12-1902

Macaroni Wheat

E.C. Chilcott
South Dakota Agricultural College

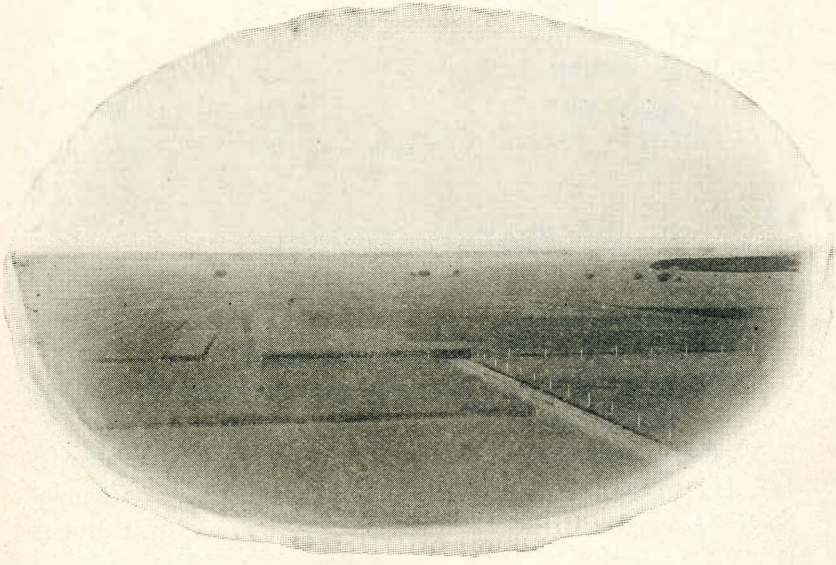
A.D. Feuling
South Dakota Agricultural College

J.H. Shepard
South Dakota Agricultural College

Bulletin 77 December, 1902

South Dakota Agricultural College

EXPERIMENT STATION



View of Experiment Plats

Macaroni Wheat

—— IN ——

SOUTH DAKOTA

Department of Agriculture

BROOKINGS, SOUTH DAKOTA

1902
NEWS PRINTING CO.
ABERDEEN, S. D.

GOVERNING BOARD

REGENTS OF EDUCATION

HON. F. A. SPAFFORD, Pres. ..... Flandreau
HON. M. F. GREELEY ..... Gary
HON. I. W. GOODNER ..... Pierre
HON. L. M. HOUGH ..... Sturgis
HON. R. M. SLOCUM ..... Herreid
HON. IRWIN D. ALDRICH (Secretary of Regents) .. Big Stone

STATION COUNCIL

R. M. SLOCUM .....
F. A. SPAFFORD ..... } Regent Members
J. W. HESTON, President of the College
JAMES W. WILSON, Director and Professor of Animal Husbandry
E. C. CHILCOTT, Vice-Director ..... Agriculturist
JAS. H. SHEPARD ..... Chemist
N. E. HANSEN ..... Horticulturist
D. A. SAUNDERS ..... Botanist and Entomologist
E. L. MOORE ..... Veterinarian and Zoologist
R. A. LARSON ..... Secretary and Accountant

ASSISTANTS

A. H. WHEATON ..... Dairy Husbandry
A. B. HOLM ..... Soil Physics
W. S. THORNBER ..... Botany and Horticulture
H. G. SKINNER ..... Animal Husbandry
F. E. HEPNER ..... Chemistry
WM. WEST ..... Agriculture
CHAS. HARALSON ..... Horticulture
LILLIAN LANGDON ..... Stenographer

Any farmer of the state can have the Bulletins of this Station free upon application to the Director.

PREFACE

In order that the reader may understand something of the plan and scope of the work in cereal investigation under way at this Station the following statements are made:

This Station has been engaged in cereal investigations for a number of years, and in the spring of 1901 the United States Department of Agriculture entered into an agreement with the Station to enlarge the scope of the work through co-operation with the Department.

In this co-operative agreement Dr. A. F. Woods of the Bureau of Plant Industry was given general supervision of the work for the Department of Agriculture, and the work at this Station was placed in charge of Prof. E. C. Chilcott, Agriculturist of this Station. Professor Chilcott was commissioned collaborator by the Secretary of Agriculture, and Mr. John S. Cole, a senior student of the College, was appointed special agent of the Department of Agriculture and detailed to assist Professor Chilcott in the co-operative work at Brookings. Mr. Sylvester Balz was assigned to a similar position at Mellette, where a duplicate set of experiments was carried on in order to ascertain whether the conditions in these somewhat widely separate parts of the state would materially affect the results obtained.

Mr. M. A. Carleton, Cerealist of the United States Department of Agriculture, has attended to the details of this co-operative work on the part of the Department at Washington.

Under this co-operative organization, in addition to the independent work being carried on by this Station, hundreds of varieties of wheat, oats, speltz, barley and rye have been grown under a carefully planned and executed system. Much valuable information has already been obtained and more is confidently expected from experiments not yet concluded.

Mr. Cole is now in the laboratories of the Bureau of Plant

Industry, Washington, D. C., engaged in working out some of the results of last season's work at Brookings and Mellette.

Professor James H. Shepard, Chemist of this Station, is engaged in working out the chemistry of the cereals in this state and has contributed an article to this Bulletin upon some of the chemical characteristics of macaroni wheat and its products.

Professor D. A. Saunders, Botanist of this Station, is carrying on extensive work in the improvement of old varieties and the development of new ones by cross-breeding and selection.

Mrs. Alice Dynes Feuling, professor of Domestic Economy in the Agricultural College, although not connected with the Experiment Station, has kindly consented to undertake some experiments in bread making, the results of which appear in this Bulletin.

Believing that some valuable results have already been obtained in the experiments with macaroni wheat, and that these results should be placed before the farmers of the state before they have made their arrangments for for next season's work, this Bulletin has been authorized by the Station Council.

December 22, 1902.

JAMES W. WILSON, Director.

VIEW IN SEED HOUSE

MACARONI WHEAT IN SOUTH DAKOTA

E. C. CHILCOTT, Agriculturist

While we are not prepared to give final and definite answers to some of the many problems concerning the growing, marketing and milling of macaroni wheat, it is believed that the following facts have been fully established by the experiments already conducted:

(1) Macaroni wheat of good quality can be raised in all parts of South Dakota.

(2) It will yield from 25 to 100 per cent more than the best Blue Stem and Fife wheats, under ordinary conditions.

(3) The difference in yield in favor of the macaroni wheats increases as the conditions for bread wheat raising become less favorable.

(4) A light to fair crop of macaroni wheat may be raised during dry seasons when ordinary bread wheat fails.

(5) Macaroni wheat can be ground into flour by any good flouring mill without any extensive modification of the methods used for milling ordinary bread wheats.

(6) The flour from macaroni wheat can be made into bread of excellent quality, more nutritious, and by many preferred to that made from ordinary bread wheat.

(7) There is a steadily increasing demand for this wheat for making macaroni and like products both in this and in foreign countries.

(8) Macaroni wheat has a considerably higher percentage of nitrogen than ordinary bread wheat and, consequently, the whole wheat as well as the flour and by-products make richer food.

(9) Macaroni wheat can be profitably grown in all parts of the state where the ordinary bread wheats can, and in some localities, and under some conditions, where they cannot.

(10) The channels of consumption of macaroni wheat are:

First—A large export demand.

Second—A large home demand for milling, the flour

being used to manufacture macaroni, spaghetti, noodles, etc., as the products manufactured from home grown wheat fully equal the imported articles.

Third—We hope that, as in Russia, there will be a large and growing demand for macaroni wheat bread, bread sticks, pretzels, etc.

(11) We are not in position to express an opinion as to whether the demand for macaroni wheat will increase as rapidly as the supply, provided that the farmers of the state begin at once to raise it on a large scale; but it is a fact that we are now importing several million dollars worth of macaroni products that should be produced at home. Many of the home manufacturers have been unable to procure enough macaroni flour and have been compelled to use flour from bread wheats, although the macaroni made from this wheat is very inferior; and, moreover, we do believe that any temporary overproduction that may occur can be profitably disposed of by feeding it to fattening animals.

(12) Macaroni wheat requires the same culture as the ordinary bread wheat, except that the seeding should be somewhat heavier. We recommend one and one-half bushels per acre of macaroni wheat where one and one-fourth bushels per acre of ordinary wheat is sown.

(13) We are not prepared to name the best varieties of macaroni wheat, but the following have all yielded well with us:

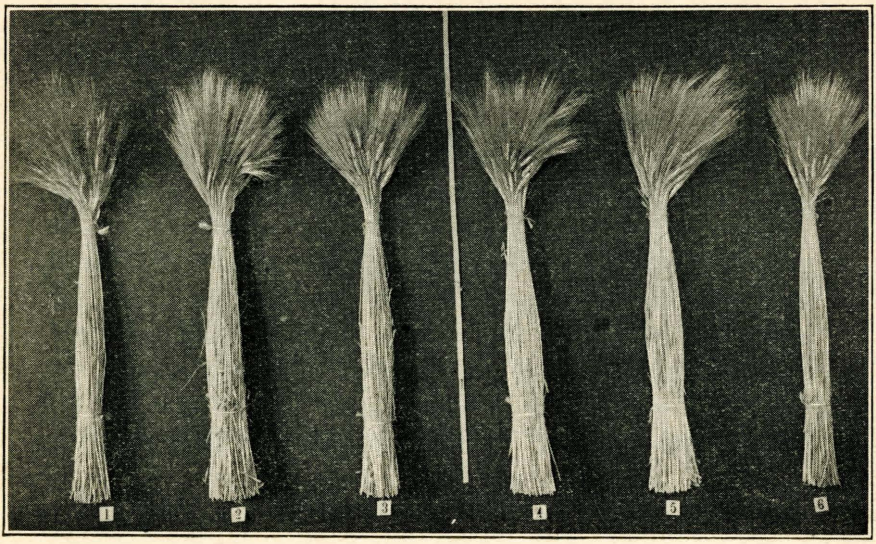
Pellissier, Berdiansk, Kubanka, Arnautka, Gharnovka, Yellow Gharnovka, Taganrog, Argentine, Medeah, Velvet Don, Black Don.

(14) "Wild Goose" or "Goose" wheat is macaroni wheat, but as most of the wheat of this variety has been grown for years without any effort to keep it pure or to maintain its quality, it is usually decidedly inferior to the recently imported varieties. It may, however, be greatly improved by careful selection.

(15) Macaroni wheat for seed may be obtained from many of the co-operators who obtained seed from this Station last

year. A list of these co-operators is given in another part of this bulletin. This Station can supply a limited quantity of seed at $1.00 per bushel, without sacks, or $1.10 per bushel, sacked and delivered f. o. b. Brookings, S. D.

(16) It is of the greatest importance that this seed be kept pure. Not only should the mixing of macaroni with bread wheats be avoided, but care should also be taken with the different varieties of macaroni wheat and not allow them to become mixed. The reason for this is that the time of ripening of the macaroni wheat differs quite widely from that of bread wheat; and there is also considerable difference between the several varieties of macaroni wheat in this respect. When these wheats become mixed they are very difficult to separate.



MACARONI WHEATS

No. 1—5351—Berdiansk
No. 2—5352—Novo-Rossisk
No. 3—5353—Algerian
No. 4—5354—Argentine
No. 5—5355—Taganrog
No. 6—5380—Pellissier

MACARONI WHEAT—WHAT IT IS

For a description of macaroni wheat I cannot do better than quote from the valuable bulletin upon this subject issued from the Bureau of Plant Industry, about a year ago, by Mark Alfred Carleton, Cerealist, which is as follows:

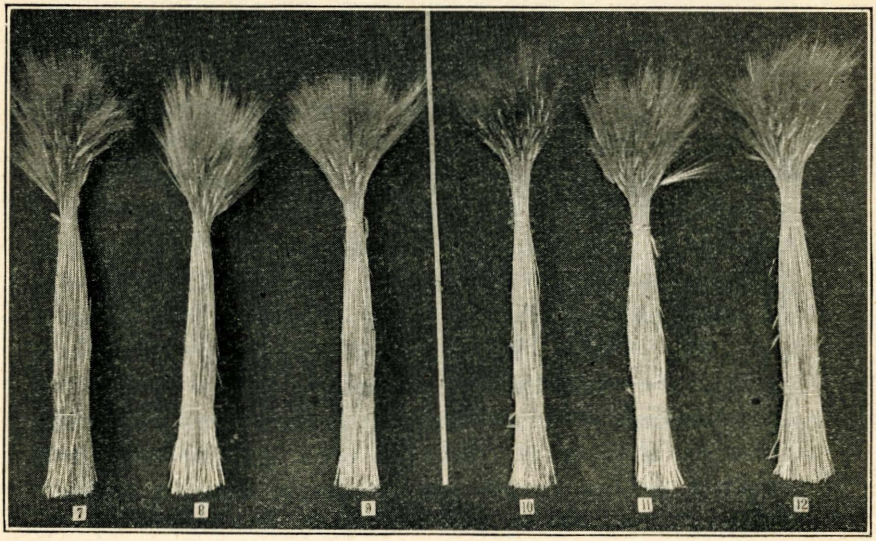
"For more than thirty-five years there have been occasional introductions into this country of the hardy, glassy wheats of the durum group, chiefly from Russia, but also from Algeria and Chile. In Europe they are called simply hard wheats, and correctly so, since the hardest bread wheats of the world are really soft compared with them. In this country they have not until recently been sufficiently well known to receive a special name. Now, however, through the recent introductions and publications of this Department, the term macaroni is already pretty well understood.

"Heretofore these wheats have been received with but little favor. In spite of their excellent yields and hardiness the lack

of a market made their establishment a practical impossibility for the time. Our own macaroni factories were using ordinary bread wheats and the attention of foreign factories had not been called to the possibility of securing excellent durum wheat from this country. Our millers refused to receive such wheat, not being able to utilize it with their present methods of milling for bread flour only. Elevator men also refused to handle it, as it would spoil the sale of other standard wheats if mixed with them in the elevators. Also the different varieties introduced had not been tested sufficiently long to obtain a just idea of their value, and were often grown in localities to which they were entirely unadapted. Thus a combination of unfortunate circumstances gave to these wheats a reputation not at all deserved. Only two years ago a writer severely criticised the Department for introducing a consignment of Kubanka wheat, saying that the variety was already considered to be a failure in this country.

"Now, however, as a result of the efforts of the Department begun two years ago to establish these durum wheats, there is being manifested a great change of opinions as to their merits, in view of their probable complete utilization in the future for the manufacture of macaroni. The following are some of the reasons for this change in opinion: (1) Certain European manufacturers are ready at any time to contract for large amounts of American grown wheats of this kind so long as they stand the proper test. (2) Samples already sent to European experts for examination have given very favorable results in comparison with foreign samples, though it is almost certain that the samples were in quality below the average of what can be produced and is being produced in this country. (3) Quite a number of American factories are showing a disposition to use semolina (the special name of the milled product as used by the macaroni manufacturer) made from these wheats just as soon as they can obtain a sufficient amount of it. (4) Several American flour mills are now grinding macaroni wheat.

"Macaroni wheats proper belong to the durum group,



MACARONI WHEATS

No. 7—5492—Medeah
No. 8—5642—Yellow Gharnovka
No. 9—5643—Gharnovka
No. 10—5645—Black Don
No. 11—5646—Gharnovka
No. 12—5800—Beloturka

known by the botanical name of *Triticum durum.* In France they are called *Ble dur;* in Germany *Hartweizen;* and in Spain, *Trigo duro.* They are sometimes called barley wheats, or *Gerstenweizen,* because of their resemblance to barley. The wheats of this group grow rather tall and have stems that are either pithy within or hollow, with an inner wall of pith, or, in a few varieties, simply hollow, as in the ordinary bread wheats. The leaves are usually broad and smooth, but have a peculiar whitish green color and possess an extremely harsh cuticle. The heads are comparatively slender in most varieties, compactly formed, occasionally very short, and are always bearded with the longest beards known among wheats. The spikelets (meshes) are two or four grained. The outer chaff is prominently and sharply keeled, and the inner chaff somewhat compressed and narrowly arched in the back. The grains are usually very hard and glassy, often translucent, yellowish-white in color, occasionally inclining to reddish,

and usually rather large. In certain varieties the grains are almost or fully as large as those of Polish wheat, and are sometimes mistaken for it.

"In the field these wheats resemble barley very much, and one seeing them there for the first time and not familiar with their appearance, is apt to think of them as being actually barleys. There are many varieties, differing in shape and size of head, color, and amount of hairiness of chaff, color of beards, etc. Besides their exceptional fitness for the manufacture of macaroni and other edible pastes, these wheats possess for the grower two other admirable qualities to a greater degree than ordinary wheats. They are extremely resistant to drought and to attacks of most fungus pests. Black stem rust, however, sometimes affects them badly. They do not stool extensively."

CO-OPERATIVE EXPERIMENTS WITH MACARONI WHEAT

In the spring of 1902, the United States Department of Agriculture furnished this Station with about 500 bushels of macaroni wheat, which was sold to farmers in various parts of the state who agreed to co-operate in testing its value for their locality. No one person was allowed more than ten bushels of any one variety, and as a rule only one variety was sent to each co-operator. After the crop had been harvested, letters of inquiry were sent out to these co-operators asking them to make reports upon the result of their experiment. Up to the time we go to press only about one-half of these co-operators have reported. It is hoped, however, that the rest of them will do so, and that we will have the results of their experiments to use in future publications. Below is given a list of these co-operators, with their location and the variety of wheat grown by them:

KUBANKA FROM URALSK, RUSSIA

Crop of 1900—No. 8212

C. L. Hyde.....Pierre .....Hughes county
Mike Dolohery .....Blunt .....Hughes county

Frank Sherwin	Brookings	Brookings county
John H. King	Huron	Beadle county
D. Koester	Madison	Lake county
William Stoddard	Westport	Brown county
W. H. Holms	Burdette	Hand county
J. G. Ehlers	Mt. Vernon	Davison county
W. Westera	Canton	Lincoln county
H. I. Sterns	Brookings	Brookings county

KUBANKA FROM URALSK, RUSSIA

Crop of 1901—No. 8213

C. L. Hyde	Pierre	Hughes county
Isaac Ratzlaff	Marion	Turner county
W. E. Heeren	Parker	Turner county
A. H. Davison	Manchester	Kingsbury county
J. C. Smith	Blunt	Hughes county
O. H. Bratsberg	Dell Rapids	Minnehaha county
D. Koester	Madison	Lake county
A. Wallman	Crandon	Spink county
C. H. Thurow	Ramona	Lake county
Holter Bros.	Canton	Lincoln county
E. T. Sweet	Menno	Hutchinson county
R. H. Williams	Brookings	Brookings county
Dion E. Pearce	Madison	Lake county
A. J. Preston	Castlewood	Hamlin county
W. H. Wintersteen	Hartford	Minnehaha county
L. Mattson	Tilford	Meade county
J. S. Irwin	Blunt	Hughes county

KUBANKA

Grown by J. H. Shepard, Brookings, 1901—No. 5639

C. L. Hyde	Pierre	Hughes county
G. A. Grant	Dell Rapids	Minnehaha county
M. L. Pierce	Gettysburg	Potter county
J. C. Herpel	Andover	Day county
R. Rotruff	Oldham	Kingsbury county
Geo. Smith	Willow Lake	Clark county
C. D. Atkins	Frederick	Brown county
D. Koester	Madison	Lake county
E. B. Graves	Clark	Clark county
A. J. Vafed	Hurley	Turner county
L. H. Willrod	Brule	Brule county
C. C. Moulten	Faulkton	Faulk county
John Fleming	Putney	Brown county
C. N. Hess	Wessington	Beadle county
William Rehfeld	Warner	Brown county
Otto Anderson	Rockerville	Pennington county
Charles Sindler	Ipswich	Edmunds county
O. A. Nash	Platte	Charles Mix county

W. O. Lawson	Holabird	Hyde county
Frank Novak	Vernon	Roberts county

VELVET DON

Grown by J. H. Shepard, 1901—No. 5644

F. D. Aukes	Steen	Rock county, Minn.
John H. King	Huron	Beadle county
J. W. Jeffery	Colman	Moody county
D. Koester	Madison	Lake county
A. Wallman	Crandon	Spink county
Joseph Markovetz	Ipswich	Edmunds county
Roy Jopp	Forestburg	Sanborn county
J. M. Zirles	Turton	Spink county
S. N. Hutchison	Twin Brooks	Grant county
John Werner	Lake Preston	Kingsbury county
Frank Sherwin	Brookings	Brookings county

YELLOW GHARNOVKA

From Ambrociveka, Russia—No. 8230

C. L. Hyde	Pierre	Hughes county
Will Eckhart	Blunt	Hughes county
O. I. Elgaaen	Sherman	Minnehaha county
A. H. Davison	Manchester	Kingsbury county
John Cruse	Spencer	McCook county
A. J. Carpenter	Hetland	Kingsbury county
John H. King	Huron	Beadle county
J. W. Parmley	Ipswich	Edmunds county
Otto Huive	Bristol	Day county
A. Wallman	Crandon	Spink county
W. H. Holms	Burdette	Hand county
L. Omvell	Mellette	Spink county
J. W. Cass	Gettysburg	Potter county
D. Koester	Madison	Lake county
G. W. Hoyman	Madison	Lake county
James H. McAllister	Parker	Turner county
J. B. Orth	Elkton	Brookings county
Alfred Wilson	Putney	Brown county
A. J. Preston	Castlewood	Hamlin county
Grant Lamber	Gettysburg	Potter county
H. B. Booth	Canning	Hughes county
B. R. Linney	Blunt	Hughes county
D. Marty	Cortlandt	Edmunds county

VELVET DON

From Ambrociveka, Russia—No. 8231

F. M. Chamberlain	Warnecke	Sully county

BLACK DON

From Ambrociveka, Russia—No. 8232

C. L. Hyde	Pierre	Hughes county
James Piper	Huron	Beadle county
D. Koester	Madison	Lake county
Geo. F. Heischedel	Lewiston	Sully county
D. Marty	Cortlandt	Edmunds county

ARNAUTKA

Grown at this Station

Mrs. May P. Denning	Willow Lake	Clark county

As will be seen from the above list, there were seventy-one co-operators, residing in twenty-nine different counties. Of these thirty-six have already reported. The yields obtained by each is given in the following list:

No.	Name of Wheat	Name of Grower	Yield per Acre, bu.
8230	Yellow Gharnovka	O. I. Elgaaen	14 6-7 20 4-5
8230	Yellow Gharnovka	J. W. Parmley	17 21
8230	Yellow Gharnovka	A. Wallman	18
8230	Yellow Gharnovka	John Kruse	27
8230	Yellow Gharnovka	James McAllister	10
8230	Yellow Gharnovka	Alfred Wilson	28
8230	Yellow Gharnovka	J. B. Orth	21 3-7
8213	Kubanka	A. Wallman	18
8213	Kubanka	L. Matteson	33 1-3
8213	Kubanka	C. H. Thurow	18
8213	Kubanka	R. H. Williams	14
8213	Kubanka	Holter Bros.	14
8213	Kubanka	Wm. Stoddard	22
8212	Kubanka	R. Rotluff	23 1-3
5639	Kubanka	G. A. Grant	10 7-10
5639	Kubanka	Otto Anderson	30
5639	Kubanka	Chas. Sindelar	18
5639	Kubanka	L. H. Willrod	18
5639	Kubanka	O. A. Nash	19
5639	Kubanka	William Rehfeld	31 3-5
5639	Kubanka	C. D. Atkins	22 1-2
8523	Velvet Don	John Werner	10
8523	Velvet Don	J. M. Zirles	25 30
5644	Velvet Don	J. W. Jeffery	20 1-4
5644	Velvet Don	A. Wallman	18
8231	Velvet Don	F. M. Chamberlain	25
	Arnautka	Mrs. May P. Denning	26 2-3
8232	Black Don	Geo. F. Heischedel	10
8232	Black Don	John King	39
8232	Black Don	C. L. Hyde	4 20

No.	Name of Wheat	Name of Grower	Yield per Acre, bu.
8213	Kubanka	W. H. Wintersteen	27 1-3
8230	Yellow Gharnovka	Grant Lambert	28
5639	Kubanka	Frank Novak	30
8230	Yellow Gharnovka	G. W. Hoyman	17 20
8213	Kubanka	W. E. Heeren	18

While there is considerable variation in the yields reported above, it will be seen that with few exceptions they are better than the average yield obtained from the ordinary bread wheats. Below are given some extracts from the letters and reports from the above named parties, which will explain the results, more fully:

O. I. Elgaaen, Sherman, S. D., writes as follows: "Gave five to eight bushels better on each acre than blue stem wheat on same farms. Quality of grain good, no rust, smut, lodging or shattering."

J. W. Parmley, Ipswich, S. D., writes: "I got a lot of seed from North Dakota, and while it was grown separately, in this report I have had to give averages. Yield one-third or one-half more than ordinary wheat with similar conditions and soil. Quality of grain good, no rust, smut, lodging or shattering. Height of straw from 5 to 5½ feet."

A. Wallman, Crandon, S. D.: "This grain was badly damaged by hail, otherwise I would have got 30 bushels per acre."

John Kruse says: "This wheat was sown immediately after blue stem, and ripened about six days before. Would have been better, I think, if dry weather had not set in, but it did not get damaged as much as the blue stem."

James McAllister, Parker, S. D., says: "It does better on heavy land than the light land. I do believe it will be all right to raise it in South Dakota; it will make flour all right. Quality of grain fair, some rust, no smut, but lodged."

Alfred Wilson, Putney, S. D., says: "We think we got a good yield under the circumstances, yielding about three times as much as our other wheat."

J. B. Orth, Elkton, S. D., writes: "When other grain suffered (that is blue stem) for want of rain, this wheat grew right along and ripened ten days or more before the blue

stem. If it makes good flour I think it is all right. Quality of grain very good, no rust, smut or lodging, very little shattering."

R. H. Williams, Brookings, S. D., says: "It was hailed out I think at least one-half before it was cut, and hailed again in the shock. I think it would have yielded at least 30 bushels per acre. I will have 75 bushels of this wheat to sell. I want to sow thirty acres this year."

Holter Bros., Canton, S. D., have this to say: "After headed it was blown down by storm, which left a bend in the straw when raised again. This perhaps hindered proper development, as heads were surprisingly short. Considered the straw too rank for good results. Quality of grain fair, no rust or smut; lodged some. We did not consider this grain a success this season as compared with our other grain, but it may do better after having become adapted to the locality. We have heard that there is only a limited market for this kind of wheat. If such is the case we do not consider it advisable to put in our seed another year."

Wm. Stoddard, Westport, S. D., writes: "The ground this wheat grew on was in corn and millet the year before. The wheat was too thin; will sow at least 1¼ bushels another year. A weevil or worm of some kind worked in the stalk after it was headed, destroying from 3 to 5 per cent of the crop. My bread wheat yielded from 8 to 12 bushels per acre; I got 44 bushels (of macaroni wheat) from two bushels sown, and I believe had it been properly threshed there would have been at least two and perhaps more than two bushels more of it. I am well pleased with the crop so far as the yield is concerned, and will sow my 44 bushels on the best land I can spare for it."

R. Rotluff, Oldham, S. D., who reports a yield of 23 1-3 bushels, adds: "The wheat was a thin stand on account of thin sowing, and the ignorance of threshers in threshing that kind of wheat; about one-third of it went in the straw pile."

G. A. Grant, Dell Rapids, S. D., reports: "The wheat was sown on a piece of ground previously used for corn; no manure

used; did better on fall plowing. The grain on fall plowing was more plump than the sample sent you."

Otto Anderson, Rockerville, S. D., writes: "The grain was tangled so it was difficult to get straw; too weak. Quality of grain good, no rust or smut."

Chas. Sindelar, Ipswich, S. D., writes: "This Kubanka was harvested a little green. More grain must be sown per acre to prevent lodging. The heads were so heavy that it went down every day." (Mr. Sindelar seeded at the rate of five pecks per acre.)

L. H. Willrod, Brule, S. D., writes: "Soil in good condition when sown, but hardly any rainfall here during growing season. Other wheat yielded from 5 to 10 bushels per acre. The best in this neighborhood did not go over 12. Grasshoppers injured my Kubanka, else it would have gone 20 bushels per acre."

O. A. Nash, Platte, S. D., reports: "I cut this grain a little too early on account of grasshoppers; there would have been 60 or 65 bushels (on three acres)."

William Rehfeld, Warner, S. D., says: "Like it well enough to sow more next year."

C. D. Atkins, Frederick, S. D., says: "It was drilled across the end of a farm so to take in different kinds of land, fall and spring plowing, millet stubble and disced speltz stubble. The spring plowing was best, fall plowing next, and the millet and speltz stubble about equal, and very small difference in any of it."

John Warner, Lake Preston, S. D., writes: "This wheat had strong healthy straw and a good even stand. It was smashed to the ground by hail July 19th. The other that stood next to it was unfit to cut. I am well satisfied with the wheat. Quality of grain good, no rust, smut, lodging or shattering."

J. M. Zirles, Turton, S. D., writes: "I am sorry I cannot give a more accurate account of grain. I am sure it is the same as goose wheat grown here. It went 30 bushels to the acre. Quality of grain good, no rust, smut, lodging or shattering."

J. W. Jeffery, Colman, S. D., writes: "The ground was first disc harrowed, then smoothing harrowed. It was sown too thick. In the thin spots the grain was much better. The berries are larger and plumper than what was sown. Quality of grain good, no rust, smut, lodging or shattering." (Mr. Jeffery sowed at the rate of 1½ bushels per acre.)

F. M. Chamberlain, Wernecke, S. D., says: "I have 200 bushels of this grain for sale, also broom grass seed. Quality of grain good, no rust, nor smut, or shattering; badly lodged."

Geo. F. Heischedel, Lewiston, Sully county, S. D., writes as follows: "You remember that I did not know that the seed was at Gettysburg until it was there about eight weeks. When I got the seed I concluded I better plow a new patch for it. I had not much over three bushels left, so I plowed three acres and sowed it on the *first of June,* and the ground was so dry that the grain did not all come up before the 15th of June. We had no hot winds this year, and the wheat was hardly ripe when I had it cut on the 1st of September. I was also away from home when it was threshed, and there is a good lot of it left in the straw pile. So, considering the circumstances, the time it was sown, cut and threshed, it did well enough. The wheat is good, and I am satisfied." (We consider this a remarkably good yield, everything considered.)

John H. King, Huron, S. D., writes: "I have in one respect a very fine report to make of the macaroni wheat. My man, however, got the kinds mixed and could not tell the difference, and when the threshers threshed it, it was not kept separate. The Kubanka 8212 and 5639 and the Velvet Don 5644 are the kinds I raised. The Yellow Garnauvka 8230 and Black Don I sold to others. My wheat yielded 39 bushels to the acre. I had 391 bushels off of a rod less than ten acres."

C. L. Hyde, Pierre, S. D., who had Kubanka, Yellow Garnauvka and Black Don, reports as follows: "It was not possible for me to judge of this in different portions, as conditions were so different. Some of the grain would have threshed 10 to 20 bushels per acre, and some parts of the same wheat only 5 to 8 bushels, and a little of the most unfavorable might

not have made better than 4 bushels per acre. We had one very hot spell which seemed to hurt most of it somewhat, as it came the worst time. We were unfortunate in getting this grain in, and it was not put in on the best land, but the worst. My man did not realize what I wanted, * * * and it was impossible to get the threshing machine here, and we decided to feed the grain unthreshed, straw and all together, to fatten the cattle for market in connection with our corn."

W. H. Holms, Burdette, S. D., writes: "I have 50 bushels of macaroni wheat for sale. I bought of you 5 bushels, sowed 2½ bushels myself and raised 60 bushels; let my neighbor have 2½ bushels. He did not get quite so much as I. The variety I sowed is the Kubanka variety. It is good wheat to raise if the mills get to handling it."

W. H. Wintersteen, Hartford, S. D., writes as follows: "Sowed it after I had sowed the rest of my wheat. Sowed the three acres with the 4 bushels, corn stalk, disced it in, sowed it broadcast. Think it should have 2 bushels to the acre. No smut. Lodged a little, but did not go down; did not shatter. It is rather hard to thresh. About three feet high. Cut it right after I cut the rest of my wheat; 52 bushels machine measure. I wrote you some time ago the millers here say it is no good; call it goose wheat. I don't know whether to sow it next year or not, as the buyers won't buy goose wheat."

Grant Lambert, Gettysburg, S. D., writes as follows: "This grain was so tall and began to lodge, and I became scared and cut it before it hardly began to ripen, which accounts for its being shrunken. Do you want to buy any of this wheat? If so, what is it worth? And would you advise sowing extensively? We have no market here for it."

Frank Novak, Vernon, S. D., writes as follows: "I am well satisfied with the wheat, but how will the market be? Is this the right kind of macaroni wheat for the market?"

G. W. Hoyman, Madison, S. D., writes as follows: "The old ground was surrounded on two sides by trees, and next to the trees it was rusted quite badly."

RESULTS AT THIS STATION IN 1901

In the spring of 1901, twelve one-tenth acre plats were sown to twelve different varieties of macaroni wheat. On nine adjoining one-tenth acre plats nine different varieties of selected fife and blue stem wheats were sown. The ground on which these several varieties were sown was very uniform in character. No manure had been applied for a number of years. The different varieties of grain were all sown on the same day and received exactly the same treatment; the yields are therefore strictly comparable.

Below is given the yields obtained from these several plats:

MACARONI WHEAT

No.	Name	Yield per Acre bu.	lbs.
5351	Berdiansk	21	20
5352	Novo-Rossisk	18	10
5353	Algerian	17	20
5354	Argentine	25	40
5355	Taganrog	25	30
5380	Pellissier	21	
5492	Medeah	22	50
5642	Yellow Garnauvaka	22	40
5643	Gharnovka	22	
5645	Black Don	22	
5646	Gharnovka	18	10
5800	Beloturka	20	30
	Average	21	26

BREAD WHEATS

No.	Name	Yield per Acre bu.	lbs.
Minn. No. 51	Haynes Blue Stem		
Minn. No. 66	Powers Fife	11	30
Minn. No. 146		12	50
Minn. No. 149		11	30
Minn. No. 163		8	30
Minn. No. 169		11	
Minn. No. 171	Ristings Fife	11	
Minn. No. 181	McKendrys Fife	4	
Minn. No. 185	Advance	12	20
Minn. No. 188	Preston	12	20
	Average	10	33

The average yield for this season of pedigreed blue stem on thirty plats in our rotation series was 16 bushels and 22

pounds per acre, while a large field of the same kind of wheat on like ground yielded 15 bushels and 20 pounds per acre.

It will be seen from the above figures that the macaroni wheat yielded just about double that of the bread wheats in tenth acre plats, where the results were most comparable, and that it yielded more than 25 per cent more than the best average yield of blue stem for that year.

RESULTS AT THIS STATION IN 1902

The results for 1902 were not as satisfactory in some respects as those of the previous year, for although we obtained better yields this year than last, the conditions under which the different varieties were raised were not such as to make the results as strictly comparable as those of the previous year. Another fact that makes it somewhat difficult to draw definite conclusions is that the same variety gave widely different yields on different plats.

Below are given the best yields obtained at this Station in 1902 of the same varieties given in the foregoing table for 1901. We also give the yields obtained at Mellette with the same varieties:

		Yield per Acre			
		Brookings		Mellette	
No.	Name	bu.	lbs.	bu.	lbs.
5351	Berdiansk	24	36	29	25
5362	Novo-Rossisk	20	6	20	
5353	Algerian	15	56	18	50
5354	Argentine	31	4	20	
5355	Taganrog	35	22	24	20
5380	Pellissier	37	32	26	30
5492	Medeah	18	28	28	55
5642	Yellow Gharnovka	20	48	23	10
5643	Gharnovka	21	10	24	
5645	Black Don	23	32	24	
5646	Gharnovka	21	54	22	10
5800	Beloturka	10	2	28	10
	Average	23	22	24	8

In 1902 the Minnesota bread wheats that were raised in 1901, as given in a preceding table, gave an average yield of

only 8 bushels and 46 pounds. The thirty rotation plats gave an average yield this year of 10 bushels and 7 pounds.

From a comparison of these figures it will be seen that the macaroni wheats yielded more than double that of the bread wheats. I do not, however, feel that this is a fair comparison, as the bread wheats were very much injured by rust, which reduced their yield very much below what it would have been had not the rust attacked them. The fact that the macaroni wheat ripened somewhat earlier than the bread wheat caused it to suffer much less from rust. This was also noticeable in the case of the winter wheats. Turkey Red winter wheat yielded 29 bushels and 6 pounds and Kharkov winter wheat yielded 22 bushels and 40 pounds per acre.

A large number of other varieties of macaroni wheat were raised, many of them yielding about as well as those given above, but as none of them seem superior to these we do not deem it advisable to give yields until further results have been obtained.

In the following table we give the average results of all the experiments that have been conducted at this station with the twelve varieties of macaroni wheat already mentioned. In computing these averages we have included the *poorest* as well as the *best* results obtained at this Station both in 1901 and 1902, and also the results obtained at the Mellette station:

No.	Name	Yield per Acre bu.	lbs.
5351	Berdiansk	22	28
5352	Novo-Rossisk	14	17
5353	Algerian	15	12
5354	Argentine	21	43
5355	Taganrog	24	5
5380	Pellissier	24	13
5492	Medeah	19	22
5642	Yellow Gharnovka	19	21
5643	Gharnovka	18	46
5645	Black Don	19	34
5646	Gharnovka	17	1
5800	Beloturka	15	33
	Average	19	18

A great many more figures might be given, but as this is

intended merely as a preliminary bulletin, and as the only point we now seek to make is that macaroni wheat will yield from 25 to 100 per cent more than the ordinary bread wheats under the same conditions, we will not burden the reader with them at this time.

CONCLUSIONS CONCERNING THE ADAPTABILITY OF MACARONI WHEAT TO CONDITIONS IN SOUTH DAKOTA

It is believed that the foregoing facts have proved beyond a question of doubt that macaroni wheat of excellent quality can be raised in nearly all parts of South Dakota. It is also believed that the fact has been established that macaroni wheat will yield from 25 to 100 per cent more than the best bread wheats under ordinary conditions. The evidence at hand also leads to the conclusion that macaroni wheat does much better, as compared with bread wheats, during dry and otherwise unfavorable seasons than it does under more favorable conditions. We believe that we are safe in drawing the conclusion that macaroni wheat can be raised in any county east of the Missouri River under the most unfavorable conditions that have ever been experienced in the history of the state. It is not to be understood that a large crop could be raised under such conditions, but there is good reason for believing that farmers could raise enough of this grain to supply them with flour for family consumption and with seed for the following year.

It ought not to be necessary to say that this Station has no interest in encouraging the growth of macaroni wheat, except in so far as it is to the interest of the farmers of the state to do so. All of the reports from co-operators that have been received up to the time of going to press have been reported. A considerable number of co-operators have not yet made reports, but as the full list of co-operators is given, any one interested in the subject may write to them, and it is believed that most of them will gladly give more detailed infor-

mation if it is desired. Only one of the co-operators has so far refused to give information unless he was paid for it. It is believed that this party enjoys the proud distinction of being the only one of his class in the state, and that the rest of them will gladly furnish any information that will be of value to the farming interests of the state.

We do not feel that we have sufficient information at present to enable us to decide as to the relative merits of the various varieties. The work is being carried on as rapidly as possible and it is altogether probable that in a few years we will be able to give some very definite and valuable information concerning the best varieties for the various localities in our state. The question of resistance to rust, the liability to shatter or lodge are being carefully worked out. The results of these experiments will undoubtedly be of great value when definite results have been obtained.

There seems to be some difference of opinion among co-operators as to the best amount of wheat to sow per acre, but the concensus of opinion seems to be that somewhat heavier seeding is desirable than with the bread wheats. Some farmers advocate as high as two bushels per acre, while others consider five pecks sufficient. It is probable that an amount ranging between these extremes will be found best for most localities in the state. It is probable that any soil in this state well adapted to the growing of bread wheats is equally well suited to macaroni wheats. Good farming is as desirable for the raising of macaroni as of bread wheat.

THE MARKET FOR MACARONI WHEAT, PRESENT AND PROSPECTIVE

The question of a market for macaroni wheat is manifestly not a local one and therefore does not come as strictly within the province of the Experiment Station as the other problems under consideration. One of the important factors in this problem is the securing of a foreign market. The United States Department of Agriculture has been at work for several

years along this line and all of the reports from the department touching upon this subject are very favorable. Large quantities of macaroni wheat are imported into France, Italy and other European countries. These supplies are now largely obtained from Russia, but it is believed that the United States can successfully compete with Russia in the growing of macaroni wheats, as she does in the growing of bread wheats. Considerable quantities of goose wheat have been imported into European countries from Canada in the past, although it is known that this goose wheat is not equal to the macaroni wheat now being produced in South Dakota. The manufacture of macaroni, spaghetti, noodles and like products in this country is of far greater magnitude than is generally realized by the farmers of this country. These manufacturers have scoured the country in the effort to obtain all of the goose and macaroni wheat available, and have never yet been able to obtain as much as they have needed for manufacture. The result has been that they have been compelled to use the ordinary bread wheats, although they all agree that the products from the bread wheats are decidedly inferior to those from macaroni wheats. When the manufacturers of macaroni in this country are able to obtain all the macaroni wheat they need, they will be able to turn out a product that can successfully compete with the imported article. This will undoubtelly lead to an increase in the output from the present macaroni factories and the organization of new ones. A superior quality of American macaroni will also enable the American manufacturer to compete in the foreign markets with macaroni of European manufacture.

Macaroni wheat is now recognized and given a grade in the Minneapolis grain market and is being bought by some of the elevator companies. The Van Dusen Elevator Co. is one of the buyers operating extensively in South Dakota that is now buying macaroni wheat.

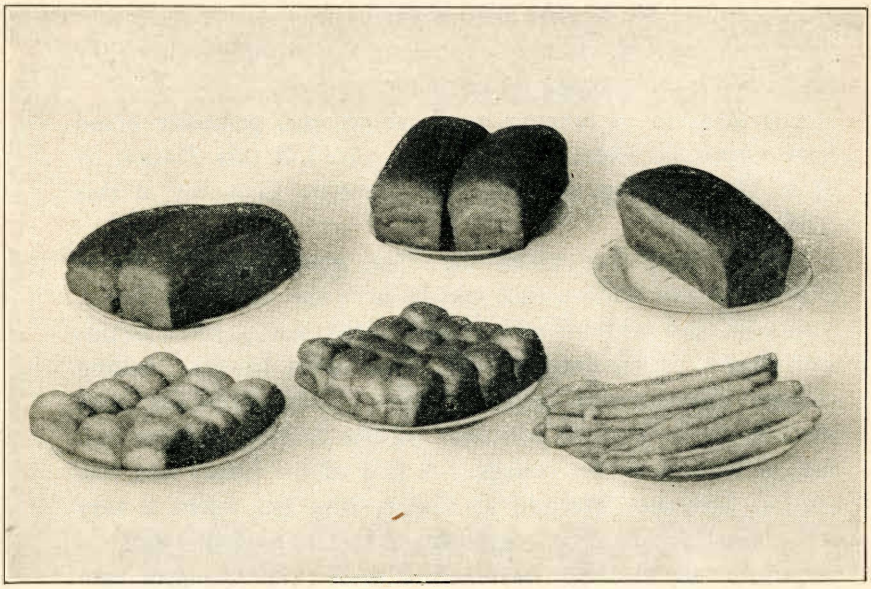
There will undoubtedly be an active demand for macaroni wheat for seed in this state during the present winter and

coming spring. Whether there will be a sufficient supply within the state to meet this demand or not we cannot say, but it certainly would not be advisable for any one having macaroni wheat of good quality to dispose of it at less than the market prices for bread wheat, until seeding time is past.

Whether there is danger of a larger amount of macaroni wheat being produced during the season of 1903 than can find a ready market at good prices is a difficult question to answer. Like all questions of crop production, so much depends upon climatic conditions and other factors of a somewhat uncertain nature, that it is hard to foresee just what the conditions are likely to be during the fall of next year. While it seems certain that the demands before mentioned exist, it it is not so easy to determine just how long it will take for the various interests that lie between the producer and the consumer to get in perfect touch with each other.

After considering the problem in all its various phases it would seem that the farmers of this state will not be taking any unwarranted risk in growing considerable quantities of macaroni wheat during the coming season. It would probably not be advisable for them to devote their entire farms to the raising of macaroni wheat; but it does not seem that a farmer would be taking any great risk in devoting a small portion of his farm to this crop. If there should not be a market for the product at threshing time he could store it; and if no market could be found during the winter or spring the wheat on hand would undoubtedly be worth all it cost to grow it, if it were ground and used for feeding stock.

In the founding of a new industry in our state it seems necessary that the farmers should do more than demonstrate the fact that they can raise macaroni wheat of good quality. They must show that they *actually have raised it* and have it on hand ready to supply the manufacturer and exporter of this grain in such quantities as the market may demand. When this condition is realized, it is confidently believed that the market will come to us, and not before.



BREAD ROLLS AND BREAD STICKS FROM MACARONI FLOUR

THE VALUE OF MACARONI WHEAT FOR BREAD MAKING

As stated in another part of this Bulletin, goose wheat has been known in this country for thirty-five years or more, but it was generally believed that it could not be ground into good flour with the ordinary machinery used for grinding the bread wheats, and if ground into flour, that flour could not be made into good bread. This Station has demonstrated the fallacy of both of these ideas.

This Station has a small roller mill used for grinding wheat in small quantities, but built upon substantially the same principles as those used in larger flouring mills. We have been able to produce flour of excellent quality from macaroni wheat grown at this Station, and we are convinced that any flour mill fitted with machinery to produce good flour from bread wheat can grind macaroni wheat without any extensive modifications of their methods. In fact there are now several mills in Minnesota and North Dakota that are grinding mac-

aroni wheat. As soon as the millers of this state realize that there is a demand for macaroni flour the prejudice that they now have against goose wheat will disappear.

The problem of making good wholesome, palatable bread from macaroni wheat has also been solved at this Station by Mrs. Alice Feuling, professor of Domestic Economy at this college.

Mrs. Feuling has taken the flour ground by Professor Shepard in our station mill and from it she has made bread, both with and without milk, bread sticks, rusks, rolls, braids and twists, raised muffins, sally lunn, soda biscuits, baking powder biscuits and griddle cakes. These products have been tested by various members of the faculty, station staff and by visitors at the college. A loaf of the bread was also sent to Governor Herreid at Pierre, who has taken a very active interest in the development of this important industry. All of the parties who have tested these products have pronounced them excellent.

The following letter from Governor Herreid gives his opinion:

State of South Dakota—Executive Chamber, Pierre, November 19, 1902.

Alice Dynes Feuling, Professor of Domestic Science, Agricultural College, Brookings, S. D.:

Dear Madam: On my return from a hunting trip in the woods of northern Minnesota I found your favor of the 6th inst., and also the package containing a loaf of bread made from macaroni wheat flour. This bread was sampled by Mrs. Herreid and myself, as well as several others, at the hotel last night and this morning, and we all agree that you have succeeded admirably.

I consider this a matter of great importance, and believe that the public should be made acquainted with what you have accomplished.

Thanking you for being kindly remembered and congratulating you upon your success, I remain

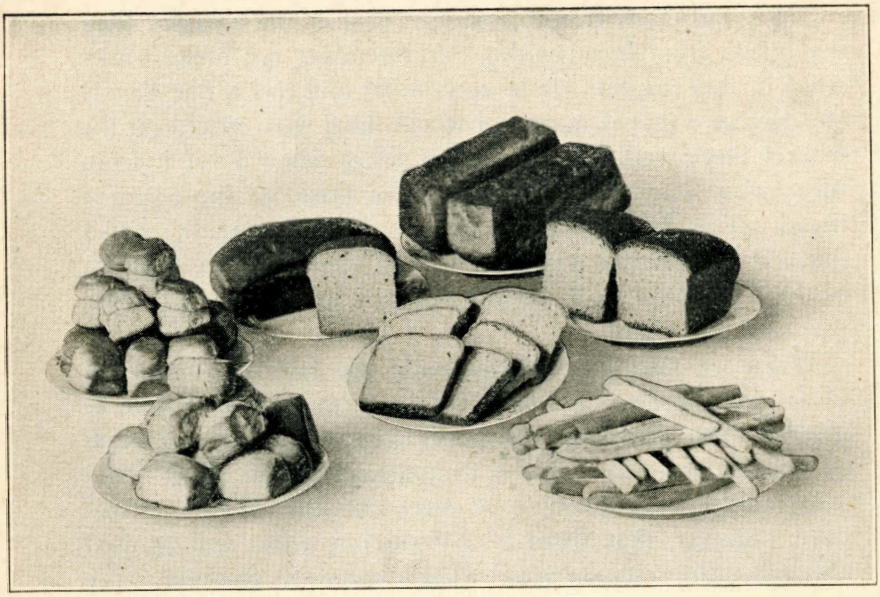
Very respectfully yours,

(Signed) CHARLES N. HERREID.

The bread made from macaroni wheat is much darker than that made from bread wheat. It resembles rye bread somewhat in this respect. It is very sweet and has a fine flavor. We feel sure that if macaroni wheat flour were placed on the market there would at once be an active demand for it from those who would prefer the macaroni bread to the common bread. This bread is much more nutritious than the bread made from ordinary wheat, as will be seen from the analyses of the flour made by Professor Shepard, and given in another part of this Bulletin.

When we take into consideration the fact that macaroni wheat may be depended upon by the farmers of this state to provide them with flour for family consumption during years of drouth, the value of the demonstration that good bread can be made from it cannot be overestimated. We do not believe, however, that bread from macaroni wheat will be used only when the common bread wheats cannot be obtained. We believe that macaroni bread will eventually become one of the staple articles of food among not only the farmers of the northwest, but among many others who will use it because they prefer it to the common bread.

Below are given some recipes and directions furnished by Mrs. Alice Dynes Feuling. The accompanying cuts need no explanation except possibly to call the attention of the reader to the lightness of the bread as shown by the cut of the loaf in section.



BREAD ROLLS AND BREAD STICKS FROM MACARONI FLOUR

MACARONI WHEAT FLOUR BREAD

RECIPE (MAKES FOUR LOAVES)

4 cups tepid water.
12 cups flour.
2 cakes compressed yeast.
2 teaspoonfuls salt.

DIRECTIONS FOR MAKING

Dissolve the yeast cakes in one cup of the tepid water, add the salt and the remainder of the water; stir in gradually six cups of flour and beat rapidly for five minutes. Add more flour to make a stiff dough and mix well. Put the remainder of the flour on the kneading board, turn out the dough and knead till it springs back in the hands (about 30 minutes). When thoroughly kneaded put in a covered bread pan and set in a warm place to rise. Allow it to double in size, then turn out on the board, divide into four equal portions and knead each portion rapidly and form into a loaf. Put the loaves into well buttered tins, rub a little melted butter over the top of

each loaf, cover and return to their warm place to rise again. When the loaves have doubled in size they are ready to bake. Much depends upon the baking of this as well as of any bread. Have the oven in the same condition as for white bread during the first fifteen minutes, or during the time the bread rises, then lower the heat gradually and let the last part of the baking be done at a low temperature. The bread should bake one and one-half hours if made in pound loaves, or one-half hour longer than white loaves of the same size. When baked, turn the loaves out of the tins and allow them to cool before putting away.

MILK BREAD

Use the above recipe, substituting two cups of milk for the two of water. That is to say, use one-half milk and the other half water. The bread made with milk is closer grained than that made with water.

BREAD STICKS

(To be eaten with soups, tea or coffee)

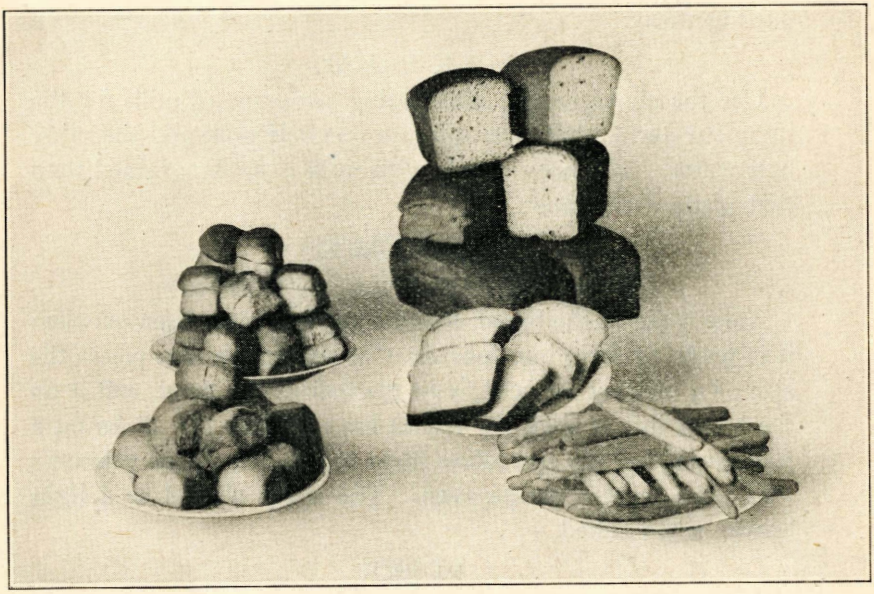
Take some of the bread dough after it is once risen or when it is ready to form into loaves. Cut the dough into pieces the size of a hickory nut and, with the ball of the hand, roll it on the board into a stick six inches long. Place the sticks on a *floured* baking tin and allow them to rise for fifteen minutes; then bake in a moderate oven. The sticks should be a light brown when baked.

RUSKS

Take enough dough to make one loaf of bread according to the above recipe and to it add two pounds sugar, one egg (well beaten), and one tablespoon of butter (melted). Mix the sugar and butter and add the beaten egg. Work the mixture into the dough until it is smooth. Knead rapidly for fifteen minutes, form into rusks of the desired shape, place closely together in a baking tin and set in a warm place to rise. When *very* light, brush the top lightly with sweet cream and sprinkle with dry sugar. Bake in a hot oven for forty minutes.

ROLLS

Take enough dough for one loaf and roll it out on the board. Spread over this dough two tablespoonfuls of butter, melted. Fold the dough and roll again to mix in the butter. Continue folding and rolling until the butter is absorbed by the dough. Cut bits of the dough half the size of an egg and form into rolls with the fingers. Place in a well buttered tin, brush the tops with melted butter and allow to rise till very light. Bake in a quick oven twenty minutes.



BREAD ROLLS AND BREAD STICKS FROM MACARONI FLOUR

DOUBLE ROLLS

(See Cut)

Use the recipe for rolls and, when ready to shape for baking, divide the dough into two equal portions. Roll each portion three-fourths of an inch thick. Butter one portion, cut into rolls and place in the tin, buttered side up, without crowding; then cut the other portion and place one of the rolls

last cut upon each of the buttered rolls in the tin. Press lightly together, cover and allow them to rise to double their size. Bake in a moderate oven thirty minutes.

BRAIDS AND TWISTS

These are made like the bread sticks and braided or twisted together into fancy shapes. Three or four pieces braided together with the center of the braid wider than the ends gives a satisfactory result. Two pieces twisted together, brushed with cream and sprinkled with sugar, are used to eat with coffee or tea.

RAISED MUFFINS

Use any good recipe, omitting the sugar and using only one-half the butter called for in the recipe.

SALLY LUNN

(Served for Tea or Supper)

RECIPE

2 cupsfull of tepid water.
1 pound of butter.
1 teaspoonful salt.
1 teaspoonful sugar.
3 eggs.
1 cake compressed yeast.
3 cups flour (about).

DIRECTIONS

Dissolve the yeast in the water, add salt, sugar and melted butter. Stir in the flour gradually until the batter is very stiff. Beat five minutes. Cover and set in a warm place to rise. When light add the well beaten yolks of the eggs, mix thoroughly, and lastly add the well whipped whites. Beat lightly and turn into a well buttered cake tin; bake in a quick oven.

SODA BISCUIT

RECIPE

1 cup sour milk.
1 cup sour cream.
1 teaspoonful salt.

1 teaspoonful soda.
2 teaspoonfuls baking powder.
4 cups of flour (about).

DIRECTIONS

Handle as little as possible and work rapidly. Put the baking powder and salt in the sieve with the flour and sift. Add the soda (dissolved in a tablespoonful of hot water) to the milk and cream. Stir and add the flour gradually, keeping the paste smooth. When enough flour is added to make a stiff dough place it in spoonfuls on a floured tin and bake twenty minutes in a hot oven.

The biscuits may be rolled out on a floured board and cut if preferred.

BAKING POWDER BISCUITS

Use recipe for soda biscuits, substituting sweet milk and cream for sour milk and cream, and omitting the soda.

GRIDDLE CAKES

2 eggs.
2 cups sour milk.
1 teaspoonful soda.
2 teaspoonfuls baking powder.
1 teaspoonful salt.
Flour to make a thin batter.

Beat the eggs, add the baking powder and salt to a cup of flour and sift. Add the soda (dissolved in one tablespoon of hot water) to the sour milk. Then add the beaten eggs, and lastly the flour gradually until a thin batter is formed. Bake on a soapstone griddle or on a greased iron griddle like buckwheat cakes.

Stale macaroni wheat flour bread may be used in several dishes which are palatable and nutritious, among which are steamed bread, toast served in many different ways, and dextrinized bread crumbs.

DEXTRINIZED CRUMBS

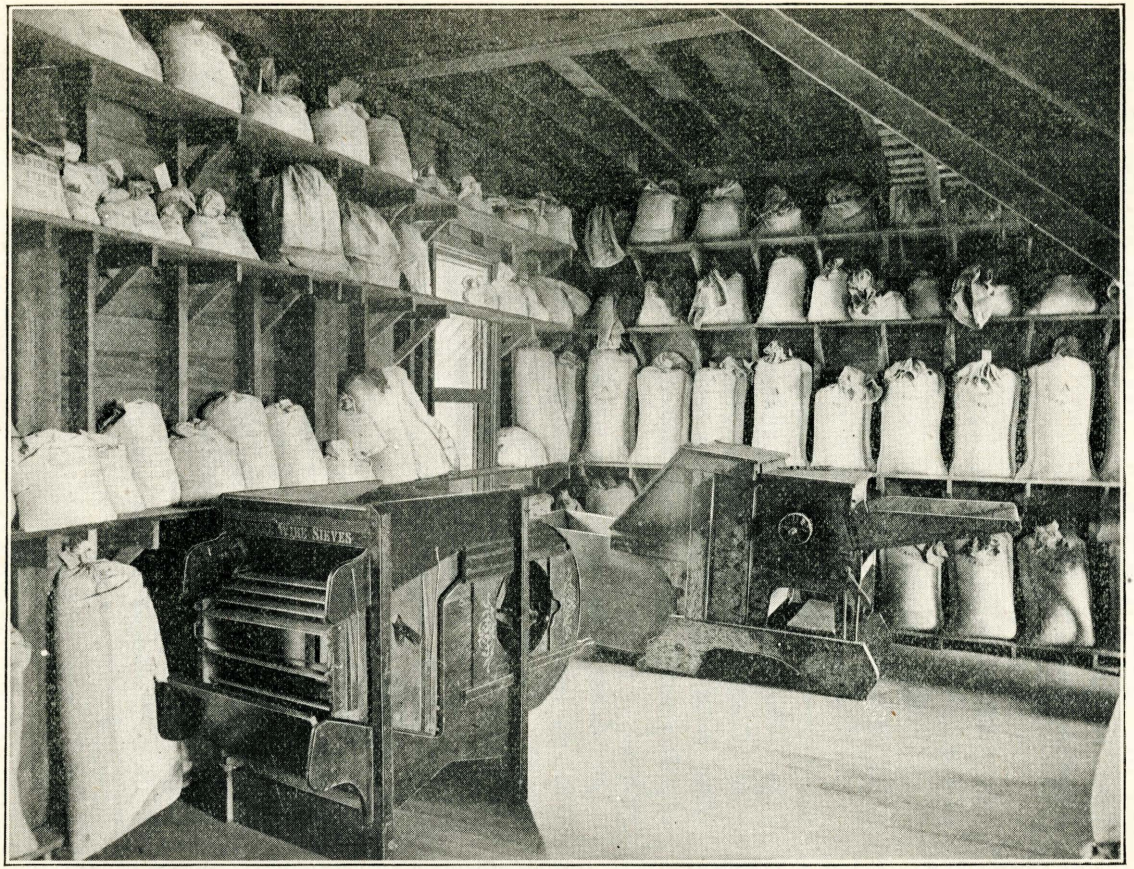
Place the stale bread in a tin and allow it to remain in a slow oven until it is dry and browned throughout. Place on

a board and roll until finely pulverized. Place in a closed jar for use. Eaten with milk these crumbs take the place of the bread in the "bread and milk" dish given to children, and are palatable and nutritious.

POINTS TO REMEMBER

1. All measures given in these recipes are stroke or even measure..
2. Follow the recipe and directions in every particular.
3. Mix the ingredients well before kneading.
4. Knead thoroughly and rapidly for about thirty minutes, using only enough flour on the board to prevent sticking.
5. This bread rises quicker than white bread.
6. Compressed yeast causes the bread to rise quicker than other yeast, but dry yeast may be used in the same manner. If soft yeast is used add one-half cup more flour to the above recipe.
7. Measure the ingredients, *never guess* at the proportions.
8. In kneading, avoid breaking into the dough with the fingers. Knead lightly with the ball of the hand and use the fingers only in drawing over the dough. This kneading soon forms a smooth crust which enables the worker to knead without dusting flour on the board. Much kneading gives a fine grained loaf.
9. Do not allow the bread to become chilled before baking.
10. In baking, have the oven in the same condition as for white bread, but after the loaves rise the heat should be gradually lessened, and during the last half hour the oven should be just warm enough to continue the baking, not hot enough to burn the crust.
11. All recipes call for *macaroni wheat flour only.*

ALICE DYNES FEULING.



A CORNER IN THE SEED HOUSE

THE CHEMICAL AND MILLING PROPERTIES OF MACARONI WHEAT

JAMES H. SHEPARD, DEPARTMENT OF CHEMISTRY

When this Station undertook the testing and propagation of different varieties of macaroni wheat in the field, the Department of Chemistry also commenced a series of chemical investigations looking towards the nitrogen control of the wheat experimented upon. While the work is by no means complete nor the series so extended as might be desired, nevertheless a short statement at this time showing the direction in which facts seem to be pointing, would certainly not come amiss.

In the season of 1890 the Bureau of Plant Industry, United States Department of Agriculture, sent the writer two varieties of macaroni wheat for the purpose of propagating them upon a commercial scale. The seed thus obtained from this importation was used by the Bureau of Plant Industry in further introducing these wheats into the northwest. Without going into many of the details it will suffice to cite some facts obtained from one variety of this macaroni wheat, namely, the Kubanka.

It is a well known fact that the superiority of foreign macaroni depends upon its high content of nitrogen, or crude protein. The first problem then was to ascertain whether these foreign wheats when grown upon our South Dakota soil would continue to carry this high nitrogen content. Accordingly the original Kubanka seed was analyzed, giving a protein content of 14.1 per cent. This seed was sown and in the season of 1901 produced a good quality of wheat, yielding a protein content of 18.8 per cent, thus showing a gain of 4.7 per cent by growing on our South Dakota soil. It is true that the grain was slightly shrunken, but this would not account for the whole protein gain. The seed obtained in 1901 was sown again in 1902. Now the year of 1902, as well known to all wheat growers, was a most unfavorable year for macaroni wheat. There was too much moisture and not enough dry and hot weather to suit the requirements of this crop. Nevertheless it gave a protein content of 13.9 per cent.

In this connection it might be well to say at this point that our investigations have shown that the nitrogen content of all wheats are liable to vary from year to year. If, however, we take an average for this Kubanka wheat during the two years it will show a gain over the original imported seed. When this series has been extended to four or five years it is hoped that a definite conclusion as to results may be obtained. At the present time, however, it seems as if there need be no fear of the deterioration of the ntirogen content of our South Dakota grown macaroni wheats.

The next important question which would now arise would be, how would macaroni made from our Dakota grown macaroni wheat compare with the best foreign article imported into the United States. While extensive work has not been done along this line, nevertheless a test to which the Foulds Milling Co. of Cincinnati, Ohio, has subjected this question is very interesting at this point. In the season of 1901 they sent the writer four unknown varieties of macaroni marked A, B, C and D, with a request that an analysis be made. Complying with this request the analyses were made and forwarded to the company at Cincinnati, who upon their receipt reported as follows:

Sample A was made from Arnautka macaroni wheat obtained from Lisbon, N. D. This gave a crude protein yield of 16.5 per cent in the water free substance. There is no certainty that this wheat was not mixed with bread wheats, which would lower the protein content.

Sample B was made from Kansas wheat, called "Hard Turkey red." This gave a protein content of 11.5 per cent.

Samples C and D were two of the best imported brands of different manufacture. The analysis showed 16.5 per cent and 22.2 per cent. In this connection it might be well to state that this firm advised the writer that their best brands of goods are now manufactured from Dakota grown macaroni wheat. These facts are all pointing toward one conclusion, namely, that macaroni made from Dakota grown macaroni wheats will equal the best imported varieties. Another interesting

point is brought out also, and that is the domestic macaroni made from our bread wheats are recognized by the trade and by consumers as inferior to the best imported varieties of macaroni. The cause of this inferiority is plainly due to the low protein content.

There seems to be a large amount of misapprehension in regard to the milling properties of macaroni wheat. All sorts of rumors have been set afloat by writers for the press who were certainly not familiar with the facts concerning which they were writing. In order to test the milling varieties of wheat grown at this Station, a complete roller mill of small size with bolting sieves and silks, together with the necessary motor power, has been installed by this Station. With this milling outfit, which resembles a roller mill in miniature, some useful and interesting data have been obtained. Among other things which have developed is the fact that macaroni wheats offer no especial difficulties in milling. It is true that the macaroni wheat grains are harder and require more power for their reduction than the ordinary bread wheats. Other than this no difficulty will arise in their reduction. In case, however, an ordinary bread wheat mill is to be changed for making macaroni flour, or semolina, slight modifications in the bolting silks might be of advantage, and also the addition of a special machine for separating the different grades of semolina.

By means of this small reduction mill I have found it possible to make a quantitative determination of the mill products obtained from the various samples. For instance, this same sample of Kubanka gave, bran 6.38 per cent, shorts 20.83 per cent, flour 71.54 per cent. From the flour obtained from this same Kubanka wheat the baking tests herein reported were made by the department of Domestic Economy in this institution.

As a matter of further information the protein content of the different mill products has been obtained. I have found that the bran of this Kubanka wheat contained of crude protein 16.3 per cent, the shorts 17.4 per cent, and the flour 16.9

per cent. An inspection of the protein content of the bran and shorts indicates another promising feature for macaroni wheat culture, that is its feeding value. There is one thing certain, the refuse mill products with a nitrogen content of 16 per cent will certainly be welcomed by stock feeders everywhere, and then again the day may not be far distant when stock men of the northwest will turn to macaroni wheat as a source of crude protein for their balanced rations. Experiments are now under way at this Station to test the feeding value of macaroni wheat with sheep.

One thing seems certain, owing to the widely diversified uses to which macaroni wheat can be put, the farmer runs little or no risk in growing it. In case so much has been produced that the home consumption of the macaroni flour and semolina does not consume the entire yield, which, by the way, is not likely to happen for some years to come, the farmer still has two channels through which he may find an outlet for his crop. First, it may be exported, or second, he may put it to better use by feeding it to stock at home.

Among other determinations which are now being made on different varieties of wheat grown at this Station, the amount of gluten is being determined. This same sample of Kubanka wheat gave of wet gluten in the flour 54.8 per cent, and of dry gluten 18 per cent. The difference between the wet and dry gluten shows the water holding power of the macaroni flour to be all that could be desired.

In conclusion, it is the opinion of the writer that the introduction of this new crop for the farmers of the northwest is wholly commendable. Not only is macaroni wheat a larger yielder than ordinary wheat, but it is the surer crop and will give fair returns when other wheat fails. But pure seed only should be sown and care exercised to avoid an admixture of bread wheats, which would lessen the protein content and lower the value of the mill products obtained from the mixed grain.