. Lated he stated (to Newman) that if Garnet should prove equal to Manitoba of the same grade it would very quickly assume the same price level.

GARNET TEST BY VAN STOLK'S COMMISSION, ROTTERDAM, HOLLAND, SEPTEMBER 16, 1929

"The 18 tons parcel of Garnet Wheat was distributed to 2 flour mills in our country and we give you below the preliminary results of one of said flour mills."

CHARACTERISTICS OF THE WHEAT AS RECEIVED

Moisture (3½ hours at 110° C.)	12·8 per cent
Ash (on a dry basis)	1·64 "
Weight per bushel	65·4 lbs.
Nitrogen	2·00 per cent
Protein (Nitrogen x 5·7)	11·40 "

The kernels were small and round, the percentage of dark and vitreous kernels amounted to 91 per cent. The wheat was tempered cold for 24 hours and went to the first break with a moisture content of 17·5 per cent.

YIELD OF PRODUCTS

Flour	77·47 per cent
Bran, etc.	24·17 "
Oats	0·09 "
Cleaning dust	0·44 "
Small and damaged kernels, etc. (separated by Second carter disc separator)	0·46 "
Total yield	102·63 "

ANALYSIS OF THE FLOUR

Moisture (3½ hours at 110° C.)	15·7 per cent
Ash (on a dry basis)	0·62 "
Gluten (wet)	29·5 "
Gluten (dry)	10·4 "
Quality of the gluten (very yellow, very short, strong, elastic).	
Diastatic activity (Mgs. of Maltose produced from 10 grams of flour at 27° C. in one hour)	152 mg.

In the baking tests the flour yielded a stiff and tough dough. A long fermentation time was required to mellow down the gluten. The resulting loaf was rather small and gluten bound. Experiments are being performed to find out the exact optimum fermentation and baking conditions.

(Signed) H. V. Stolk's Commissiehandel.

FURTHER GARNET WHEAT TESTS BY VAN STOLK'S COMMISSION, ROTTERDAM, SEPTEMBER 21, 1929

We submit herewith a report of the milling and baking results obtained from mill No. 2.

Garnet Wheat

ANALYSIS

Water content (4 hours at 105° C.)	13·3 per cent
Protein content (n x 5·7)	11·4 "
Ash content	1·61 "
Hectolitre weight	82·6 Kg.
Per cent purity of the wheat	98·0 per cent
Broken and damaged wheat kernels	0·6 "
Foreign matter	1·4 "
Specific weight of the wheat	1·275 per cent
Germination (after 24 hours at summer temperature)	92·0 "

An examination of Garnet wheat under ultra violet light permitted a slight lightening of the colour to be observed, similar but to a somewhat lesser degree than was the case with the durum wheats.

Prior to milling, the wheat was cleaned and washed in the usual manner and allowed to stand for about twenty-four hours. It came on the first brake roll with 17·1 per cent moisture and with a hectolitre weight of 77·3 kg.

The wheat broke very quickly and gave a high yield of a sharp hard semolina. The power necessary to mill this semolina was significantly higher than with other wheat sorts, exclusive of durums. The bran is thin and light and purifies or separates readily.

The yield of straight grade flour, according to our standard method, was 76 per cent (with an ash content of 0·63 per cent), in addition to which there was 1·9 per cent of low-grade or feed flour, so that the total yield of flour was approximately 78 per cent.

The flour is strongly yellow, somewhat reddish brown, but bleaches relatively well. It is gritty and sharp and resembles rather closely the flour made by the so-called "hard wheats" or durums when observed under the microscope. It also consists exclusively of large sharp-cornered particles, which in their composition and size resemble more closely the type of those found in durum than in the ordinary Manitobas. Starchy kernels throughout the sample were also absent. Undoubtedly, this wheat behaved more like a wheat suited to the manufacture of semolina rather than for the manufacture of ordinary flour.

Flour from Garnet Wheat

ANALYSIS

Water content (4 hours at 105° C.)	15·2 per cent
Ash content	0·63 "
Wet gluten	30·6 "
Dry gluten	11·0 "
Gluten quality: The gluten is very hard and strong, with good elasticity but not ductile; on washing it becomes rather brittle.	
Diastatic power: 10 per cent flour water suspension at 27° C. for one hour in Thermostat (method of Lane and Eynon)—	
Untreated	2·3 per cent maltose
Treated	3·4 " "

Under ultra violet light, Garnet wheat appeared weak, again showing a similarity to that obtained from the hard or durum wheats.

Baking Test (bakery and laboratory)

The water absorption of Garnet is normal:

For untreated flour—60 per cent.

For treated flour—62-63 per cent—calculated on 15 per cent moisture in the flour.

The fermentation proceeded fairly briskly, as was to be expected in view of the high maltose producing power of the flour. The dough felt at first somewhat sticky and soft but stiffened up somewhat during the process of fermentation. The dough in this wheat cannot stand any very strong working, especially in the case of that made from untreated flour, as it breaks easily. The dough can, however, stand fairly long fermenation without noticeably influencing its behaviour.

The yield of bread in the bakery was 143 per cent and in the laboratory 144 per cent; the volumes in the bakery were as follows:—

Untreated flour—2,810 cm.

Treated flour—3,200 cm. (with a dough weighing 900 gms.).

The volumes in the laboratory test were as follows:—

Untreated flour—850 cm.

Treated flour—1,110 cm. (with a dough weighing 400 gms.).

On the above basis the volumes from 100 gms. of flour on a 15 per cent moisture basis was as follows:—

In the Bakery:

Untreated flour—500 cm.

Treated flour—570 cm.

In the Laboratory:

Untreated flour—340 cm.

Treated flour—447 cm.

The improvement in the volume of the loaves made from Garnet through the treatment of the flour is very significant (in the bakery 14 per cent, in the laboratory 31 per cent.

The cell walls of the crumb were finer and more uniform both in the bakery and in the laboratory from the treated flour than from the untreated (according to the method of Dr. Mohs):—

Bakery, untreated 7; laboratory, untreated 8.*
Bakery, treated 7; laboratory, treated 8.*

The colour of the crust is very good—red brown and glossy—it does not become crisp and in this respect shows again a distinct similarity to the crust of durum and Manitoba flour mixtures. The colour of the crumb is yellowish, as would be expected from the very yellowish flour.

All data thus far collected by us does not show that Garnet is a first-class wheat in all respects, especially for the manufacture of wheat flour. Its chief characteristics and its behaviour in milling and in the baking of flour correspond quite closely with what one obtains from a mixture of Manitoba and durum, although in this case, as in the case of Garnet, the durum characteristics predominate.

(Signed) N. V. Stolk's Commissiehandel.

GARNET WHEAT INVESTIGATIONS BY THE RESEARCH INSTITUTE OF CEREAL CHEMISTRY, FRANKFURT, GERMANY

During a visit by Dr. F. J. Birchard to the above institution in July last, Dr. Von E. Berliner, Director, expressed a desire to make a study of Garnet. Arrangements therefore were made to secure a sample from Dr. Kent-Jones of Dover, England. In the following letter to Dr. Birchard, Dr. Berliner reports his findings:—

"In the following, we report the results of our investigation with 'Garnet flour.'

(1) *Gluten Washing.*—Garnet wheat flour behaved less favourably than normal Manitoba wheat flour during the extraction of gluten. The gluten was not homogeneous, i.e., during the washing, it was somewhat sticky, but, at the same time, was also strong.

(2) *Gluten Swelling Test.*—The gluten swelling test employed at our institute gave barely the number 20 for Garnet flour, while the corresponding number for good Manitoba flours is over 20, and sometimes is as much as 25.

(3) *Under the Ultra Lamp.*—Garnet flour glowed brighter than normal flour, resembling in this respect Durum wheat flours, which almost always appear very bright under ultra violet light.

(4) In the permanganate test (the Peker test dipped in a dilute, wine-red potassium permanganate solution) Garnet wheat flour was stained brown and not yellow, as is the case with ordinary flour. Here again Garnet is similar to Durum wheat flour, which also turns brown under this test.

(5) Baking tests show that the dough from Garnet is more sticky and not so homogeneous as that of Manitoba doughs. Although no differences worthy of mention could be noted as regards the baking quality of Garnet, as compared with Manitoba (unfortunately at that time we had at our disposal nothing better than a Manitoba V) and although the mixture of 50 per cent Garnet

* Shows the uniformity of the structure of the pores.

and 50 per cent Manitoba showed the same bread-making qualities as Manitoba alone and Garnet alone, nevertheless, we prefer the Manitoba flour, on account of the superior quality of the dough.

We emphasize that, on account of the small sample available, we do not consider our baking tests absolutely reliable; but we do come to the general conclusion that Garnet Wheat Flour, from a technical baking point of view, is not quite equal to that of a good Manitoba flour.

The main observations of Garnet wheat flour lead one to surmise that Garnet wheat is derived from a cross with Durum wheat and therefore does not possess the qualities of a first class Manitoba flour.

It would be very interesting for us to hear whether this supposition is correct.

Our conclusions refer only to the sample of Garnet wheat flour submitted to us. From a consideration of the above tests, it would be premature to attribute a pronounced inferiority to Garnet wheat, as compared with Manitoba, nevertheless, our investigations confirm certain views, namely, that Garnet wheat does not meet the requirements of the mills and bakeries as do the well known standard varieties, as are found in the so-called Manitoba wheats.

October 1, 1929.

(Signed) Berliner.

REPORT ON INVESTIGATIONS OF GARNET WHEAT—BY T. BIENERT, FLOUR MILLS, DRESDEN, GERMANY, PER DR. BURGHART, CHIEF CHEMIST

Object of Investigation

This investigation was designed to show whether Garnet wheat (grading No. 2 Northern) is entitled to rank with ordinary No. 2 Manitoba wheat from the standpoint of milling and baking.

Material Used

Three thousand (3,000) kilograms (110 bushels) of Garnet wheat, having a hectolitre weight of 85 kilograms were obtained by this firm. For comparison there were obtained two samples of Man. 2-Atlantic and two samples of Manitoba 2 Pacific, having the following natural weights per hectolitre, viz.:—

	Natural weight
No. 7672—Manitoba No. 2—Atlantic	85 kg.
No. 7729—Manitoba No. 2—Atlantic	85 "
No. 7622—Manitoba No. 2—Pacific	83 "
No. 7663—Manitoba No. 2—Pacific	84 "

For comparison in baking tests there was also used a sample of average quality German wheat, produced in Germany in 1928.

Milling Tests

The wish of the Minister of Agriculture for Canada was that the above Garnet wheat should be milled by one of our larger mills and that the flour obtained therefrom should be used in connection with the present study. Although the value of such a course cannot be denied, I have always abstained from so using such relatively small quantities through the large commercial mill, since such a practice would introduce an unavoidable error which would confuse the final results. Therefore, the experiment was conducted in accordance with a practice which has been evolved by us after forty years' experience, during which time many thousands of critical tests have been made of commercial samples. These experiments, requiring only 50 or 100 kilograms, may be kept

under complete control and observation throughout the entire process of milling. In the case of the present test we took 100 kilograms of Garnet wheat, added 2 per cent water and allowed it to stand for fourteen hours. It was then passed through a revolving hydrolyzer and milled. An ordinary plansifter was used and a flour extraction of about 60 per cent obtained. In like manner were the ordinary Man. 2 samples treated.

In this test Garnet milled splendidly and, contrary to the criticisms of certain Canadian millers, proved a very easy wheat to purify. It even excelled, in this respect, the Manitobas with which it was compared.

In spite of the glassy character of the kernel of Garnet the flour separated easily from the bran.

BAKING EXPERIMENTS

The flour obtained was subjected to baking tests in accordance with the following method: The dough made consisted of ingredients used in the following proportions, viz. flour—one kilogram, water as required, salt, 15 grs., and yeast, 20 grs. The total " liquor " was applied at once but a part of the flour was withheld for adding later. Following the addition of the remainder of the flour and the final kneading of the dough, the latter is weighed off into small loaves called "Brödchen" each weighing 90 grs. These are then baked in accordance with common practice, in a large bake oven and on the hearth rather than in tins. The size and relative volumes of ten of these loaves, selected for uniformity, are then determined.

I would emphasize here that a single baking test can give only an indication of the relative baking qualities of a given lot of flour since experimental errors can be overcome only through a long series of similarly conducted tests.

The results thus far obtained in baking tests of this wheat are submitted in tabular form below. The data submitted represents the average of two baking tests made in the same manner. Regarding these baking tests the following observations may be specially referred to: Garnet wheat when baked by itself ranks midway between the Atlantic and Pacific Manitobas used for comparison, in so far as concerns baking quality. As regards the ability of Garnet to improve the baking qualities of German wheat when the two were mixed together it was found that this wheat proved not only equal to the above Manitobas but, according to our data, was even superior to the latter.

Under " Handling", as this term is used in the table, is meant the "easiness" with which the dough is worked and converted into bread. As regards this character Garnet was tough and woolly—two technical expressions which are perfectly intelligible to the baker. The greater " woolliness ' of the Garnet dough may be due to the higher diatase content which is possessed by this wheat.

The term ' woolly ' is rather a difficult one to define. The baker applies it to a dough which is torn apart easily by hand; not shining wet or sticky but dry and tough and yet very porous.

By the term ' absorption ' as used in the table, is meant the weight of the water absorbed by the dough made from one kilogram of flour. Garnet, in this respect, ranks with the Manitobas with which it was compared, the slight variations being well within the range of experimental error.

The baking quality is indicated in the table under the heading ' Volume of loaf produced from 100 grs. of flour'. In regard to this characteristic we may conclude from our tests, that the baker must regard the flour of Garnet as equal in value to that made from ordinary Manitobas of the same grade.

Colour

Bleaching tests were conducted with flour of the above wheat, strong, medium and weak applications being made. Similar bleachings were made of the flour produced from Manitoba 2 Atlantic and Manitoba 2 Pacific.

These tests have shown that Garnet wheat not only possesses good but extraordinary bleaching qualities, although it must be admitted that the flour made from Garnet is very obviously a yellow colour.

The results of our bleaching tests are given in the following table:—

COLOUR SCORES

Wheat	Unbleached	Strongly bleached	Production in colour scores
			%
Garnet	157	57	64
Manitoba 2 Atlantic (No. 7729)	127	44	65
Manitoba 2 Atlantic (No. 7672)	121	41	66
Manitoba 2 Pacific (No. 7622)	113	44	61
Manitoba 2 Pacific (No. 7663)	117	50	57

The colour score was determined according to the method of *Jorgensen* and constitutes an expression of the content of carotin.

An examination of the above table shows that the flour of Manitoba 2 Atlantic used in this test was made lighter in colour by bleaching, than was the flour of Manitoba 2 Pacific although the latter in the untreated state possessed a lighter colour. On the other hand the Garnet flour showed a very high degree of colour in the unbleached state but by severe bleaching the colour was reduced by 64 per cent. In order to see if the colour can be still further reduced, a new sample of flour of Garnet was bleached still more severely. This treatment resulted in a colour score of 29 being reached which is a reduction in the original colour score of about 82 per cent.

From the standpoint of the German millers there can be no objection to the colour of the flour of Garnet. Furthermore, should a much more lightly bleached flour come to be preferred for any reason—such as a change in taste or fashion—a delicate ivory colour in the flour would be regarded as indicating a rich gluten content and good general quality.

In the bleaching tests above discussed, the system used most in Germany, viz., the Electric (Dollinger) system was employed.

Chemical Investigations

The results of chemical tests made of the flours used in this investigation are recorded in the table submitted below. Here it will be noted that the protein is calculated on the 6·25 basis. The gluten of the Garnet flour was of very good quality and was at least as good as was Manitoba 2. A certain mildness and softness which is possessed by the former may possibly be due to high Lipoid content, and may account in part for the particular baking qualities which this wheat possesses. Possibly with the assumed high Lipoid content of Garnet flour also is associated the yellow colour by which the latter is characterized.

On the basis of the above findings we must conclude that there can be no objection toward Garnet, although we might wish that the protein or gluten content were a little higher.

Conclusions

(1) From the standpoint of the miller, no objection can be raised against the use of Garnet in place of Manitoba 2, nor against the mixing of Garnet with Manitoba 2.

(2) Neither in the milling nor in the baking does Garnet wheat offer any difficulties whatever and this variety we consider at least equal in value to the Manitoba 2 with which it was compared.

(3) No objection is justified concerning the colour of the flour of Garnet.

I must emphasize that I can see no ground why this Garnet wheat grading No. 2 Northern should be kept separate from the present Manitoba 2 Northern with which it was compared, in view of the similarity of the two lots in all essential particulars.

Since we in Germany are situated so as to be able to purchase wheat from all parts of the world, the relatively small differences which exist between the above wheats become of practically no significance.

BAKING TEST RESULTS BY BIENERT'S FLOUR MILLS

Number	Sort	Absorption	Volume of loaf	Handling
		grs.	cc.	
7662	50% Man. 2 / Pacific	715	541	Good.
7663	50% Man. 2 / Pacific			
7672	50% Man. 2 / Atlantic	710	583	Good.
7729	50% Man. 2 / Atlantic			
7742	100% Garnet	700	567	Good.
	100% mixed German	650	519	Tough, woolly, somewhat hard, shrinks.
7622	25% Man. 2 / Pacific			
7663	25% Man. 2 / Pacific	690	560	Somewhat hard, shrinks.
7672	25% Man. 2 / Atlantic			
7729	25% Man. 2 / Atlantic			
7742	100% Garnet	700	563	Tough, woolly.
7742	25% Garnet / 75% German	690	553	Tough, woolly.
	25% mixed Man. / 75% German	680	543	Good.
	40% Garnet / 60% German	695	587	Tough, woolly.
	40% mixed Man. / 60% German	685	577	Good, tough, woolly.
	20% Garnet / 20% Man. 2 / 60% German	685	567	Good, tough, woolly.

CHEMICAL TESTS BY BIENERT'S FLOUR MILLS

—	Water content	Protein	Wet gluten	Dry gluten	Ash
	%	%	%	%	%
Man. 2 Pacific No. 7622	14·3	15·8	.....	.....	.....
60% flour from above	14·8	.....	34·4	14·4	.....
Man. 2 Pacific No. 7663	12·9	15·8	.....	.....	.....
60% flour from above	15·0	.....	39·8	14·8	.....
Man. 2 Atlantic No. 7672	13·5	15·8	.....	.....	.....
60% flour from above	15·0	.....	35·5	13·9	.....
Man. 2 Atlantic No. 7729	12·3	16·2	.....	.....	.....
60% flour from above	14·8	.....	40·5	14·2	.....
Garnet wheat No. 7742	13·1	16·1	.....	.....	.....
60% flour from above	14·3	16·6	39·2	15·1	0·76
60% flour from Mixed Atlantic and Pacific	13·1	15·6	37·6	15·2	0·76
60% flour from German wheat	13·3	10·4	26·2	9·6	0·65

Supplementary Report on Tests with Garnet Wheat by Bienert's Flour Mills

At the special request of Dr. Birchard and Mr. L. H. Newman, further milling tests were recently undertaken, in order to clear up a contradiction of the results obtained elsewhere. Thus it had been stated by another milling company that a mixture of Garnet and Manitoba or Garnet and German wheats could not be milled to advantage.

In order to clear up this matter, five samples of wheat were ground on our Experimental Mill:—

(1) 100 kg. Garnet wheat.
(2) 100 kg. Manitoba *IV* Atlantic.*
(3) 100 kg. German wheat.
(4) 50 kg. Garnet wheat } Mixture.
50 kg. Manitoba *IV* Atlantic }
(5) 50 kg. Garnet wheat } Mixture.
50 kg. German wheat }

Test No. 1

100 Kg. Garnet Wheat (Test 7776)

This wheat had a moisture content of 13·7 per cent, and a further 3 per cent was added. After standing for 16 hours, the wheat was milled to a 60 per cent extraction.

There are hardly any noticeable differences in the milling of Garnet as compared with Manitoba *IV* Atlantic, but if any, they are favourable to the Garnet. The semolina felt good, and it was easy to obtain the desired yield.

This flour gave 36·2 per cent wet gluten, and 14·3 per cent dry gluten (calculated on dry basis).

In the baking test, the dough behaved well; it was pliable and tenacious, and yielded a volume of 551 cc., calculated on 100 grams of flour.

Test No. 2

100 Kg. Manitoba *IV* Atlantic (Test 7777)

This wheat had an original moisture content of 12·7 per cent to which was added a further 4 per cent. After standing sixteen hours, the wheat was milled to a 60 per cent extraction.

The milling was satisfactory, and there was scarcely any difference observed, as compared with the Garnet milling, though perhaps the Manitoba *IV* was somewhat more brittle while milling.

The flour gave a wet gluten of 37·0 per cent, and a dry gluten of 13·9 per cent (calculated on dry basis).

The baking test showed the flour to have normal baking properties, and a loaf volume of 542 cc., calculated on 100 grams of flour, was obtained.

Test No. 3

German Wheat (Test 7778)

This wheat had originally a moisture content of 15·7 per cent, and a further 0·75 per cent was added. After standing for sixteen hours, the wheat was milled.

As was to be expected on account of its being very soft, this wheat easily gave the desired yield.

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* Originally it was intended to use a Manitoba II for this comparison, but not having any on hand, this sample was substituted.

This flour gave 27·0 per cent wet gluten, and 9·65 per cent dry gluten (calculated on dry basis).

The dough from the German wheat flour was somewhat less tenacious, and a loaf volume of 487 cc., calculated on 100 grams of flour, was obtained.

Test No. 4

50 Kg. Garnet Wheat)
50 Kg. Manitoba *IV*) Mixture.

(Test 7780)

This mixture had a moisture content of 13·8 per cent, to which was added a further 2·75 per cent. After standing sixteen hours, the wheat was milled.

The milling characteristics were satisfactory in every respect, and corresponded exactly with those of the individual wheats alone. The milling properties of these wheats by themselves were excellent. Nothing whatsoever objectionable was found in the milling quality of the mixture of Garnet and Manitoba wheats. In any case, the differences were so slight that it could be said that our equipment, which is well adapted for the milling of various wheats from different countries, was able to overcome far greater differences and difficulties than any which could occur with this mixture of Garnet and Manitoba wheat.

The dough from the Garnet-Manitoba flour was good and pliable, and gave a loaf volume of 521 cc., from 100 grams of flour.

Test No. 5

50 kg. German wheat)
50 kg. Garnet wheat) Mixture
(Test No. 7779))

The mixture had a moisture content of 14·4 per cent, to which was added 2·1 per cent additional water, and was milled after standing for 16 hours. The milling was satisfactory. The flour stocks felt good—they were light and soft to the touch. The mixture milled somewhat softer than Garnet alone. No difficulties whatever were found in the milling.

The flour gave 31·4 per cent wet gluten, and 12 per cent dry gluten (on dry weight basis).

The dough worked well, and gave a loaf volume of 512 cc. from 100 grams of flour.

FINAL CONCLUSION

The question as to whether Garnet wheat, either alone or in mixtures, causes any difficulties in milling, must be answered in the negative.

There is nothing in the milling of this wheat, either alone or in mixtures, which could cause the slightest difficulty in a well-equipped modern mill which could not be overcome by an experienced head miller.

(Signed) BIENERT'S FLOUR MILLS.

October 7, 1929. Per Burghart.

REPORT ON GARNET WHEAT TESTS—BY THE MILLING INSTITUTE OF GRAIN RESEARCH, BERLIN, GERMANY

(DR. KARL MOHS, DIRECTOR)

(1) Milling Characteristics of Garnet Wheat

In order to study the milling properties of Garnet wheat, the following millings were made:—

(*a*) One parcel Garnet wheat.
(*b*) One parcel Manitoba II wheat.
(*c*) One parcel Mixture—
50 per cent German wheat.
25 per cent Garnet wheat.
25 per cent Manitoba II wheat.

The milling of Garnet wheat resembled in every respect that of a hard, glutenous wheat, and presented no technical difficulties. As compared with Manitoba II, however, it was found that the bran coating of Garnet wheat had a tendency to be more brittle. An endeavour was made to overcome this characteristic by suitable conditioning, but it was not found possible to accomplish this to the same degree as with Manitoba II. The effect of the more brittle nature of the wheat was shown in the higher ash content of the Garnet flour as compared with Manitoba II. The milling yield of Garnet wheat was 2 per cent lower than that of Manitoba II. in spite of the fact that in the case of the Garnet milling, one more reduction was used than with Manitoba II. The milling of the Garnet wheat in a mixture with 25 per cent Manitoba II and 50 per cent German wheat was carried out without any difficulty. Both the colour and the ash content of the mixture were normal. The yield of flour was good.

(2) Flour Colour and Gluten Properties

The colour of the flour from Garnet wheat was yellower than the corresponding Manitoba flour. For comparison, flours of the same type and the same ash content were used, so that the influence of the presence of a higher percentage of bran particles was avoided. These differences in colour were also observed in the washed out gluten. The properties of the gluten were the same as those of a good, high protein wheat. However, when compared with the gluten of the Manitoba II, the former was less ductile, and absorbed less water. This follows also from the relation between protein and wet gluten, which is higher in the case of the Manitoba II wheat.

Experiments were also made regarding the bleaching properties of the flour. Bleaching was carried out with electrically produced nitrogen dioxide (NO_2) and with the preparation "Novadelox." Both the Garnet and the Manitoba flour bleached very well, and in their reaction towards bleaching agents, no differences could be observed in the behaviour of the two flours.

(3) Wetting and Conditioning of Garnet Wheat

Garnet wheat offered a significantly higher resistance to the absorption of conditioning water than did Manitoba II. While in the case of Manitoba II a conditioning time of 20 to 24 hours was found sufficient, thirty hours were found necessary in the case of Garnet. When conditioned by heat, similar results were obtained. Thus at 40° C. the conditioning time for Manitoba wheat was found to be $1\frac{1}{2}$ hours, while that for Garnet was 2 hours.

Wetting and conditioning of Garnet wheat in mixtures with Manitoba wheat presented no difficulties. However, in view of the character of Garnet

wheat, the conditioning time must be increased to 26 to 28 hours. On account of its peculiar character, it also was found advantageous to condition Garnet by itself, in order to ensure a thorough dampening of same, as well as to prevent the Manitoba wheat from standing longer than its most favourable conditioning time.

In conclusion, the following can be said of the milling properties of Garnet wheat:—

Garnet wheat possesses in a marked degree the milling qualities of a typically hard wheat. This hardness of the wheat demands special treatment in its preparation for milling (conditioning), the exact nature of which the millers must acquire and by which they must be governed.

If Garnet wheat is propertly handled by itself throughout, in a manner to correspond with its characteristic properties, it can be said that the milling properties and flour yields will resemble very closely those of Manitoba II. It must be emphasized, however, that this special preparatory treatment presents greater difficulties as compared with Manitobas, inasmuch as it demands a more careful application of milling methods to the peculiar characteristics of the wheat.

(Signed) INSTITUTE FOR MILLING.
MOHS.

November 7, 1929.

ANALYSES BY MILLING INSTITUTE

—	Ash Content		Yield		Protein		Wet Gluten	
	Garnet	Manitoba II	Garnet	Manitoba II	Garnet	Manitoba II	Garnet	Manitoba II
1. Break-flour	0·77	0·75	1·25	3·35	14·47	16·06	34·71	48·32
2. "	0·76	0·83	1·39	2·19	14·65	18·25	34·58	49·80
3. "	0·70	0·82	2·22	2·09	15·78	18·56	38·79	49·65
4. "	0·73	0·90	1·76	1·33	17·26	19·72	43·44	55·70
5. "	1·09	1·50	1·88	1·71	20·27	21·91	49·53	60·07
6. "	1·09	1·96	1·57	1·00	16·66	18·00	38·75	47·58
Break-flour	0·92	1·00	10·07	11·65	16·8	18·4	40·8	51·4
1. Semolina	0·51	0·44	13·65	19·50	13·68	13·42	35·83	38·57
1. "	0·49	0·40	7·68	9·73	14·95	14·01	37·04	35·50
1. "	0·47	0·92	6·57	8·09	14·34	13·36	36·00	35·46
2. "	0·54	0·43	7·96	6·52	13·79	12·63	34·54	31·58
2. "	0·49	0·42	5·00	3·38	14·41	13·07	35·84	35·15
Semolina	0·51	0·43	40·87	47·22	14·2	13·4	35·9	36·2
1. "Koppenmehl"	1·31	1·81	1·76	0·90	15·70	16·82	33·17	29·76
2. "	1·61	2·56	1·85	1·00	16·43	18·58	32·29	.....
1. Flour middlings	1·04	0·66	3·15	3·86	15·72	14·13	38·43	34·83
2. "	1·04	0·80	2·96	2·62	16·85	15·18	38·02	39·92
3. "	0·99	1·07	2·82	2·10	16·79	17·19	39·09	45·14
4. "	1·00	1·33	2·55	1·43	17·07	17·03	37·01	39·51
5. "	1·18	1·69	2·32	1·33	17·07	17·85	36·09	32·71
6. "	1·40	.....	1·25	.....	17·24	.....	35·43	.....
	1·13	1·14	18·66	13·24	16·56	16·0	36·6	37·0
1. Feed Flour	1·99	1·93	1·48	1·52	.....	.....	.....	.....
2. "	2·13	3·03	1·62	1·05	.....	.....	.....	.....
Feed Four	2·06	2·38	3·10	2·57	.....	.....	.....	.....
Flour	0·78	0·71	72·70	74·68	.....	.....	.....	.....
Coarse Bran	5·53	7·19	4·16	4·29	16·79	16·46	.....	.....
Fine Bran	4·09	5·78	10·82	9·64	17·66	17·84	.....	.....
Middlings	2·90	3·28	5·56	4·56	18·34	19·27	.....	.....
Scouring Loss	3·65	2·80	4·63	4·57	15·42	14·74	.....	.....
Total Loss	4·00	4·95	25·17	23·06	.....	.....	.....	.....
Invisible Loss	.....	.....	2·13	2·26	.....	.....	.....	.....

REPORT ON GARNET WHEAT TESTS—BY THE BAKING INSTITUTE OF GRAIN RESEARCH, BERLIN, GERMANY (PROF. M. P. NEUMANN, DIR.)

The following flours were milled on the experimental mill of the Milling Institute:—

(1) *German Wheat*—	(2) *Garnet Wheat*—	(3) *Manitoba Wheat*—
(*a*) Patent flour.	(*a*) Patent flour.	(*a*) Patent flour.
(*b*) Baker's flour.	(*b*) Baker's flour.	(*b*) Baker's flour.
	(*c*) Feed flour.	(*c*) Feed flour.

Comparisons as regards baking qualities were made, not only between the above wheats themselves but between mixtures of same. The first tests were carried out according to the ordinary methods of the Institute (See Neumann, Brotgetreide und Brot).

A. Patent Flour from German, Garnet and Manitoba Wheats

(*a*) German, Garnet and Manitoba Flour baked by Themselves

—	German	Garnet	Manitoba
Quality of dough	Viscous and sticky	Normal dry	Normal dry
Yield of dough	159	164	165
Yield of bread	138	139	139
Vol. from 400 gms. dough	698	954	1,091
Vol. from 100 gms. flour	285	400-(466, 468 468)	460
Texture	8	8-9	8
Baking Number	.....	98	130

Further remarks.—All figures are calculated on a 15 per cent moisture basis in the flour, and are therefore directly comparable.

Garnet and Manitoba flour gave elastic, dry, and nice handling doughs, while the German flour furnished a viscous and sticky dough, which, however, gradually tightened up. The Manitoba flours gave good dough yields, and withstood fermentation well. The loaves were of remarkably good volume, with the crumb soft and elastic, and of uniform texture. The yield of dough from the Garnet flour was only very slightly less than that of the Manitoba, although the differences in loaf volume were somewhat noteworthy. The volumes of the Garnet loaves were at times smaller than those of the Manitoba, but the texture was extraordinarily fine and delicate. In other tests, however, the volume equalled that of the Manitoba loaves but in these cases, the texture was somewhat coarser, or was accompanied by quite large holes and air spaces directly under the crust. This accounts for the large volumes as above recorded from the Garnet flour. From this it follows that Garnet flour may furnish loaves of large volume, but only with difficulty, since the dough is obviously more sensitive than that from Manitoba. In addition, it was noted, not only in these tests, but also in accordance with past experience, that excessive volume is obtained only at the expense of texture.

Judging from these experiments, the Garnet flour is doubtless very similar to the Manitoba, even though this is not always evident from the above tests. All the characteristics of Garnet flour, and its behaviour in the dough, indicate a flour of such strong baking quality that it can be truly said, by proper conditioning of the wheat and suitable treatment, Garnet wheat is to a certain extent quite equal to Manitoba. The differences may perhaps be better understood when attention is drawn to the fact that the patent flour from Garnet wheat behaves, in many respects, like Russian Durum flours, when these are used

for bread-making purposes. These are typically strong flours, which, however, require very special treatment, in order to obtain the best results.

The German wheat flour used was intentionally chosen as representing a typical, weak flour, it having been shown that in dough yield and in dough properties, it obviously belonged to the class of weak gluten flours. The small volume is here noteworthy, since it cannot be considered an exact measure of the true baking quality. By the use of suitable methods, such as, for instance, the addition of Canadian flour, the volume of the loaf is increased enormously. This German wheat, therefore, was particularly well adapted for carrying out tests with the blends described below:—

B. German Flour Mixed with Garnet and Manitoba Flour in Different Proportions

(1) (*a*) 80 per cent German plus 20 per cent Garnet.
(*b*) 80 per cent German plus 20 per cent Manitoba.

—	Wheat flour 0–40	
	(a)	(b)
Properties of dough	Normal	Normal
Yield of dough	161	164
Yield of bread	138	140
Vol. from 400 gms. dough	954	997
Vol. from 100 gms. flour	395	420
Baking number	95	105
Texture	8	7–8

Further remarks.—All figures are calculated on a 15 per cent moisture basis in the flour, and are therefore directly comparable.

There was no difficulty in preparing the doughs with either of the flours, and both withstood fermentation very well. The yield of dough and the volume of the loaf from the Garnet flour was not quite equal to that from the Manitoba. The crumb of the Garnet loaves was more delicate, and more even that that of the Manitoba loaves, which latter did not appear as stable as those from the Garnet. It appears, not only in this case, but also in the blends, that Garnet wheat flour, if properly treated would have shown better baking quality, and would more closely resemble Manitoba. The great improvement in the baking quality of German wheats, through the addition of 20 per cent Garnet flour, is also very remarkable, so that as compared with German wheat, Garnet shows, in a marked degree, the characteristics of a hard wheat.

(2) (*a*) 70 per cent German plus 30 per cent Garnet.
(*b*) 70 per cent German plus 30 per cent Manitoba.

—	(a)	(b)
Dough properties	Normal	Normal
Dough yield	163	164
Bread yield	139	140
Volume from 400 grams dough	950	1,022
Volume from 100 grams flour	400	430
Texture	8	8
Baking number	96	114

Further remarks.—All figure are based on 15 per cent moisture in the flour, so are directly comparable.

Both flours worked well and gave good dough yields, the Garnet being scarcely inferior to the Manitoba, although the difference in the volume was again in favour of the latter. The texture of the Garnet baked products appeared to be somewhat more distinct and uniform.

(3) (*a*) 60 per cent German plus 40 per cent Garnet.
(*b*) 60 per cent German plus 40 per cent Manitoba.

	Wheat flour 0–40	
	(a)	(b)
Dough properties	Normal	Normal
Dough yield	164	165
Bread yield	139	139
Volume from 400 grams dough	951	1,027
Volume from 100 grams flour	400	430
Texture	7–8 (with air holes)	8 (with air holes)
Baking number	91	116

Further remarks.—All figures are based on 15 per cent moisture in the flour, so are directly comparable.

Here again was found the same differences and the same degree of difference between Garnet and Manitoba. In this case the Garnet mixtures showed a much more sharply defined cell structure while in the Manitoba mixture the latter obviously was somewhat indistinct.

(4) (*a*) 50 per cent German plus 50 per cent Garnet.
(*b*) 50 per cent German plus 50 per cent Manitoba.
(*c*) 50 per cent German plus 25 per cent Garnet and 25 per cent Manitoba.

	Wheat flour 0–40		
	(a)	(b)	(c)
Dough properties	Normal	Normal	Normal
Dough yield	164	165	165
Bread yield	139	141	139
Volume from 400 grams dough	1,025	1,096	1,085
Volume from 100 grams flour	430	460	460
Texture	8	8–9	8–9
Baking number	115	132	129

Further remarks.—All factors are based on 15 per cent moisture in the flour, so are directly comparable.

By comparing the above figures it will be noted that 25 per cent Manitoba together with 25 per cent Garnet when mixed with German wheat improved the baking quality of the latter wheat in the same proportion as did the addition of 50 per cent Manitoba to German wheat.

B. Baker's Flour of German, Garnet and Manitoba Wheat.

(*a*) German, Garnet and Manitoba flour *unmixed.*

	Wheat flour 0–70		
	German	Garnet	Manitoba
Dough properties	Normal	Normal	Normal
Dough yield	161	168	171
Bread yield	139	143	145
Volume from 400 grams dough	830	1,081	1,079
Volume from 100 grams flour	338	475	467
Texture	8	8	8–9
Baking number	38	128	134

Further remarks.—All factors are based on 15 per cent moisture in the flour, so are directly comparable.

The three flours were normal in behaviour showing, however, great differences in respect of dough yield, volume, and baking properties. The Manitoba flour showed up the best, the Garnet flour came next, while the German flour followed far behind. It is worthy of note that with the baker's flour the volume difference between the Manitoba and Garnet is not so strongly pronounced as in the patents. Also there was to be observed here a certain sensitiveness in the Garnet dough, the volume fluctuating more than in the other wheat flours. Some of these fluctuations reached the volume of the Manitoba, but only at the expense of texture.

(*b*) German flour mixed with increasing quantities of Garnet or Manitoba.

(1) (*a*) 80 per cent German wheat plus 20 per cent Garnet wheat.
(*b*) 80 per cent German wheat plus 20 per cent Manitoba wheat.

—	Wheat flour 0–70	
	(a)	(b)
Dough properties	Normal	Normal
Dough yield	161	163
Bread yield	137	138
Volume from 400 grams dough	956	969
Volume from 100 grams flour	387	401
Texture	8	8
Baking number	88	101

Further remarks.—All factors are based on 15 per cent moisture in the flour, so are directly comparable.

The addition of 20 per cent Garnet improved the baking qualities of the German baker's flour appreciably, as will be noted when the figures given here are compared with those of test 6. The Manitoba clearly had a stronger influence than had the Garnet, a fact which was less clearly expressed in the texture and the elasticity of the crumb than it was in the dough yield and volume.

(2) (*a*) 70 per cent German plus 30 per cent Garnet.
(*b*) 70 per cent German plus 30 per cent Manitoba.

—	(a)	(b)
Dough properties	Normal	Normal
Dough yield	164	165
Bread yield	139	138
Volume from 400 grams dough	953	1,004
Volume from 100 grams flour	393	422
Texture	8 (with air holes)	7–8
Baking number	93	104

Further remarks.—All factors are based on 15 per cent moisture in the flour, so are directly comparable.

According to the above data the Manitoba again proved superior to Garnet, the most noteworthy difference being in volume. The greater volume of the Manitoba baked products, however, was at the expense of the fineness in texture, but the strength of the dough did not appear to have been fully utilized.

The crumb of the Garnet baked products, in contrast with that of the Manitoba had smaller pores and was not so open.

(3) (*a*) 60 per cent German, 40 per cent Garnet.
(*b*) 60 per cent German, 40 per cent Manitoba.

—	Wheat flour 0–70	
	(a)	(b)
Dough properties	Normal	Normal
Dough yield	161	165
Bread yield	139	142
Volume from 400 grams dough	1,029	1,1
Volume from 100 grams flour	418	462
Texture	8 (with air holes)	8 (with air holes)
Baking number	109	131

Further remarks.—All factors are based on 15 per cent moisture in the flour, so are directly comparable.

The strong character of the Manitoba flour was clearly apparent in these tests. In the Garnet baked products the dough was somewhat slow during fermentation, but the texture appeared just as strong and stable as did that of the Manitoba baked products.

(4) (*a*) 50 per cent German and 50 per cent Garnet.
(*b*) 50 per cent German and 50 per cent Manitoba.
(*c*) 50 per cent German, 25 per cent Garnet and 25 per cent Manitoba.

—	Wheat flour 0–70		
	(a)	(b)	(c)
Dough properties	Normal	Normal	Normal
Dough yield	160	166	164
Bread yield	139	143	141
Volume from 400 grams dough	955	1,125	1,128
Volume from 100 grams flour	385	469	463
Texture	7-8 (with air holes)	7-8 (with air holes)	7-8 (with air holes)
Baking number	81	128	125

Further remarks.—All factors are based on 15 per cent moisture in the flour, so are directly comparable.

These tests gave the same general results as were obtained with the patent flour. Thus the Manitoba wheat was able to increase the baking qualities of German wheat to a greater degree than was the Garnet, in both cases. It should be noted, however, that 25 per cent Garnet plus 25 per cent Manitoba gave practically the same results when combined with German wheat as did 50 per cent Manitoba plus 50 per cent German.

TESTS IN SPONGE DOUGHS

In order to test the behaviour of the different flours when used in sponge doughs, the following method was employed:—200 cc. of water with the corresponding quantity of flour and 8 grams of yeast (about half of what is used in the direct method) were mixed into a sponge dough, which stood for three to four hours and then became mixed into a dough with the remaining quantity of flour and water.

These tests showed that the German flour, through the sponge dough, produced better baked products as far as concerned volume and structure, on account of the more intensive working of the yeast. On the other hand these sponge doughs with reduced quantity of yeast (as is usual in Germany) do not, in spite of the intensive influence of the yeast, contain a sufficient quantity of yeast for these hard wheats. The volume of the Manitoba as well as of the

Garnet therefore, was inferior to the volumes resulting from the usual method. This showed more in the Garnet than in the Manitoba and revealed again the less uniform resistance on the part of the latter variety.

After these tests it was not surprising that the addition of Canadian wheats to the German wheats gave baked products of smaller volume, and in this connection it is not strange that the slight addition of Canadian flour—namely 30 per cent, gave the same or even better improvement than the addition of 50 per cent. In these tests also the same difference between the Garnet and Manitoba was to be observed.

—	Wheat flour (Sponge dough)		
	German	Garnet	Manitoba
Dough properties	Normal	Normal	Normal
Dough yield	157	160	166
Bread yield	134	136	140
Volume from 400 grams dough	781	845	909
Volume from 100 grams flour	331, 315, 300	345, 340, 365	390, 390, 393
Texture	8	8	8
Baking number	14	44	86

Further remarks.—All factors are based on 15 per cent moisture in the flour, so are directly comparable.

—	German Patent Flour 0–40 (Sponge Dough)			
	Plus 50% Garnet	Plus 50% Manitoba	Plus 30 % Garnet	Plus 30% Manitoba
Dough properties	Normal	Normal	Normal	Normal
Dough yield	158	159	159	161
Bread yield	136	138	138	140
Volume from 400 grams dough	828	894	852	889
Volume from 100 grams flour	335	367	347	367
Texture	8	8	8 (with air holes)	7-8 (with air holes)
Baking number	35	67	47	64

Further remarks.—All factors are based on 15 per cent moisture in the flour, so are directly comparable.

SUMMARY

From this very comprehensive series of tests, which in each case was repeated several times, the following comparisons between Manitoba and Garnet wheat can be made. Both kinds of wheat are of the hard, glutinous and strong baking flour-type, the gluten being without doubt more stable in the case of Garnet. With this greater stability there are associated greater resistance to fermentation and more consistent but less plastic doughs. It naturally follows from this that the volume of Garnet tends to be lower than in the case of Manitoba. These properties are apparent also in mixtures with typically weak wheats such as dark winter wheats (Square Head). On the other hand it should be noted that the crumb of Garnet possessed very good elasticity with sharply defined pores.

Garnet may be regarded at the present time as a wheat which may become of distinct value, but experience in the use of it must be acquired. When this experience has been gained one can almost say that Garnet is practically equal to Manitoba.

With reference to the particular sample under consideration it cannot be said that the Garnet is the exact equivalent of the Manitoba, since the latter although well known for its great strength, still furnishes doughs which are sufficiently plastic and porous.

November 5, 1929. (Signed) NEUMANN.

MILLING TESTS OF GARNET AND NO. 2 NORTHERN (CANADIAN GRADE) WHEAT—BY R. C. SHERWOOD, MINNESOTA STATE TESTING MILL

The two lots of wheat delivered to the State Testing Mill for comparative milling tests at the request of Mr. L. H. Newman, were graded according to United States federal grades as follows: The Manitoba No. 2 Northern, our laboratory number 516, was graded No. 2 Northern Spring, 0 per cent dockage, total damage 2·6 per cent, foreign matter 1·4 per cent, weight per bushel 62·7 pounds. Moisture content was found to be 13·7 per cent (vacuum oven), protein content 12·50 per cent. The Garnet wheat, our laboratory number 517, graded 1 Hard Spring, 0 per cent dockage, total damage 2·0 per cent, 63·3 pounds per bushel. Moisture content was found to be 13·50 (vacuum oven), protein content 12·70 per cent.

Milling tests of the two lots of wheat were made individually, followed by tests of a mixture of 50 per cent of each wheat. The milling tests were designed to determine if possible the comparative milling qualities of the wheats and also to determine whether milling properties of the Northern wheat were influenced by the mixture of 50 per cent of the Garnet wheat.

The Northern Spring wheat, No. 516, was tempered with sufficient water to bring it to 16·4 per cent moisture and allowed to stand for twenty-three hours. A second tempering period of three hours with a small addition of water brought the total tempering time to twenty-six hours. The wheat at the first break rolls contained 16·2 per cent moisture. All moisture determinations reported here were made by the official A.O.A.C. vacuum oven method. Yields of flour were calculated to a basis of 13·5 per cent moisture in both wheat and flour in all the tests reported here. The wheat ground normally on the break rolls and appeared to contain as much moisture as desirable for good milling. The middlings reduced normally on the smooth rolls with apparently no large amount of stocks being carried to the tail of the mill. The bran flaked well and was cleaned well in the bran duster. A duplicate test was made under nearly the same conditions, with two hours shorter tempering period and 0·3 per cent less moisture on the first break roll. Yields of flour in the two tests were nearly the same: first test, 74·65 per cent; second test 74·50 per cent; average of total feeds, 27·60 per cent.

In the first test of the Garnet wheat it was tempered under similar conditions as the No. 2 Northern, namely, twenty-seven hours total time with moisture content of 16·0 per cent at the first break rolls. Under these conditions it was more difficult to mill than the No. 2 Northern. There was a tendency to cut the bran more on the break rolls and it was necessary to open the rolls for best grinding. The moisture content of the stocks on the third break rolls appeared about the same as in the Northern tests. The middlings produced on the break rolls were sharper and harder to reduce on the smooth rolls. The noise of the rolls during this test indicated greater difficulty in grinding. The sixth middlings stocks and the first and second tailing stocks were heavier and whiter, indicating that some of the endosperm was being carried to the tail of the mill because it was harder to grind on the first few parts of smooth rolls. The bran was cleaned well but appeared to be cut up slightly more than the Northern wheat. The yield of flour obtained was 71·21 per cent.

For a second milling test the Garnet wheat was tempered for forty-two hours (15·8 per cent H_2O.). Then a small amount of water was added and the wheat allowed to remain two hours in the second tempering bin. The moisture content was 16·2 per cent at the first break rolls. The condition for milling was im-

proved by the longer tempering. Judging from the condition of the stocks on the break rolls as well as the moisture content of the samples of flour taken from various flour streams, the water had penetrated into the endosperm to a greater extent than in the first test and as a result the middlings were reduced more easily on the smooth rolls. Even with this longer tempering, however, the middlings do not appear to reduce as readily as with the Northern wheat and there were heavier stocks to grind on the sixth middlings, first tailings and second tailings rolls. The yield of flour corrected as before to 13·5 per cent moisture basis was 70·92 per cent, slightly lower than in the first test. A third test was made with the same tempering period as used for the No. 2 Northern, but with sufficient water added to bring the moisture content to 16·4 per cent. The wheat was allowed to stand for a total time of twenty-three hours before milling, a small amount of water added on the second temper. Moisture content was 16·4 per cent at the first break rolls. In this test the yield of flour was 72·14 per cent, somewhat larger than in the other two tests but considerably smaller than in the No. 2 Northern tests. The average yield of total feeds for the three tests was 28·85 per cent, 1·25 per cent larger than in the case of No. 2 Northern. The average flour yield from the Garnet wheat was 71·42 per cent; approximately 3·0 per cent less than in No. 2 Northern.

Two tests were made with the two wheats mixed in equal proportions. The mixture was tempered under the same conditions as the No. 2 Northern, namely 24 hours total time with sufficient water to raise the moisture content to 15·9 per cent at the first break rolls. Judged by observation of the wheat and the ground stocks on the rolls, the mixture did not grind as well as the Northern wheat alone, but it appeared to be reduced more easily than the Garnet alone. As nearly as could be determined by the appearance and the "feel" of the stocks during the tests, the mixture was rendered more difficult to grind approximately in proportion to the amount of Garnet included in the mixture. Difficult grinding as the term is used here means difficulty in reducing the middlings and also the increased tendency for heavier stocks to be carried along for grinding on the last rolls of the mill. If the middlings are not thoroughly reduced to flour in passing through the series of smooth rolls, the unground particles of endosperm are naturally carried down to the last rolls in the mill from which they are carried into the low grade flour and the feeds. Observation made during the entire series of tests showed definitely that tendency to carry a portion of the endosperm to the low grade stocks and feed was greater in the tests where Garnet appeared in the wheat mix than in the tests with the No. 2 Northern. The yield of flour in the test of mixed wheat averaged 72·0 per cent, the total feed 27·60 per cent.

Some interesting information was obtained in making ash determinations in various flour streams sampled during the tests. Ash determinations of the first flour middlings flours which represent usually in this mill about 45 per cent of the total flour showed variations in the different tests. Calculated to uniform moisture content of 13·5 per cent, the average ash content was as follows:—

	Per cent.
No. 2 Northern	0·376
Garnet	0·428
Mixed Wheat	0·392

This tendency toward higher ash content in the Garnet flour streams was apparent throughout the tests, although the ash content of the Garnet wheat was 0·1 per cent lower than the No. 2 Northern. The Garnet straight grade flours produced were not higher in ash content than the Northern straight grade flours, probably due to the fact that lower yields of flour were obtained since more of the low grade stocks were carried to low grade flour and feed. This of course would result in lower yields of flour.

Laboratory baking tests were made of the several flours produced during the milling tests. Briefly the results may be summarized as follows: There were no large differences in loaf volume between the flours from the wheats ground individually and in the mixture. Colour and texture, however, did differ. Average results of a series of bakes showed the following scores:—

	Colour	Texture
No. 2 Northern	98·8	99·1
Garnet	96·8	95·9
Mixture	97·7	96·8

These baking results show that Garnet wheat yielded flour giving poorer colour and texture in the bread than the No. 2 Northern and impaired the colour and texture when mixed with the No. 2 Northern.

SUMMARY

Summarizing the results of the milling tests, the following conclusions can be drawn. The No. 2 Northern yielded a larger percentage of flour than the Garnet, although the weight per bushel of the Garnet wheat was 0·6 pounds per bushel larger. The Northern wheat was conditioned satisfactorily for the milling system of the State Testing Mill with a tempering time of twenty to twenty-four hours. The same length of tempering period was insufficient for the Garnet wheat. A tempering period of approximately forty-two hours conditioned the Garnet wheat better for grinding. A tempering period of 24 hours with about 0·5 per cent more water than used for the Northern conditioned the Garnet wheat better than the short tempering, but it still did not grind as well as the Northern wheat. In each of the three Garnet tests the yield of flour was lower than in the Northern tests. When the Garnet wheat was mixed with the No. 2 Northern the effect upon milling properties was easily recognized. The mixture of the two wheats was more difficult to reduce than the Northern wheat alone but naturally was easier to reduce than the Garnet alone. It appeared from these tests that the Garnet sample required a longer tempering period and more water to condition it properly for milling than the No. 2 Northern sample. Although tests were not made with varying percentages of Garnet wheat, it is safe to assume that under the conditions of these experiments the Garnet wheat would have affected the milling properties of the No. 2 Northern in proportion to the quantity of the Garnet wheat used.

It is rather hazardous to attempt to predict how serious a condition would result from the use of Garnet in the wheat mix under other commercial milling practices. It would probably require extremely close observation to recognize any effects from the use of quantities of the order of 10 per cent of the wheat mix.

It is conceivable that tempering conditions best suited to Garnet wheat would render a wheat mix containing a large percentage of Garnet acceptable to the miller, and the effects of over-tempering upon other wheat in the mix would not be so readily apparent as were the effects of insufficient time and water upon Garnet as found in these experiments.

It is a common practice for wheat millers to blend several different types of wheat to produce bread flours. Both soft, starchy, low-protein wheats and hard, dry, high-protein wheats are commonly included in the same wheat blend, because of their particular contributions to baking quality, and in spite of their difference in tempering and milling properties.

In any crop season it is possible to secure different types of wheat which show as great variance in milling properties as exhibited by the Garnet and the No. 2 Northern in these tests. In such cases separate tempering systems for

different types of wheats with facilities for blending after tempering would be a decided improvement but few commercial mills are equipped for this practice.

These comments are made, not as an attempt to minimize the differences in milling properties found upon testing these two lots of wheat, but instead to call attention to similar differences which may be found upon similar examination of different types of commercial wheats of the same variety grown under different climatic conditions.

The findings in these milling experiments show the differences in milling properties of the two lots of wheat tested. The importance of these differences must be determined by the flour miller as applid to his local conditions.

TEST BY PILLSBURY FLOUR MILLS, MINNEAPOLIS, U.S.A.

We ground sixty bushels of each of the following: Garnet, Manitoba One Northern, Manitoba Two Northern, Manitoba Three Northern, ½ Garnet and ½ Manitoba One Northern, ½ Garnet and ½ Manitoba Two Northern, ½ Garnet and ½ Manitoba Three Northern.

The results are self explanatory, but we will make the following comments: The Garnet seems to be noticeably inferior to the One, Two and Three in colour, volume, and score. The mixture of each one of these grades with the Garnet shows inferiority to the unmixed grade in all respects except colour in the Three Northern-Garnet mixture, which for some reason is slightly superior to that of the Three Northern alone.

The absorption of all the samples is too close to be an important difference.

—	Colour		Score		Volume		Absorption		Flour		Wheat		
	Agene	Alsop	Agene	Alsop	Agene	Alsop	Agene	Alsop	Protein	Ash	U.S. Grade	U.S.T.W.	Prot.
Garnet	98·5 GY	97·0 Y	81·50	80·00	39·00	39·00	64·00	63·75	11·40	0·41	1 Hd. Spg.	64·0	12·70
Man. 1 Nor	102·0 CW	101·5 CY	89·00	89·00	42·25	42·00	63·50	63·25	12·80	0·37	1 Hd. Spg.	62·6	14·10
½ 1-N. ½ Gar	100·5 CY	101·0 Y	87·00	87·00	41·00	41·25	64·50	64·00	12·20	0·40	1 Hd. Spg.	63·2	13·40
Man. 2 Nor	02·5W	102·0CY	90·50	89·50	42·75	42·25	63·00	62·50	12·70	0·37	2 D.N. Spg.	62·4 (3·2% Green)	14·00
½ 2-N. ½ Gar	100·0 CY	101·0 Y	86·00	87·50	40·75	41·50	63·75	63·50	11·80	0·40	1 Hd. Spg.	63·3	13·10
Man. 3 Nor	101·5 GY	100·0 Y	88·00	85·50	41·00	40·75	65·00	64·50	11·70	0·405	3 D.N. Spg.	62·5 (6·5% Frosted)	12·90
½ 3-N. ½ Gar	102·0 CW	100·5 Y	86·00	84·00	40·25	40·00	64·25	64·00	11·60	0·39	1 Hd. Spg.	63·3	12·75

(Signed) R. N. McCaull,

Pillsbury Flour Mills Co.

COMMERCIAL BAKING TESTS OF GARNET WHEAT AT TRENT INSTITUTE O.A.C., GUELPH

Commercial baking tests were run for the purpose of determining the loaf characteristics of Garnet wheat, and the reactions of flour milled from Garnet in the fermentation of the dough and the resultant loaf in commercial manufacture of bread.

For this work, six commercial sized batches were run as follows:—

1st. No. 2 Northern straight flour unbleached.
2nd. 50-50 per cent blended No. 2 Northern and Garnet straight flour unbleached.
3rd. Garnet wheat flour unbleached.
4th. No. 2 Northern straight flour bleached.
5th. 50-50 per cent blend No. 2 Northern and Garnet straight flour bleached.
6th. Garnet straight flour bleached.

The formula used to test these flours was as follows:—

	Per cent
Flour	100
Water—As per absorption to yield all doughs of same consistency.	
Yeast	1·75
Salt	1·75
Malt	0·75
Sugar	1·5
Milk powdered skimmed	1·5
Shortening	2·0
Mineral yeast food	0·25

The temperature of the doughs after being mixed were, as accurately as it was possible to get them, 80° F. The temperature of the dough was maintained at 80° F. and the relative humidity at 72 per cent throughout the entire test.

Each dough was fermented to as nearly as possible the same degree of fermentation and their fermentation times noted.

A portion of each dough was made up by hand and the remainder entirely made up by machinery of a commercial size and common commercial make. The purpose of making up the bread by both hand and machinery was to determine the ability of the gluten in the various flours to withstand treatment of machine make-up.

Each batch was proofed as nearly as possible under the same conditions of temperature and humidity. Also the oven was maintained as nearly as possible at the same baking temperature of 440° F. Each batch was given the same amount of steam in the oven as it was possible to control.

After the bread was cooled, representative loaves were chosen from each batch both hand-made and machine made, and the volumes determined. The following morning the loaves were judged.

The fermentation and make up data as well as the loaf scoring are given in the accompanying table.

Observations

1. Northern unbleached.—Slightly sticky when mixed but dried while fermenting and upon going to machines was quite dry and very lively.

2. Northern and Garnet—Blend—unbleached.—Dough felt very good when mixed, only slightly sticky, and dried during fermentation. It was not as lively as dough No. 1 when going to machines.

3. Garnet unbleached.—Dough when mixed seemed quite short but on fermenting toughened and felt very good when ready for the machines, but lacked that liveliness or resilience of dough No. 1 or No. 2. Was decidedly yellow in colour.

4. Northern bleached.—Produced an excellent dry dough when mixed and after fermentation was very lively. The best feeling dough of the test.

5. Northern and Garnet bleached.—Dough when mixed was slightly short and somewhat sticky, but on fermenting the dough toughened remarkably and became quite dry. Was not as lively a dough, however, as No. 4.

6. Garnet bleached.—Was noticeably short and sticky, but toughened and dried remarkably during fermentation. When ready for machines, however, the dough felt somewhat dead and the gluten lacked that liveliness or resiliency so marked in dough No. 4. Although the dough felt soft and somewhat dead it recovered in proofer almost as quickly as the other doughs.

In reviewing the data from the table, we see the loaf volumes were the greatest from Northern, next the blend of Northern and Garnet and lastly the Garnet. We also note that Garnet bleached produced the loaf of lowest volume and this dough felt the least lively of all batches, thus showing the gluten from Garnet wheat does not favourably respond to bleaching.

With regard to general appearance, a percentage of Garnet improves the Northern, but all Garnet flour scored lowest.

The colour of the loaf is influenced by the yellowness of Garnet and, in the case of Garnet bleached, the colour changes from yellow to gray in the crumb.

The texture of the loaf is improved in the Northern and Garnet blend, producing a more velvety and softer feel than in Northern Straight, but the texture of the loaf in 100 per cent Garnet is very much inferior in all cases.

The grain of the loaf is also improved in the blend. The gluten of the Garnet is softer and helps to mellow that of the Northern thus permitting it to enmesh the CO_2 more finely and split into finer cells.

The flavour of the loaf is improved in the use of Garnet. Of course, this quality is influenced by the personal taste of the writer.

The average value is highest in the loaves made from the Northern-Garnet blend. This value is the average of all loaf qualities, except volume. Volume is not considered in this value as the writer was only trying for average commercial loaf volume in these tests and not for maximum volume. He is convinced from running these tests, had maximum volume of loaf been striven for, the loaf characteristics would be greatly sacrificed in value in some respects due to Garnet flour.

Conclusions

As a result of these tests, the writer is convinced that Garnet wheat flour would not prove satisfactory for commercial bread-making purposes when used alone, but that it has its merits and advantages when blended with Northern Manitoba wheat. In some years would it work to advantage and the general improvement of the flour if Garnet wheat were blended with Manitoba Northern, due to its higher sugar content and its softer gluten. Certain years, the Northern Manitoba flour is low in sugar content and this deficiency could be made up by the blending of Garnet. Also Northern Manitoba wheat some years produces a very strong and stubborn gluten which could be mellowed and the baking qualities of the flour improved by blending in a percentage of Garnet due to its softer or milder gluten properties. There might, however, be limitations in the use of Garnet wheat in blending with Manitoba Northern in such years with a wet cold maturing season or a season of early frosts and immature wheat berries when the enzymatic action of the resulting flour may be high.

A 50 per cent blend of Garnet might be somewhat high, but the writer is firmly convinced that a properly proportioned blend of Garnet would react to the improvement of the flour from Manitoba Northern under ordinary conditions, and the yellow colour characteristic of Garnet wheat, which, when used alone reacts to its detriment in commercial bread-making, would reflect an improved creamy caste to the colour of the crumb of the loaf and improve the sheen of the bread.

H. C. MAEDEL,
Professor of Baking Technology.

——	Dough				Bread								
	Temp. dough mixed	Absorption %	Fermentation time in minutes	Dough remarks	Volume in c.c.	General appearance	Bloom	Break and shred	Colour	Texture	Grain	Flavour	Average value
Hand, unbleached—													
Northern Straight 1.....	80	58·5	189	Somewhat sticky when mixed.	2,876	100	100	100	100	100	100	100	100·0
Northern and Garnet 2...	80	59·25	178	Slightly sticky.....	2,720	102	104	96	92 y	102	102	102	100·7
Garnet 3.....	80	59·25	164	Short and somewhat sticky.	2,602	96	108	90	92 Y	94	92	104	95·0
Machine, unbleached—													
1.....	.....	.....	.....	.....	2,522	100	100	100	100	100	100	100	100·0
2.....	.....	.....	.....	.....	2,537	98	104	95	98 y	103	102	102	100·3
3.....	.....	.....	.....	.....	2,492	97	106	92	95 y	95	92	104	97·3
Hand, bleached—													
Northern Straight 4.....	80	59·5	183	Excellent, lively....	2,852	100	100	100	100	100	100	100	100·0
Northern and Garnet 5...	80	59·5	186	Excellent.....	2,756	101	102	98	98 y	102	102	102	100·7
6...	80·5	59·5	180	Short and sticky....	2,650	97	106	96	94G	94	90	104	97·3
Machine, bleached—													
4.....	.....	.....	.....	.....	2,537	100	100	100	100	100	100	100	100·0
5.....	.....	.....	.....	.....	2,505	102	102	100	99 y	104	104	102	101·8
6.....	.....	.....	.....	.....	2,497	98	103	96	94 g	92	93	104	97·0

Bread made from Northern Straight flour used as a standard in scoring and given value of 100 throughout.

y = yellow. Y = very yellow. g = Gray. G = very gray.

TRENT INSTITUTE—ONTARIO AGRICULTURAL COLLEGE

GUELPH, September 13, 1929.

Mr. H. C. MAEDEL, Trent Institute, O.A.C.

Sample	340 2 Nor. Str. unbleached	408 Garnet Str. unbleached	375 Nor. Gar. straight bleached
Moisture	11·80	12·40	12·60
Ash	0·49	0·49	0·44
Protein, actual	11·49	11·31	11·73
Gluten, wet	34·60	34·70	34·85
Gluten, dry	11·50	11·55	11·60
Quality of gluten	B+	B−	B
Protein comp. to a 13·5% moisture basis	11·30	11·20	11·60
Baking Test			
Absorption	56·2	55·9	55·9
Bloom	B	A−	B+
Appearance of loaf	A	B−	B+
Yield of bread	100·0	101·2	101·0
Volume of loaf	100·0	95·3	99·1
Colour of loaf	100·0 C-W	96·5 Y	98·0 G-W
Texture of loaf	100·0	97·0	98·5
Average value	100·0	98·0	99·1
Oven spring	A	A−	A
Fermentation (minutes)	131	134	131

Explanation.—The water absorption, moisture, ash, protein and gluten are expressed in percentage. The markings of gluten quality, oven spring and appearance of loaf are:—

A—Very good. B—Good. C—Fair. D—Poor. F—Worthless. The yield of bread, volume, colour and texture of standard loaves are expressed as 100.

Abbreviations.—W. white; C. creamy; Y. yellow; Br. brown; Gr. gray; El. elastic; S. soft; Sp. specky; M. moisture.

Flour Testing Department.

(Signed) F. MICKA,
Chemist.

TRENT INSTITUTE—ONTARIO AGRICULTURAL COLLEGE

GUELPH, September 13, 1929.

Mr. H. C. MAEDEL, Trent Institute.

Sample	311 2 Nor. straight unbleached	311B 2 Nor. straight bleached	320 Garnet straight unbleached	320B Garnet straight bleached	395 Nor. Gar. straight unbleached	395B Nor. Gar. straight bleached
Moisture	13·10	12·40	12·60	12·50	12·50	12·50
Ash	0·49	0·50	0·49	0·49	0·49	0·44
Protein, actual	11·71	11·56	11·63	11·89	11·81	11·73
Gluten, wet	34·10	33·90	34·55	34·50	34·30	34·50
Gluten, dry	11·35	11·25	11·50	11·45	11·45	11·50
Quality of gluten	B+	B	B−	B−	B	B
Protein comp. to a 13·5% moisture basis	11·60	11·50	11·50	11·80	11·70	11·60
Baking Test						
Absorption	56·2	56·2	56·2	56·8	55·9	56·2
Bloom	B	B	A−	A−	B+	B+
Appearance of loaf	A	B+	B−	C+	B−	C
Yield of bread	100·0	100·0	101·6	102·0	100·6	102·0
Volume of loaf	100·0	99·6	95·7	93·2	98·3	97·9
Colour of loaf	100·0 C-W	103·0 W	96·0 Y	95·0 G-Y	99·0 C-Y	101·0G-W
Texture of loaf	100·0	102·0	97·0	96·0	99·0	96·0
Average value	100·0	101·2	97·6	96·6	99·2	99·2
Oven spring	A	A	B+	B	A−	A−
Fermentation (minutes)	136	131	131	130	130	129

Explanation.—The water absorption, moisture, ash, protein, and gluten are expressed in percentage. The markings of gluten quality, oven spring and appearance of loaf are:—

A—Very good B—Good. C—Fair. D—Poor. F—Worthless. The yield of bread, volume, colour and texture of standard loaves are expressed as 100.

Abbreviations.—W. white; C. creamy; Y. yellow; Br. brown; Gr. gray; El. elastic; S. soft; Sp. specky: M. moisture.

Flour Testing Department.
(signed) F. MICKA,
Chemist.

TRENT INSTITUTE—ONTARIO AGRICULTURAL COLLEGE

GUELPH, September 13, 1929.

Mr. H. C. MAEDEL,
Trent Institute, O.A.C.

Sample	312 2 Nor. patent unbleached	312B 2 Nor. patent bleached	407 Garnet patent unbleached	407B Garnet bleached	394 Nor. Gar. patent unbleached	394B Nor. Gar. patent bleached
Moisture	12·60	12·20	12·30	12·30	12·20	12·50
Ash	0·42	0·41	0·44	0·45	0·40	0·41
Protein actual	11·01	11·17	10·98	11·05	10·73	10·52
Gluten, wet	34·30	34·10	35·30	34·20	34·80	34·20
Gluten, dry	11·30	11·20	11·70	11·30	11·50	11·20
Quality of gluten	B+	B	B−	B−	B	B
Protein comp. to a 13·5% moisture basis	10·90	11·00	10·80	10·90	10·60	10·40
Baking Test						
Absorption	56·5	57·1	55·9	56·5	56·5	56·5
Bloom	B−	B−	B+	B+	B	B
Appearance of loaf	A	B	C	C−	B−	C
Yield of bread	100·0	100·8	101·0	102·2	101·6	102·6
Volume of loaf	100·0	96·0	86·9	84·7	97·8	92·1
Colour of loaf	100·0 C-W	102·0 W	94·0 Y	93·0 G-Y	96·0 C-Y	97·0 G-W
Texture of loaf	100·0	101·5	96·0	92·0	98·0	97·0
Average value	100·0	100·1	94·5	93·0	98·4	97·2
Oven spring	A−	B+	C−	C−	B+	B−
Fermentation (minutes)	129	126	132	129	126	125

Explanation.—The water absorption, moisture, ash, protein, and gluten are expressed in percentage. The markings of gluten quality, oven spring and appearance of loaf are:—

A—Very good. B—Good. C—Fair. D—Poor. F—Worthless. The yield of bread, volume, colour and texture of standard loaves are expressed as 100.

Abbreviations.—W. white; C. creamy; Y. yellow; Br. brown; Gr. gray; El. eleastic; S. soft; Sp. Specky; M. moisture.

Flour testing department.
(signed) F. MICKA.

DOMINION EXPERIMENTAL FARMS

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