With the compliments of the Author.

# SEED WHEAT

. . BY . .

N. A. COBB.

*Published by Authority of the*

GOVERNMENT OF THE STATE OF NEW SOUTH WALES.



SYDNEY, 1903.

## BY THE SAME AUTHOR.

1. **List of Plants found Growing Wild within 30 miles of Amherst.**
   51 pages—in Atlas of Hampshire County, Mass., 1887.
2. **List of Plants.**
   Separate edition, S. E. Bridgeman & Co., Northhampton, Mass., 1887.
3. **Beitrage zur Anatomie und Ontogonie der Nematoden.**
   36 pages, with 32 original illustrations on 3 lithographic plates Jenaischen Zeitschrift für Naturwissenschaft, XXIII Bd., N.F. XVI, 1888.
4. **Inaugural-Dissertation zur Erlangen der Doktorwürde.**
   Gustav Fischer, Jena, 1888. Same as the above.
5. **The Differentiator.**
   Sydney, 1889. Reprint in *American Naturalist*, Philadelphia, 1889.
6. **Report on Occupation of the Table of the British Association at the Naples Zoological Station.**
   Report of the British Association, London, 1889.
7. **Neue parasitische Nematoden.**
   3 pages, with 9 original illustrations on one plate. Archiv für Naturgeschichte, Berlin, 1889.
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11. **Reprint of the above.**
    Department of Agriculture, Sydney, 1890.
12. **Contributions to an Economic Knowledge of the Australian Rusts (Uredineæ).**
    In course of publication. So far issued, 154 pages, with 303 original illustrations in the text, and 1 plate. *Agricultural Gazette*, Sydney, 1890–94.
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17. **Pathological Notes.**
    2 pages, with 4 original illustrations in the text. Disease of lucerne. *Agricultural Gazette*, Sydney, 1891.
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    Department of Agriculture, Sydney, 1891.
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    11 pages. *Agricultural Gazette*, Sydney, 1891.
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26. **Smuts.**
    Separate and enlarged with more illustrations. Department Agriculture, Sydney, 1891.
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    Reprint in *The Annals and Magazine of Natural History*, London, 1891.
31. **Pathological Notes.**
    Diseases of maize and the apple. *Agricultural Gazette*, Sydney, 1891.
32. **Notes on the Diseases of Plants.**
    Diseases of the apple, pear, peach, and flax. *Agricultural Gazette*, Sydney, 1891.
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    Department of Agriculture, Sydney, 1891.
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    2 pages, with 2 original illustrations in the text. *Agricultural Gazette*, Sydney, 1891.
36. **Notes on the Diseases of Plants.**
    9 pages, with 8 illustrations (mostly original) in the text, and one plate with 2 illustrations. Diseases of the potato, onion, tobacco. *Agricultural Gazette*, Sydney, 1891.
37. **Reprint of the above.**
    Department of Agriculture, Sydney, 1891.
38. **Devastating Eel-worm.**
    5 pages, with 7 original illustrations in the text. *Agricultural Gazette*, Sydney, 1891.
39. **Devastating Eel-worm.**
    The above with 2 additional illustrations. Department of Agriculture, Sydney, 1891.
40. **Plant Diseases, and How to Prevent them.**
    28 pages, with 30 original figures in the text, and 7 figures on 4 plates. Diseases of the apple, pear, apricot, grape, rose, strawberry, pumpkin, cabbage, and turnip. *Agricultural Gazette*, Sydney, 1892.
41. **Miscellaneous Publication, No. 12,**
    Department of Agriculture, Sydney, 1893, is a reprint of the above.
42. **Notes on the Diseases of Plants.**
    2 pages. Disease of the orange. *Agricultural Gazette*, Sydney, 1892.
43. **Plant Diseases, and How to Prevent them.**
    14 pages, with 25 original illustrations in the text, and 2 original illustrations on one plate. The diseases "Take-all," and "Dry Blight." *Agricultural Gazette*, Sydney, 1892.
44. **Reprint of the same.**
    Department of Agriculture, Sydney, 1893.

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# Seed Wheat:

## AN INVESTIGATION AND DISCUSSION OF THE RELATIVE VALUE AS SEED OF LARGE PLUMP AND SMALL SHRIVELLED GRAINS.*

BY N. A. COBB.

### Introduction.

ALL the remedies we devise for the alleviation of crop diseases are but so many acknowledgments of the existence of disease.

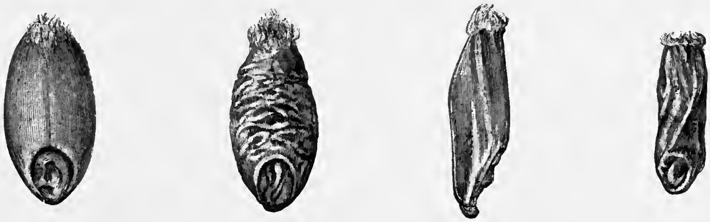
Our greatest hope is for the production of disease-resistant varieties. These will be resistant through certain constitutional characteristics.

Next in importance to such constitutional characteristics is the maintenance throughout the life of the plant of vigorous growth. This involves health and strength from the very start. The seed must be good, and the seedling strong, if the best results are to be secured.

Manifestly one of the main elements in the production of a strong seedling is a strong sound seed. In all annual crops, such as wheat, this question of strong sound seed is an ever recurring one, and one that requires careful attention. Nevertheless, it is frequently neglected. It is so much neglected that I am of the opinion that the losses caused by the diseases from which such crops suffer would be very materially lessened if we could bring the average of our seed up to the point actually found profitable by, say, the best fourth of our farmers.

The following pages present the results of an inquiry into the state of our seed wheat, with the object of defining the extent to which it is practicable to add to the vitality of our wheat crops through more careful attention to the seed.

The quality of our seed wheat is looked at here only in the light of a single test, namely, the relative amount of small and



A B C D

**Fig. 1.**—Four grains of wheat showing varying condition—A, plump; B, slightly shrivelled: C, shrivelled; D, much shrivelled; enlarged four diameters.

shrivelled seed and useless or deleterious matter to be found in the sample tested. Needless to say a better test would have given more

* This investigation was suggested by the Interstate Wheat-rust Conference. Two related investigations are reported in the published proceedings of the Conference. The present report differs from previous ones in being the result of several years' field work on an extended scale, with the object of arriving at average figures that might be made the basis of definite rules for practice.

valuable results. The test applied has the merit of having a proved relation* to the amount of the resulting crop, as well as that of being easily applied.

I cannot help feeling that a number of people will, at first glance, regard any effort to prove the lower value of small grains as seed to be rather in the nature of an effort to kill a dead horse. Still I find it impossible to disclaim the necessity of harping on this subject so long as there exist among us advocates of the use of such seed, and, above all, so long as it can be shown that our practice is as far below what it ought to be as it is at present.

So long as it can be shown in the manner here adopted that the bulk of our wheat growers are using seed of a quality no higher than that disclosed by these examinations, there will exist the disagreeable necessity on the part of our leading lights to keep on pointing out the

3·25 3·00 2·75

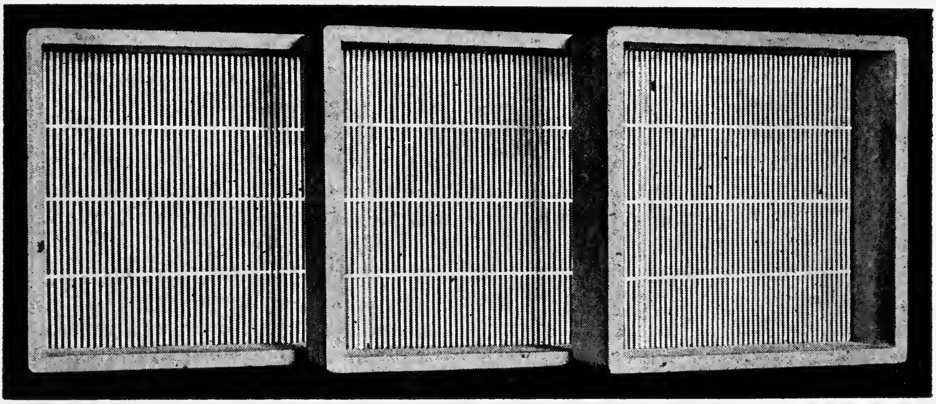


Fig. 2.—Three sieves with meshes of three different widths, from 3·25 millimetres to 2·75 millimetres; shown about one-tenth natural size.

fact. It seems to me that our agricultural officers of all kinds, and especially the teachers in the agricultural schools, should keep the facts of the case prominently before growers and intending growers.

This can be done at the schools and colleges through passages in lectures, and even more forcibly by ocular demonstration year by year through the growth side by side of plants derived from small, medium-sized, and large seed. Object lessons of this kind have an exceedingly high value if used in the right way—far higher than is generally realised. Both students and visitors will, from such continuous annual demonstrations, be more strongly impressed than through almost any other means.

For several years demonstration plots of this nature were grown at the Wagga Farm, and they were inspected, first and last, by thousands of people. Side by side were to be seen rows of plants grown from large, medium-sized, and small grains. In each season these were to be seen growing on varying soil, and exemplified in the most diverse

* The proof is presented in the second part of this report.

varieties of wheat. They were indeed eloquent and convincing, though silent, arguments against the use of anything but large and plump seed.

To this day growers of a conservative type have not ceased to tell me that these little demonstration plots were the means of opening their eyes to the fact that the extra number of seeds in a bushel of pinched wheat was not all that had to be taken into consideration in connection with the comparison of large and small grain for seed purposes, and that further trials have convinced them of the advisability of using the large grains for seed.

This is not to be wondered at, for no one could fail to see, if he examined the demonstration plots with care, that the plants from large and plump seed were not only larger but healthier and more resistant

2·50 2·25 2·00

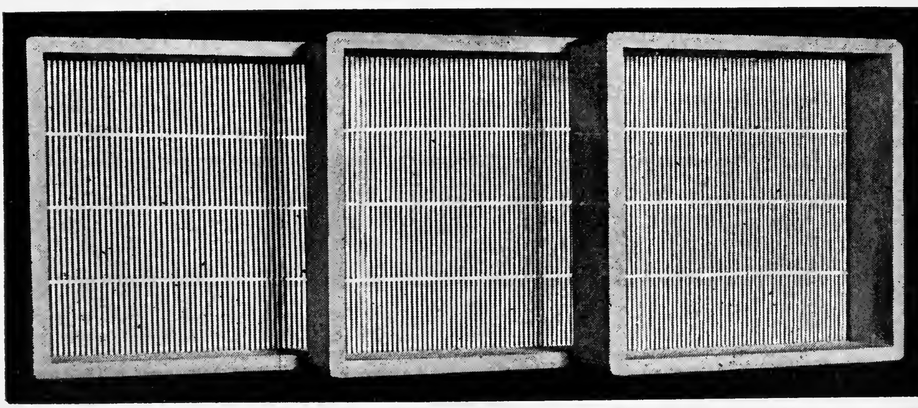


**Fig. 3.**—Three sieves of varying mesh from 2·50 millimetres to 2·00 millimetres; shown about one-tenth natural size.

Figures 2 and 3 show the kind of sieves used in testing the quality of seed-wheat for this report. The sieves are made from "half-round" brass wire, placed with the flat side down. They were specially made with accuracy.

to all adverse conditions. They suffered less from disease if disease appeared, and they more readily surmounted the difficulties placed in their way by bad patches of soil or by scanty rainfall.

Rev. E. E. Hale, consoling with one too sensitive about unfavourable comments in the public prints, remarked that of all the people who saw the print not half would see the item in question; and of those who saw it, half would not read it; and of the half that read it, half would not understand it; and of the half that understood it, half would forget; and that under such a haphazard process the ones that remembered probably would not amount to much any way.

It is some such thought as this that leads me to emphasise the advisability of demonstration plots at our colleges and farms and wherever else we can present them. I fear that experts are terribly prone to over-estimate the number of people that read their lucubrations, and if these be sifted according to Dr. Hale's keen-witted method it will be seen that our printed teachings stand in need of all the reinforcement possible.

## I.—Our Seed Wheat.

The differences in yield arising from the use of seeds of different sizes,* and the consequent gain to farmers through the proper grading of seed wheat so as to secure for seed only that which is best, led to a desire to ascertain the precise quality of the seed wheat being used in this State. Accordingly arrangements were made for collecting samples in various parts of the State at sowing time, the samples to be as far as possible the ones actually being sown.

The task of collecting these samples was entrusted to Mr. E. D. Butler, and it was carried out carefully and systematically—several hundred samples being collected, to each of which was attached a statement showing the locality in which it was being sown, by whom it was being sown, and the name of the variety. Each sample consisted of about five pounds of grain, though in some cases there was somewhat less, and in a few cases more.

These samples were graded in the same manner as the samples that were used as the basis of the article entitled "The Grading of Wheat," published in the *Agricultural Gazette*, Vol. VIII, p. 855, that is to say the December number, 1897. The same sieves were again used, and the sizes of the grain were the same as then secured, and similar illustrations were again prepared as the result of these siftings. It is, therefore, sufficient to allude to the methods then used; and to reproduce here some of the illustrations prepared in explanation of that article. *See* Figs. 2, 3, and 4 to 10. I was careful to use as far as possible the same methods as before, in particular because it was from similar gradings that various sized seeds were obtained for the experiments made to ascertain precisely what are the relative yields from large and small seed growing under similar conditions for a series of years; experiments whose results are presented in the second part of this article.

3·25 3·00 2·75 2·50 2·25 2·00 Tailings.

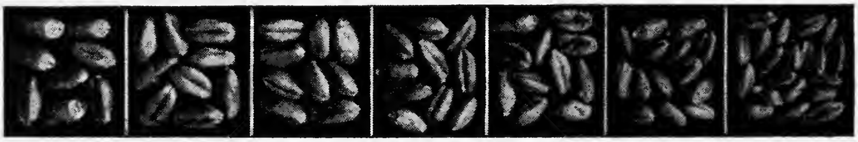


Fig. 4. Fig. 5. Fig. 6. Fig. 7. Fig. 8. Fig. 9. Fig. 10.

Figures showing the actual size of the grains belonging to each grade yielded by the sieves shown in Figures 2 and 3. The proper grade numbers are placed above each illustration.

An attempt is made in the above illustrations to show the sizes of the grains that result from the grading done with the sieves shown in Figures 2 and 3, but these illustrations are somewhat deceptive because of the nature of the wheat grain. If the reader will examine a shrivelled grain, such as is figured at C, D, Fig. 1, he will at once remark the fact that its outline is large in proportion to its actual weight. This is owing to the shape and structure of the wheat grain, a shape that prevents it from being so placed with reference to the observer that its contour will adequately represent the loss of substance due to shrivelling. The actual differences in size are also obscured by the assemblage of the grains. If the reader will bear these facts in mind in looking at the above seven illustrations, he will derive a more correct impression. Grains of these seven sizes are also shown in Figs. 14, 20, 21 and 22. The actual variation in the size of the grains derived from a single ear of wheat is well and accurately illustrated in the woodcut, Fig. 11, which was prepared with great care to illustrate this point.

Of course the sizes of the meshes here used in the sieving are purely arbitrary, but they are the result of considerable study of the question of the range of variation in the grain of wheat, and, in the absence of any recognised standard, have served the purpose of the present and other investigations.

*Method of Examination.*

After the samples collected by Mr. Butler were graded, the weight of each of the seven resulting grades was taken, and, with a calculating machine, reduced to its percentage of the whole sample from which it was taken. Each sample, therefore, gave a result like the following:—

| % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % T | Mixture. | Contamination. |
|---|---|---|---|---|---|---|---|---|
| 1·1 | 7·6 | 20·7 | 23·4 | 35·6 | 5·5 | 5·9 | Slightly mixed .... | Oats and white-heads. |

* See the second part of this report.

by which is meant that 1·1 % of the sample was composed of grains of the size shown in Fig. 4, 7·6 % of the sample was composed of grains of the size shown in Fig. 5, and so on down through the seven grades. Thus, the series of seven figures gives a kind of picture of the sample. Looking at the first of the seven figures, we can see at once what proportion of the grains are large ; looking at the other end of the series, we can see at once what proportion of the grains are small.

The sample on being compared with first-class samples of the same variety could be classed as good, bad, or medium ; and it is needless to say that this classification was the main object of the examination. The results enable us to pass judgment with some certainty on the quality of the seed being used, and to discuss on a sounder basis than heretofore the question whether we are using seed as good as we ought to use, and, if not, what amount of money farmers could afford to expend in grading with a certainty of increasing the profits of wheat-growing.

In 1898, at the instance of the Hon. Sydney Smith, the then Minister for Agriculture in this State, the late Mr. Thompson collected data as to the proportion of the various varieties of wheat in actual use in the State. The record of his results, which appears in the Annual Report of this Department for 1899, shows that the varieties then in favour were as follows, and in the following order :—First, Steinwedel, Purple Straw, and Allora Spring; second, White Lammas and Australian Talavera.

Mr. Thompson had unequalled opportunities for collecting this information, travelling, as he was, among the farmers in all parts of the State as lecturer on agricultural subjects, and the information should be very reliable.

It is interesting to note that the samples gathered for the purposes of the present inquiry give as the favourite varieties the following, and in the following order :—Purple Straw, 52% ; White Lammas, 27% ; Steinwedel, 14% ; Red Wheat, 3% ; Golden Drop, 2% ; Blount's Lambrigg, 1% ; Velvet, 1%.

From this it will be seen that, at the time of collecting these samples, 93% of the wheat being sown consisted of Purple Straw, Lammas, and Steinwedel, with a large preponderance of Purple Straw.

Now the farmers must use these varieties either because they prefer them or because they can get no others, unless, indeed, they give the matter no thought, and simply sow whatever comes handy. I think we may unhesitatingly dismiss this latter contingency from the discussion, as experience shows that farmers have decided opinions, and are no more likely than others to neglect to think about the means they employ to make a living.

Of the remaining two alternatives, namely, whether they use these varieties because they prefer them, or because they can get no others, it seems to me we must choose the former. Other sorts are available, and at prices within the reach of all. If a farmer does not use some other variety, it is not because he cannot get it, nor because he cannot afford it. This seems to me the inevitable conclusion.

It seems equally clear that the farmers must prefer these varieties because they consider them to be the most profitable ones to grow.

**Fig. 11.**—An ear of Defiance wheat, with the grains arranged as extracted from one side of the ear.

Against this opinion on the part of farmers, we must place that of the numerous experts and specialists in this country, among them the writer, that these varieties are not absolutely the best wheats.

No name was known for 6·5 per cent. of the samples collected. To this figure may be added the number that were submitted under wrong names, and though there is no evidence to show precisely what this latter number is, there can be no doubt that it reaches a considerable magnitude. I consider it to be quite safe to say that the samples unnamed or incorrectly named would constitute 20 per cent. of all the samples collected. This evidence that 20 per cent. of our farmers are sowing "wheat" shows that we have yet a great deal to do in spreading elementary knowledge concerning one of our most important agricultural industries.

The samples that were manifestly mixed or slightly mixed constitute 45 per cent. of the whole number collected. This mixture of different varieties in our seed wheat is a serious obstacle to progress. How will it ever be possible to judge of the relative merits of varieties under such conditions? If we have no means, or imperfect means, of judging the relative value of varieties, how are we to make satisfactory progress in the introduction of better varieties?

The percentage of bunted samples was seven. This shows that the various methods of combating this, the second most important of our wheat diseases, are probably made use of widely and with good effect. There is no reason why, if farmers would systematically make use of the means now at their command, this disease should not be practically eradicated. The production of seed wheat by the methods advocated by the officers of the Department and practised at the experiment farms, together with the use of the various fungicidal treatments that experience has shown to be efficient would practically annihilate this disease in the State in five years time.

The best samples were handed in under the names White Lammas and Steinwedel. This is in accord with the results of the three years' tests formerly made on the principal varieties grown in the State, both these varieties standing high in that series of tests. Incidentally, this gives corroboration to the names under which the samples were handed in, and is one of several points that have given me sufficient confidence in the nomenclature of these samples to base certain reasoning upon it.

## SAMPLES OF NEW SOUTH WALES SEED WHEAT, GRADED TO SHOW QUALITY, 1897–8.

**Note.**—The higher the figures in the left-hand columns the better the sample.

| Locality. | Variety. | Remarks. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|---|---|
| Canowindra | P. St. | ............ | 3·8 | 24·6 | 23·1 | 37·3 | 8·5 | 1·4 | 1·4 |
| Nyngan | ,, | Mixed .. .. .. | 17·4 | 41·7 | 31·3 | 8·7 | ·3 | ·1 | ·4 |
| Near Dubbo | ,, | Mixed Oats . .. | 10·0 | 22·4 | 33·7 | 29·7 | 3 7 | ·4 | ·3 |
| Dubbo | ,, | Mixed .. .. .. | 6·9 | 24·8 | 32·2 | 27·9 | 7·2 | ·9 | ·3 |
| Near Dubbo | ,, | Mixed Oats Split | 9·2 | 25·6 | 27·5 | 23·8 | 10·4 | 2·1 | 1·4 |
| Dubbo | ,, | Mixed Oats .. .. | 12·6 | 28·7 | 27·4 | 24·9 | 4·1 | 1·1 | 1·4 |
| ,, | ,, | ............ | 15·3 | 35·5 | 25·7 | 15·5 | 6·0 | 1·6 | ·9 |
| Geurie | Stnw. | Mixed Oats .. .. | 13·3 | 33·0 | 28·8 | 17·5 | 5·3 | 1·0 | 1·3 |
| Narramine | ,, | ............ | 6·7 | 26·5 | 26·3 | 26·0 | 12·1 | 1·8 | ·4 |
| Near Dubbo | ,, | Mixed .. .. .. | 5·6 | 26·0 | 33·2 | 27·4 | 4·8 | ·7 | ·3 |
| Near Wellington | ,, | ............ | 8·6 | 14·7 | 25·0 | 33·4 | 12·1 | 3·7 | 2·4 |
| Wellington | P. St. | ............ | 7·9 | 31·8 | 28·8 | 20·7 | 7·3 | 1·8 | 1·5 |
| ,, | ,, | Mixed Oats Bunt | 15·5 | 14·7 | 27·2 | 32·3 | 5·9 | 1·5 | 3·0 |
| ,, | ,, | .. Oats Bunt | 5·2 | 24·0 | 28·1 | 31·0 | 8 3 | 2·1 | 1·3 |
| Near Wellington | ,, | Mixed Oats Bunt | 4·7 | 28·5 | 28·7 | 25·4 | 9·4 | 2·1 | 1·3 |
| Wellington | ,, | Mixed Oats Bunt | 6·5 | 26·8 | 28·2 | 24·8 | 10·0 | 2·2 | 1·4 |
| ,, | ,, | Mixed Oats Bunt | 1·3 | 10·4 | 27·2 | 34·3 | 20·9 | 4·6 | 1·4 |
| , | ,, | Mixed Oats .. .. | 6 2 | 19·8 | 25·2 | 33·2 | 11·6 | 2·6 | 1·1 |
| ,, | ,, | Mixed Oats Bunt | 2·3 | 13·6 | 24·8 | 40·5 | 15·4 | 2·5 | 1·1 |
| .. | ,, | .. Oats Bunt | 5·0 | 24·7 | 30·1 | 28 6 | 8·2 | 2·1 | 1·3 |
| ,, | ,, | Mixed Oats .. .. | 2·0 | 14·9 | 22·5 | 38·3 | 18·1 | 2·9 | 1·3 |
| ,, | ,, | Mixed Oats Bunt | 6 2 | 23·1 | 25·5 | 30·8 | 10·1 | 3·0 | 1·4 |
| ,, | Wh. T. | ............ | 3 0 | 18·3 | 23·1 | 33·7 | 17·9 | 3·3 | ·7 |
| ,, | ,, | Mixed Oats .. .. | 6·9 | 23·7 | 28·8 | 24·2 | 9·5 | 3·0 | 3·8 |
| ,, | ,, | Mixed Oats .. .. | 8·3 | 26·8 | 32·2 | 21·0 | 7·4 | 1·6 | 2·7 |
| ,, | ,, | ............ | 5·3 | 12·9 | 24·0 | 43·3 | 11·7 | 1·6 | 1·2 |
| Near Wellington | Wh. L. | ............ | 3·4 | 14·4 | 25·2 | 39·0 | 14·4 | 2·4 | 1·2 |
| Wellington | Stnw. | .. Oats .. .. | 8·6 | 34·5 | 18·2 | 16·2 | 9·7 | 3·1 | 9·5 |
| Lincoln | ,, | Mixed Oats .. .. | 9·3 | 29·7 | 28·6 | 20·4 | 9·4 | 1·4 | 1·4 |
| Mitchell's Creek | P. St. | Mixed Oats .. .. | 20·6 | 12·2 | 24·4 | 28·7 | 10·7 | 1·6 | 1·8 |
| Lincoln | ,, | Mixed .. . .. | 11·7 | 27·9 | 31·4 | 20·3 | 4·4 | ·9 | 3·6 |
| Maryvale | ,, | ............ | ·6 | 4·5 | 13·2 | 34·7 | 31·0 | 11·0 | 5·0 |
| ,, | Wh. T. | Mixed Oats .. .. | 8·2 | 27·7 | 31·5 | 22·0 | 6 6 | 1·5 | 2·6 |

Samples of New South Wales Seed Wheat, Graded to show Quality, 1897–8—*continued.*

| Locality. | Variety. | Remarks. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|---|---|
| Maryvale | Wh. T. | Mixed Oats | 3·7 | 9·5 | 25·2 | 41·8 | 18·6 | ·6 | ·7 |
| Deniliquin | P. St. | | 7·4 | 19·4 | 22·3 | 28·9 | 15·5 | 4·6 | 1·7 |
| ,, | ,, | | 2·0 | 11·9 | 21·2 | 33·2 | 25·2 | 5·2 | 1·7 |
| Finley | ,, | Mixed | 1·8 | 13·6 | 31·0 | 36·2 | 12·2 | 1·9 | 3·2 |
| ,, | ,, | Mixed | 2·3 | 10 6 | 22·3 | 40·6 | 16·1 | 5·7 | 2·3 |
| ,, | ,, | Mixed | 3·5 | 20·3 | 33·1 | 34·6 | 7·0 | ·8 | ·8 |
| ,, | ,, | | 3·9 | 15·5 | 26·4 | 39·0 | 12·9 | 1·6 | ·6 |
| ,, | ,, | Mixed Bunt | 12·9 | 29·7 | 35·0 | 19·8 | 2·6 | ·1 | ·1 |
| Jerilderie | ,, | | 23 0 | 43·5 | 20·9 | 9·1 | 2·8 | ·4 | ·4 |
| ,, | ,, | Oats | 3·2 | 15·8 | 25·8 | 31·6 | 14·6 | 4·6 | 4·4 |
| Berrigan | P. St. | Mixed | 2·8 | 19·1 | 33·0 | 36·5 | 7·8 | ·8 | ·4 |
| ,, | ,, | Mixed | 6·5 | 29·8 | 29·3 | 29·8 | 3·8 | ·5 | ·2 |
| Argoon | .... | | 2·0 | 16·0 | 34·7 | 39·5 | 7·3 | ·2 | ·1 |
| Coolamon | R. St. | | .. | 4 0 | 18·0 | 36·1 | 34·0 | 6·2 | 1·7 |
| Banksdale | ,, | | ·9 | 7·5 | 26·8 | 40·0 | 22·2 | 2·2 | ·5 |
| Wagga Wagga | P. St. | Oats | 3·1 | 15·6 | 30·5 | 33·4 | 15·2 | 1·4 | ·7 |
| Coolamon | R. St. | Mixed | 1·8 | 10·0 | 28 2 | 41·1 | 16·4 | 2·2 | ·7 |
| Fairfield (Coolamon) | P. St. | | ·8 | 4·5 | 14·6 | 41·0 | 31·0 | 7·3 | ·8 |
| Coolamon | ,, | Oats Smut | 1·9 | 10·3 | 24·6 | 31·7 | 14·1 | 2·8 | 14·7 |
| ,, | ,, | | 1·4 | 8·6 | 21·6 | 40·2 | 21·8 | 3·2 | 3·2 |
| ,, | ,, | | 2·9 | 18·4 | 31·8 | 32·7 | 10·2 | 1·5 | 2·3 |
| ,, | ,, | Mixed | ·6 | 6·7 | 14·6 | 35·8 | 35·3 | 5·9 | 1·2 |
| ,, | ,, | Mixed Oats | 2·4 | 15·2 | 27·2 | 36·4 | 15·2 | 2·7 | 1·1 |
| Currawana | ,, | | 3·6 | 15·4 | 32·3 | 37·5 | 9·4 | 1·5 | ·4 |
| Coolamon | ,, | Mixed Oats | 3·2 | 15·9 | 25·0 | 40·2 | 12·7 | 1·9 | 1·3 |
| North Berry Jerry | ,, | Mixed | 2·0 | 20·0 | 37·0 | 38 0 | 2·3 | ·4 | ·4 |
| Coolamon | R. St. | | 3·8 | 15·3 | 29·1 | 40·6 | 9·8 | 1·0 | ·4 |
| ,, | R. Tu. | Mixed | ·6 | 13·3 | 21 9 | 40·3 | 21·8 | 1·4 | ·6 |
| ,, | R. Wh. | | 2·0 | 8·7 | 16·9 | 44·8 | 26·1 | 1·8 | ·7 |
| ,, | Stnw | | 2·2 | 17·3 | 24·1 | 35·5 | 16·1 | 3·6 | 1·3 |
| ,, | ,, | | 7·0 | 32·8 | 32·3 | 16·0 | 9·8 | 1·3 | ·7 |
| Berry Jerry | ,, | | 6·6 | 22·3 | 30·3 | 26·2 | 11·6 | 2·2 | 1·2 |
| Ganmain | P. St. | | 2·1 | 16·8 | 34·3 | 35·6 | 9·2 | 1·3 | ·7 |
| ,, | ,, | | 3·0 | 20·6 | 35·6 | 33·3 | 5·6 | ·7 | 1·2 |
| ,, | Stnw | Mixed | 6·4 | 22·4 | 27·1 | 26·9 | 13·9 | 2·4 | ·9 |
| ,, | ,, | | 2·3 | 19·7 | 30·1 | 30·6 | 13·1 | 2·8 | 1·5 |
| Old Junee | Bl. L. | | 1·0 | 2·9 | 6·3 | 39·5 | 41·2 | 6·7 | 2·4 |
| ,, | Wh. H. | | 8·8 | 18 8 | 32·8 | 35·9 | 3·5 | ·1 | ·1 |
| ,, | R. St. | | 2·9 | 14·1 | 30·1 | 36·0 | 14·6 | 1·8 | ·5 |
| Junee | Rt. T. | Mixed | 3·5 | 8·8 | 29·9 | 44·0 | 12·2 | 1·7 | .. |
| Cootamundra | Stnw | | 12·9 | 32·5 | 25·4 | 19·6 | 6·9 | 1·4 | 1·4 |
| ,, | P. St. | Oats Bunt | 2·3 | 13·9 | 19·3 | 32·0 | 21·8 | 5·7 | 4·9 |
| ,, | ,, | Mixed Oats | 5·1 | 15·7 | 27·3 | 32·8 | 14·2 | 2·2 | 2 7 |
| ,, | ,, | | 2·4 | 6·3 | 25·3 | 36·7 | 22·6 | 3·2 | 3·5 |
| Temora | ,, | Oats | 3·2 | 15·1 | 20·7 | 36·5 | 16·1 | 3·7 | 4·9 |
| ,, | ,, | | 6·4 | 30·7 | 34·4 | 20·5 | 6·1 | 1·1 | ·8 |
| Near Temora | ,, | Oats | 3·9 | 17·2 | 27·5 | 36·3 | 13·2 | 1·4 | ·5 |
| Temora | ,, | Mixed | 3·1 | 19·0 | 26·7 | 37·2 | 11·4 | 1·5 | 1·1 |
| ,, | ,, | Mixed Oats | 2·2 | 15·7 | 27·5 | 35·2 | 13·6 | 2·4 | 3·1 |
| ,, | ,, | Mixed | 4·1 | 15·4 | 20·1 | 37·3 | 18·9 | 3·4 | ·8 |
| ,, | ,, | Mixed Oats | ·7 | 4·6 | 14·8 | 34·8 | 33·0 | 8·3 | 3·9 |
| ,, | ,, | Oats | 2·5 | 20·4 | 27·7 | 31·3 | 13·9 | 2·2 | 2·2 |
| ,, | .... | Mixed Oats | ·6 | 4·8 | 17·3 | 37·7 | 32·6 | 4·5 | 2·5 |
| ,, | ,, | Mixed Oats | 1·5 | 9·1 | 23·6 | 39·5 | 21·1 | 3·6 | 1·6 |
| ,, | ,, | Mixed | 6·7 | 19·6 | 23·1 | 33·0 | 15·4 | 1·9 | ·6 |
| ,, | ,, | Mixed Oats Bunt | 4·2 | 19·4 | 30·4 | 33·9 | 9·3 | 1·7 | ·4 |
| ,, | ,, | Mixed | ·9 | 7·7 | 22·4 | 45·9 | 19·1 | 1·9 | 2·1 |
| ,, | ,, | Mixed Oats | 1·9 | 11·2 | 24·8 | 37·0 | 16·5 | 3·7 | 4·9 |
| ,, | ,, | Mixed | 1·1 | 5·6 | 17·2 | 43·8 | 25·4 | 5·3 | 1·5 |
| ,, | ,, | Mixed | 4·2 | 18·0 | 35 0 | 34·4 | 5·7 | ·8 | 1·6 |
| ,, | Stnw | | 8·6 | 26·8 | 30·1 | 22·9 | 9·6 | 1·5 | ·5 |
| ,, | ,, | Mixed | 1·1 | 8·5 | 19·7 | 41·2 | 25·4 | 3·1 | ·8 |
| ,, | ,, | | 4·9 | 31·4 | 29·5 | 25·2 | 6·9 | 1·6 | ·3 |
| Junee Road, Temora | Impl. | | 2·0 | 13·8 | 30·0 | 41·3 | 11·2 | 1·2 | ·6 |
| Temora | P. St. | Oats Bunt | 2·9 | 10·5 | 21·8 | 41·8 | 18·3 | 3·0 | 1·9 |
| Mimosa | ,, | Mixed | 1·4 | 6·9 | 22·4 | 38·8 | 24·7 | 3·8 | 1·9 |
| ,, | R. St. | | 1·6 | 7·6 | 22·8 | 39·2 | 21·8 | 3·8 | 3·3 |
| Barmedman | P. St. | Mixed | 1·5 | 11·9 | 25·8 | 41·4 | 16·5 | 2·2 | ·8 |
| Junee Road, Temora | ,, | Oats | 1·0 | 9·8 | 23·8 | 42·6 | 18·8 | 2·8 | 1·2 |
| Stockinbingal | R. Tu. | | 1·7 | 10·2 | 19·7 | 37·4 | 25·6 | 3·1 | 2·1 |
| Marengo | P. St. | Oats | 14·0 | 34·7 | 34·3 | 13·8 | 2·7 | ·2 | ·3 |
| Grenfell Road | ,, | Mixed | 14·6 | 40·2 | 27·0 | 14·9 | 2·6 | ·4 | ·3 |
| Grenfell | ,, | Oats | 1·9 | 12·4 | 29·0 | 32·9 | 17·4 | 3·9 | 2·2 |
| Garangula | Wh. T. | Mixed | 6·6 | 22·5 | 35·8 | 29·4 | 4·1 | ·3 | 1·2 |
| Barwang | Tusc. | | ·6 | 5·7 | 20·7 | 48·9 | 21·8 | 1·8 | ·6 |
| Bethungra | R. Wh. | Mixed | 2·6 | 9·8 | 27·7 | 31·4 | 15·9 | 4·1 | 8·6 |

SAMPLES of New South Wales Seed Wheat, Graded to show Quality, 1897–8—*continued.*

| Locality. | Variety. | Remarks. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|---|---|
| Murrumburrah | P. St. | ............ | 6·4 | 18·4 | 34·0 | 30·9 | 6·3 | 1·7 | 2·1 |
| ,, | R. Tu. | ............ | 9·5 | 40·7 | 29·2 | 16·8 | 2·1 | ·5 | 1·1 |
| ,, | N. Rd. | Mixed | 1·6 | 7·9 | 10·0 | 44·5 | 27·5 | 3·8 | 4·6 |
| ,, | ,, | Mixed | 1·6 | 7·9 | 10·0 | 44·5 | 27·5 | 3·8 | 4·6 |
| Young | P. St. | Mixed Oats | 13 9 | 47·1 | 24·2 | 11·9 | 2·4 | ·2 | ·3 |
| ,, | ,, | Mixed Oats | 16·3 | 38·8 | 28·0 | 12·9 | 2·8 | ·2 | ·3 |
| ,, | ,, | Mixed | 14·0 | 41·7 | 29·5 | 12·7 | 1·7 | ·3 | ·3 |
| ,, | ,, | Mixed Oats | 17·0 | 41·2 | 27·0 | 12·3 | 1·7 | ·3 | ·4 |
| ,, | Stnw | Oats | 7·0 | 22·1 | 30·8 | 28·4 | 8·4 | 1·8 | 1·5 |
| Bowning | Wh. L. | Mixed | 12·2 | 23·7 | 25·5 | 23·4 | 7·7 | 2·7 | 5·0 |
| ,, | P. St. | Mixed Oats Bunt | 3·3 | 17·5 | 24·2 | 35·1 | 13·6 | 4·3 | 2·1 |
| Illabo | Wh. L. | ............ | 1·4 | 6·9 | 19·4 | 49·8 | 20·7 | 1·7 | .. |
| Yass | ,, | Mixed | 20·0 | 37·2 | 28·6 | 12·0 | 1·9 | ·2 | ·2 |
| Grabben Gullen | .... | Oats Bunt | 7·4 | 29·4 | 34·6 | 23·8 | 3·0 | ·6 | 1·3 |
| Yass | Wh. L. | ............ | 40·8 | 47·2 | 10·5 | 1·5 | .. | .. | .. |
| ,, | R. Wh. | ............ | 6·5 | 18·1 | 25·1 | 33·4 | 14·0 | 2·5 | ·5 |
| ,, | Rd. L. | ............ | 11·4 | 30·0 | 37·5 | 19·7 | 1·3 | ·1 | .. |
| Harden | Stnw | Mixed | 9·5 | 29·9 | 27·1 | 22·9 | 5·8 | 1·6 | 3·2 |
| Near Cowra | .... | ............ | 3·5 | 10·9 | 22·3 | 39·7 | 15·7 | 5·2 | 2·4 |
| Cowra | Stnw | ............ | 2·5 | 21·4 | 24·2 | 32·0 | 12·8 | 3·3 | 3·7 |
| ,, | ,, | ............ | 2·6 | 12·4 | 30·2 | 34·3 | 15·8 | 2·6 | 2·1 |
| ,, | ,, | Oats | 5·1 | 17·2 | 26·3 | 31·6 | 15·8 | 3·2 | ·8 |
| West Ville | Wh. L. | ............ | 4·2 | 10·4 | 24·5 | 50·0 | 9·3 | ·8 | ·8 |
| Back Creek | Y. Tu. | Oats | ·8 | 9·8 | 21·3 | 39·4 | 23·6 | 4·3 | ·9 |
| Morongla Creek | ,, | Mixed | 1·9 | 5·6 | 14·9 | 44·0 | 25·7 | 3·8 | 4·2 |
| Cowra | P. St. | ............ | ·8 | 6·9 | 18·3 | 44·2 | 25·5 | 3·3 | ·9 |
| ,, | ,, | Mixed Oats Bunt | ·2 | 2·9 | 11·2 | 39·7 | 37·0 | 5·7 | 3·2 |
| Molong | ,, | Mixed Oats Bunt | 1·8 | 14·1 | 19·4 | 37·6 | 20·5 | 5·8 | ·8 |
| Canowindra | Wh. W. | ............ | 2·2 | 8·7 | 17·0 | 30·3 | 30·5 | 9·2 | 2·2 |
| ,, | P. St. | ............ | 3·0 | 16·4 | 30·9 | 35·8 | 11·6 | 1·6 | ·7 |
| ,, | ,, | ............ | 3·1 | 24·9 | 31·7 | 24·5 | 8·9 | 1·6 | 5·4 |
| Blayney | Wh. L. | Mixed Oats | 15·9 | 44·8 | 26·0 | 10·3 | 1·9 | ·8 | ·3 |
| Barry | ,, | Mixed | 4·2 | 11·7 | 25·7 | 35·5 | 18·6 | 2·6 | 1·5 |
| Blayney | P. St. | Oats | 17·1 | 43·5 | 25·6 | 10·6 | 1·4 | 1·1 | ·7 |
| Avondale | Wh. L. | Mixed | 4·9 | 14·4 | 23·8 | 19·7 | 32·8 | 2·6 | 1·7 |
| Near Orange | ,, | Mixed Oats | 9·1 | 43·6 | 32·7 | 7·8 | 1·9 | 2·6 | 2·1 |
| Forest Reefs | Wh. H. | Mixed Oats | 13·9 | 52·1 | 23·8 | 7·1 | 2·3 | ·6 | ·1 |
| Raglan | .... | Bunt | ·5 | 9·9 | 16·6 | 42·4 | 24·9 | 3·6 | 2·6 |
| ,, | .... | Oats | ·4 | 6·5 | 18·7 | 42·1 | 25·6 | 4·1 | 2·6 |
| ,, | Wh. L. | Mixed | 3·3 | 14·9 | 31·5 | 30·3 | 16·6 | 2·4 | 1·0 |
| Perth | ,, | ............ | 4·8 | 14·3 | 20·3 | 36·1 | 18·8 | 3·9 | 1·8 |
| ,, | ,, | ............ | 24·1 | 52·4 | 22·6 | 1·0 | ·1 | .. | .. |
| White Rock | ,, | Mixed | 5·0 | 13·3 | 20·5 | 38·6 | 16·6 | 4·4 | 1·5 |
| Broula | P. St. | ............ | 1·6 | 14·5 | 27·3 | 41·5 | 12·5 | 1·9 | ·8 |
| White Rock | Wh. L. | Mixed | 5·4 | 15·4 | 21·3 | 33·4 | 20·3 | 2·7 | 1·5 |
| George's Plains | Wh. T. | Oats | 7·9 | 33·8 | 29·5 | 21·2 | 4·8 | 1·2 | 1·6 |
| Millthorpe | Bl. L. | ............ | 3·9 | 12·9 | 26·6 | 40·2 | 12·1 | 2·9 | 1·3 |
| W. Orange | ... | ............ | 10·2 | 38·2 | 24·6 | 16·5 | 6·4 | 1·6 | 2·6 |
| Shaw | .... | Mixed Oats | 1·8 | 6·1 | 14·3 | 33·4 | 27·7 | 9·9 | 6·7 |
| Near Orange | Stnw. | Oats | 11·5 | 18·3 | 27·4 | 33·8 | 6·7 | 1·2 | 1·2 |
| Millthorpe | F. Fr. | ............ | 31·5 | 43·2 | 15·7 | 5·9 | ·8 | 1·1 | ·7 |
| Spring Hill | P. St. | Mixed Oats | 12·1 | 46·7 | 28·6 | 8·3 | 1·7 | 1·2 | 1·3 |
| ,, | Wh. H. | ............ | 16·0 | 49·7 | 24·0 | 5·8 | 1·5 | 2·0 | 1·1 |
| Near Orange | P. St. | ............ | 17·3 | 39·0 | 20·2 | 10·7 | 3·4 | 2·4 | 7·1 |
| Burrowa River | Wh. T. | Mixed | 2·4 | 14·2 | 28·8 | 44·2 | 9·4 | ·7 | ·3 |
| Wattamondarra | P. St. | ............ | 1·6 | 4·4 | 16·3 | 37·5 | 28·7 | 8·8 | 2·7 |
| Neville | ,, | ............ | 20·7 | 37·7 | 21·3 | 13·2 | 3·8 | 1·3 | 2 0 |
| Evans' Plains | Wh. L. | ............ | 6·1 | 15·1 | 23·6 | 34·1 | 16·6 | 3·1 | 1·3 |
| Brewongle | ,, | Mixed | 6·3 | 14·7 | 19·6 | 38·1 | 17·2 | 2·5 | 1·6 |
| Barwang | ,, | Mixed | 3·4 | 7·7 | 12·6 | 51·4 | 22·4 | 1·7 | ·9 |
| Kialla | Tal. | ............ | 8·6 | 19·8 | 43·6 | 21·9 | 4·7 | ·9 | ·6 |
| Garangula | Wh. W. | ............ | 2·9 | 9·4 | 31·4 | 44·5 | 8·0 | 1·4 | 2·4 |
| Evans' Plains | Wh. L. | Mixed | 4·7 | 16·4 | 20·6 | 32·2 | 18·1 | 3·6 | 1·4 |
| Lucknow | ,, | ............ | 13·4 | 41·7 | 24·5 | 13·0 | 3·8 | 1·2 | 2·5 |
| Jerrawa | R. Wh. | Mixed | 1·4 | 8·4 | 17·8 | 39·5 | 26·4 | 5·2 | 1·5 |
| Demondrille | Stnw. | Mixed Oats | 5·9 | 40·5 | 24·3 | 19·3 | 7·5 | 1·7 | ·7 |
| Wattamandarra | ,, | ............ | 2·8 | 16·7 | 27·9 | 31·7 | 13·4 | 4·7 | 2·8 |
| Currawang | P. St. | ............ | 4·7 | 21·8 | 39·3 | 27·2 | 5·2 | ·8 | 1·0 |
| Jeir | ,, | ............ | 13·7 | 32·8 | 40·8 | 12·3 | ·4 | .. | .. |
| ,, | Wh. L. | ............ | 21·3 | 43·7 | 33·9 | 1·2 | .. | .. | .. |
| ,, | Rd. L. | ............ | 11·4 | 26·9 | 46·1 | 15·4 | ·1 | .. | .. |
| Adelong Crossing | Wh. L. | Mixed | 6·1 | 29·2 | 35·7 | 24·7 | 3·7 | 2 | ·4 |
| ,, | P. St. | Mixed Oats | 8·9 | 26·9 | 35·7 | 19·3 | 7·6 | 1·1 | ·7 |
| South Gundagai | Wh. T. | ............ | ·8 | 7·4 | 21·7 | 49·7 | 19·3 | 1·2 | ·8 |
| Near Gundagai | ... | ............ | 7·5 | 20·2 | 25·0 | 27·5 | 16·9 | 2·4 | ·7 |

SAMPLES of New South Wales Seed Wheat, Graded to show Quality, 1897–8—*continued.*

| Locality. | Variety. | Remarks. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|---|---|
| Gundagai | .... | Mixed Oats | 4·7 | 15·2 | 27·9 | 34·0 | 14·8 | 2·5 | ·9 |
| Tamworth | .. | ........... | 13·1 | 30 6 | 29·1 | 18 9 | 5·8 | 1·0 | 1·5 |
| ,, | P. St. | ........... | 20·0 | 32·6 | 18·3 | 16·7 | 7·6 | 2·4 | 2·4 |
| Moor Creek | Stnw. | .. Oats | 18·6 | 34·4 | 22·7 | 13·6 | 7·3 | 2·7 | ·7 |
| ,, | Wh. T. | Mixed | 4·9 | 10·6 | 25·7 | 37·5 | 18·0 | 2·0 | 1·2 |
| Near Tamworth | P. St. | Mixed | 11·2 | 33·7 | 33·1 | 19·1 | 2·2 | ·4 | ·3 |
| Moonbi | R. Pr. | Mixed | 2·5 | 12·9 | 20·8 | 42·2 | 16·9 | 2·4 | 2·4 |
| ,, | Stnw. | .. Oats | 17 6 | 36·9 | 24·0 | 16·6 | 2·9 | ·6 | 1·5 |
| ,, | F. Gl. | .. Oats | 39·8 | 37·8 | 9·9 | 5·4 | 1·3 | 1·6 | 4·2 |
| Bective | Bl. V. | Mixed | 37·0 | 28·8 | 15·1 | 11·6 | 3·3 | 2·1 | 2·0 |
| ,, | Stnw. | ........... | 51·5 | 29·8 | 9·6 | 6·0 | 2·1 | ·7 | ·5 |
| ,, | P. St. | ........... | 29·5 | 43·4 | 14·7 | 7·6 | 3·0 | 1·1 | ·7 |
| Quirindi | G. Dr. | Mixed Oats | 4·8 | 10·9 | 26·5 | 42·2 | 12·2 | 1·9 | 1·5 |
| ,, | P. St. | Mixed Oats | 10·8 | 17·5 | 28·5 | 28·2 | 11·9 | 1·5 | 1·6 |
| Manilla | Stnw. | ........... | 20·5 | 27·9 | 17·0 | 13·4 | 10·1 | 6·4 | 4·8 |
| Upper Manilla | Aust. | ........... | 20·7 | 24·8 | 30·0 | 16·3 | 3·9 | 2·2 | 2·2 |
| ,, | P. St. | Mixed .. Bunt | 25·6 | 36·8 | 18·6 | 10·8 | 3·8 | 1·7 | 2·6 |
| Glenmore | ,, | ........... | 1·5 | 9 7 | 21·0 | 37·5 | 23·6 | 4·9 | 1·7 |
| Wallabadah | Wh. T. | Mixed Oats | 4·1 | 15·5 | 32·6 | 37·8 | 9·2 | ·5 | ·2 |
| Nundle | ,, | Mixed Oats | 10·1 | 25·0 | 37·5 | 22·9 | 3·7 | ·5 | ·4 |
| Duri | Wh L. | ........... | 6·4 | 20·4 | 30·5 | 33·8 | 8·2 | ·4 | ·2 |
| Nemingha | Stnw. | .. Oats | 53·2 | 28·0 | 8·7 | 5·8 | 1·8 | ·9 | 1·6 |
| Castle Mountain | G. Dr. | .. Oats | 10·5 | 19·8 | 26·7 | 32·5 | 8·7 | ·9 | ·8 |
| ,, | ,, | ........... | 8·4 | 22·2 | 32·8 | 28·7 | 4·1 | 1·8 | 2·0 |
| Brooman | P. St. | ........... | 1·8 | 11·4 | 19·5 | 36·2 | 25·1 | 4·5 | 1·5 |
| Glen Innes | Sp. W. | .. Oats | 21·8 | 40·1 | 24·5 | 9·8 | 2·7 | ·8 | ·4 |
| ,, | Vlvt. | Mixed | 26·4 | 41·1 | 24·0 | 6·1 | 1·5 | ·6 | ·5 |
| Begginbeggin | R. Tu. | ........... | 3·9 | 14·8 | 34 5 | 37·7 | 7·3 | ·8 | ·8 |
| Morongla Creek | Wh. T. | ........... | 1·6 | 8 6 | 16·2 | 37·5 | 25·7 | 7 5 | 2·9 |
| [?] | .... | Mixed Oats | 1·1 | 7·6 | 20·7 | 23·4 | 35·6 | 5·5 | 5·9 |
| Berthong | G. Dr. | Mixed .. Bunt | 3·8 | 12·5 | 36·4 | 39·2 | 10·4 | 1·4 | 2·4 |
| Begginbeggin | Npr. | Mixed | 5·1 | 18·2 | 34·1 | 28·6 | 8·6 | 1·2 | 4·1 |
| Limestone Creek | Stnw. | ........... | 18·3 | 38·6 | 22·6 | 11·7 | 5·3 | 1·6 | 1·9 |
| Water Vale | ,, | Mixed | 1·5 | 10·0 | 24·8 | 27·5 | 27·5 | 5·4 | 3·4 |
| Warrangong | Wh. L. | .. Oats | 5·6 | 24·5 | 6·6 | 54·0 | 5·7 | 1·4 | 2·3 |
| Ashburton | ,, | Mixed Oats | 10·8 | 33·9 | 31·0 | 18·7 | 2·6 | 1·0 | 2·0 |
| Quong Dong | P. St. | ........... | ·9 | 7 7 | 24·4 | 46·5 | 18·6 | 1·9 | ·2 |
| ,, | Stnw. | ........... | ·9 | 9·6 | 25·3 | 37·5 | 16·3 | 5·9 | 4·4 |
| ,, | .... | ........... | .. | 3·6 | 10·8 | 37·4 | 37·0 | 7·6 | 3·6 |
| [?] | .... | Mixed | .. | .. | .. | .. | 58·0 | 42·0 | .. |
| [?] | .... | Mixed | 4·3 | 18·2 | 35·1 | 35·3 | 4·9 | ·6 | 1·4 |
| Water Vale | P. St. | Mixed Oats | 2·5 | 18·3 | 28·2 | 31 7 | 13·4 | 3·7 | 1·9 |
| Newry | ,, | Mixed | 2·4 | 12·9 | 26·9 | 40·9 | 13·0 | 1·6 | 2·2 |
| Springfield | ,, | Mixed | 3·4 | 19·5 | 33·0 | 30·3 | 10·9 | 1·6 | 1·3 |
| Clear Hills | ,, | ........... | 4·9 | 30·1 | 32·4 | 27·7 | 4·0 | ·5 | ·4 |
| North Berry Jerry | ,, | Mixed Oats | ·8 | 9·6 | 26·1 | 48·7 | 13·3 | 1·2 | ·2 |
| Bomory Villa | ,, | .. Oats | 3·7 | 20·9 | 28·5 | 29·4 | 8·7 | 2·6 | 6·2 |
| Coree | ,, | ........... | 2·3 | 9·8 | 18·8 | 37·6 | 24·2 | 5·5 | 1·7 |

*Analysis of the foregoing Table.*

The table of the gradings shows a number of interesting features, according to the way in which it is analysed. If we separate the varieties we observe that Steinwedel yields the best results on the average :—

| Grades. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Steinwedel | 10·7 | 24·8 | 25·3 | 24·3 | 10·5 | 2·4 | 1·9 |

The miscellaneous samples are, however, nearly as good, giving practically the same grade figures.

Next these, but considerably poorer, come Purple Straw and White Lammas, of which the latter is a trifle the better. The unnamed samples are the poorest, some of them being extremely rubbishy. See the following table.

TABLE of AVERAGES.

| Name of the Variety. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Steinwedel, 31 samples .. | 10·75 | 24·8 | 25·3 | 24·3 | 10·5 | 2·4 | 1·9 |
| Miscellaneous, 15 ,, . | 10·2 | 18·6 | 24·5 | 30·2 | 12·0 | 2·3 | 2·4 |
| White Lammas, 36 ,, .. | 6·2 | 24·0 | 25·3 | 30·4 | 11·2 | 1·9 | 1·1 |
| Purple Straw, 113 ,, .. | 6·6 | 20·3 | 26·2 | 30·4 | 12·4 | 2·4 | 1·7 |
| White Tuscan, 21 ,, .. | 4·4 | 17·0 | 26·4 | 34·7 | 13·9 | 2·0 | 1·5 |
| Without name, 15 ,, .. | 3·8 | 14·2 | 22·1 | 30·1 | 21·1 | 6·2 | 2·3 |

From this average table it is possible to derive the average of all the samples, the *average for the State*, as we may term it :—

| Grades. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| State average .. .. .. | 6·9 | 19·8 | 24·9 | 30·0 | 13·5 | 2·9 | 1·8 |

The State average may be more conveniently stated by giving approximate figures, as follows :—

| Grades. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| **State average .. .. ..** | **7·** | **20·** | **25·** | **30·** | **13·** | **3·** | **2·** |

These figures can easily be carried in the mind during the following discussions and comparisons, all the more easily after studying Figures 12 and 20. Of course it is not meant to imply by the term State average that the above figures are exactly the average that would have been obtained, if, say, ten thousand samples had been examined in the same manner as this smaller number of samples. Nevertheless, it is extremely doubtful if a larger number of examinations would have materially changed the figures, and this justifies us in using the term, thus qualified.

It will be noted that the various samples are described in the text as very good, good, medium, poor, bad, and very bad. These words refer mainly to the size of the grains composing the samples.

*Average Quality of First-class Sample.*

In order to make clearer the precise meaning to be attached to these words let us for a moment consider what are the qualities of a first-class sample of wheat so far as relates to the size of its grains. As the Purple Straws are largely grown let us take as an example a sample of ordinary Purple Straw grain of first quality. Such a sample grades up as follows :—

| Grades. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Farmer's Friend .. .. .. | 46·96 | 39·63 | 8·01 | 3·79 | 1·09 | ·29 | ·23 |

These figures are the result of grading three first-class samples grown in three successive years, as described in the article on the grading of wheats already cited. It will be observed that 86 per cent. of the grains belong to the two largest grades. Experience has shown that the yield from the last four grades is less from equal numbers of seeds, and that the crop is of inferior quality. Consequently any sample that graded up so as to throw the bulk of its grain into these grades would be of inferior quality. The sample given above may be taken as somewhere near perfection, as the plants from which it was derived were picked plants. It is, however, quite safe to say that any good sample of Purple Straw should throw three-fourths of its grain into the first three grades.


**Fig. 12.**—Average sample of New South Wales seed-wheat, graded and placed in piles to show the relative proportions of large and small grains in the sample. The largest grains are in the piles at the left, and the smallest grains are in the piles at the right. It will be seen from this illustration that the average New South Wales sample of seed-wheat is about equal in quality to the medium sample shown in Figure 7, and far below the quality of a perfectly grown sample of its own type, such as is shown in Figure 13, at the other side of this page. This proves that the average New South Wales sample of seed-wheat shows very little evidence of grading preparatory to sowing.

### *What we should Aim at.*

It will be found on reference to the source of the figures relating to the sample of Farmer's Friend, that they represent a high grade of grain, in fact something like the perfection of growth under normal conditions in one of the principal wheat-growing districts of the State. It is well to bear this fact in mind, and not lay too much stress on comparisons between this well-nigh perfect growth and the averages derived from these present examinations of our ordinary seed wheat. There is, I think, no mistake more commonly made by experts and enthusiasts than that of over-estimating the rate at which we may reasonably expect to approach the perfect standard which they can so easily picture to themselves from their vantage ground of superior knowledge and foresight. While it is advisable, therefore, to always present the ultimate goal toward which all are striving, it is often more useful to make comparisons with a standard more easily within reach.

Particular attention is therefore invited to the comparisons made between the seed-wheat of the better farmers of the State and that of the remaining three-fourths or four-fifths.

There is no doubt, as will be seen when we come to the later pages of this report, that the stamina of *our wheat crops would be very much improved if the example set by our better growers could be widely imitated, and it is equally beyond doubt that their example could be profitably followed at once. There is no difficulty in the way.*

Such bad seasons as the present would be fraught with much less loss from disease and poor growth if our wheat crops had the additional stamina derived from the use of plump graded seed.

### *The Illustrations.*

It is desirable that the percentage figures used in these pages should convey a definite idea to the reader's mind. Accordingly, 100 ounces of particular samples have been divided up and placed in piles according to the percentage figures. See illustrations 12, 13, etc.

While this method of grading the wheat and placing it in piles is in its way very effective in


**Fig. 13.**—A well-nigh perfect sample of Farmer's Friend, a Purple Straw wheat, graded and placed in piles to show the proportion of the various grades of grain in the sample. The left-hand pile is composed of the largest grains in the sample, while the right-hand pile is composed of the smallest grains in the sample. It will be noted what a large proportion of the grains belong to the two highest grades. The threshing of the sample was such that every grain was saved. The same sample is shown in a different way in Fig. 14, which should be compared with this. This serves to illustrate a good, in fact well-nigh perfect, sample of Purple Straw wheat.

showing the nature of a given sample of seed it has some drawbacks. In the first place the illustration does not show the striking difference in the sizes of the grains composing the various piles. Again the method of piling is not the most effective way of showing the precise relative amounts of the different grades. However those accustomed to wheat are so used to seeing it in piles that this method has been adopted as one that will appeal to the senses through the ordinary channels.

A better method is that adopted in Fig. 14, on this page, in which every grain is shown, and in its natural size, as is explained in the small paragraph relating to the illustration.

*How to Judge the Tabulated Gradings.*

All the grains of the lower grades in any sample will lower its quality as seed wheat, the very lowest grades of course being a greater defect than those immediately higher. In harmony with this criterion the samples in the tables may be classed as good or bad according as a majority of their grains are found in the upper or lower grades. Thus a sample that graded :—

| | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Purple Straw. | 3·1 | 19·0 | 26·7 | 37·2 | 11·4 | 1·5 | 1·1 |

would be classed as *medium*, while one that graded as follows :—

| | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Purple Straw. | ·7 | 4·6 | 14·8 | 34·8 | 33·0 | 8·3 | 3·9 |

would be called *poor* or bad. One grading into the lowest grades, as follows :—

| | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Purple Straw. | 0·0 | 3·6 | 10·8 | 37·4 | 37·0 | 7·6 | 3·6 |

would be called *very bad*, especially if it contained, as would probably be the case, dirty rubbish and split grains.

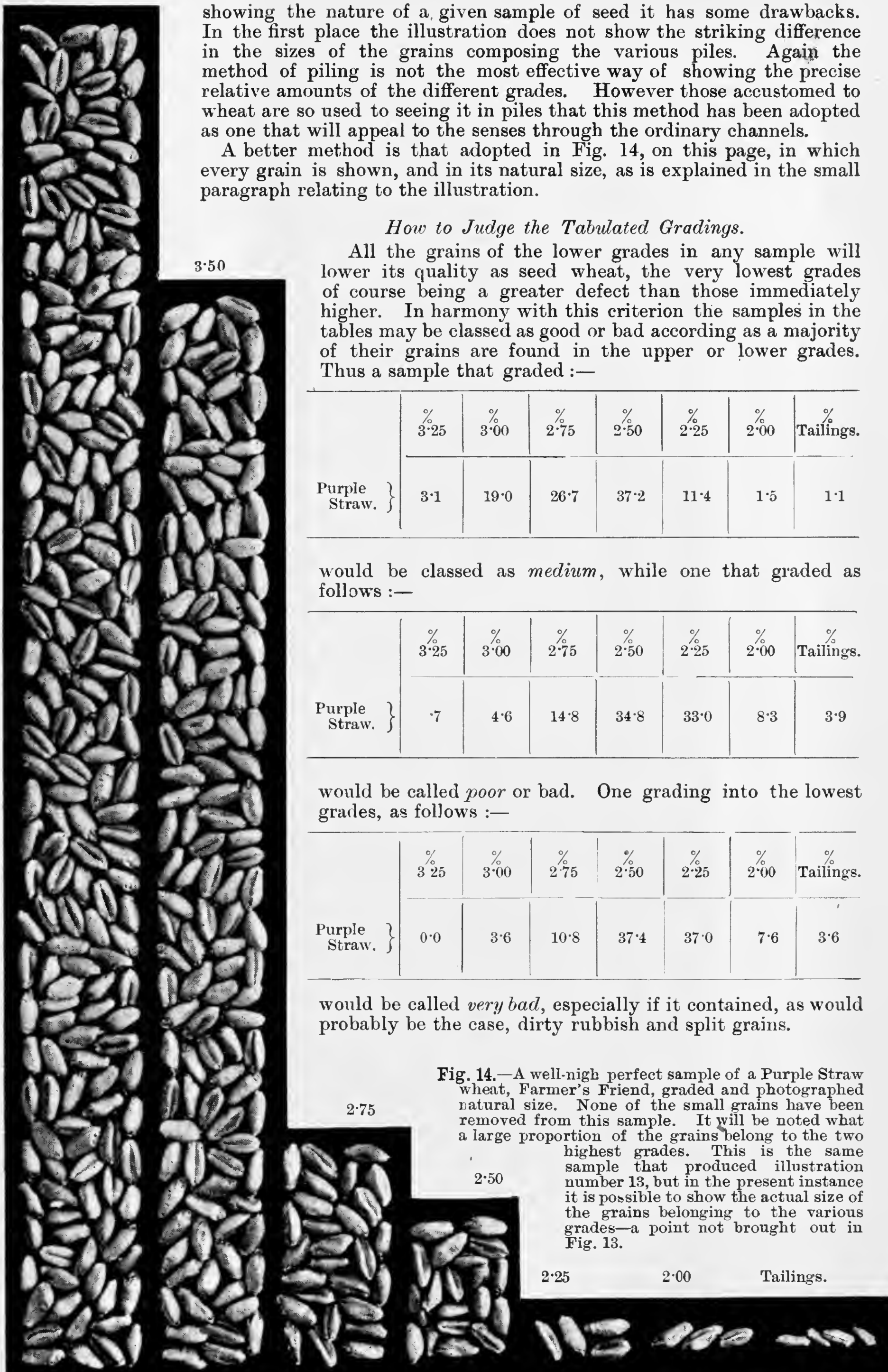



**Fig. 14.**—A well-nigh perfect sample of a Purple Straw wheat, Farmer's Friend, graded and photographed natural size. None of the small grains have been removed from this sample. It will be noted what a large proportion of the grains belong to the two highest grades. This is the same sample that produced illustration number 13, but in the present instance it is possible to show the actual size of the grains belonging to the various grades—a point not brought out in Fig. 13.

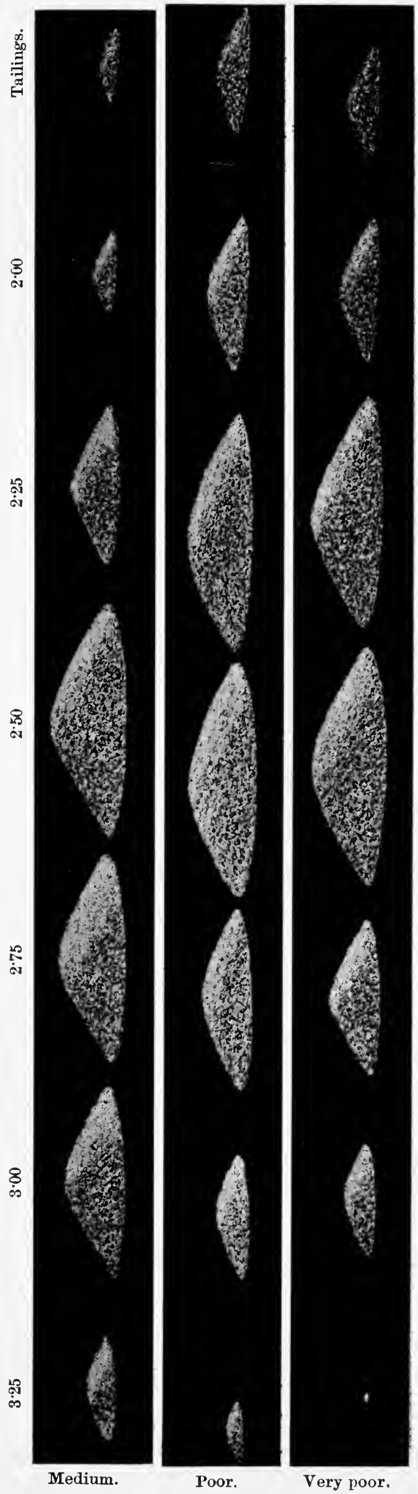
It will be observed that some of the farmer's samples grade up better than the perfect sample tabulated on page 10. This is explained by the fact that the perfect sample was the *entire product of the plants, large grains and small*, the harvesting having been conducted with special reference to securing every single grain. On the other hand, the small grains had been already removed from some of the samples collected from farmers as they were being sown. It will be seen, therefore, that it is impossible to compare such samples with those graded from the three years' experiment cited from Vol. VIII, with any other object than that of securing a rough result.

About fifty of the samples tabulated on pages 6 to 9, show evidence of having been more or less graded preparatory to use as seed-wheat. The others are as they came from the stripper and cleaner, or thresher and cleaner. In other words about three-fourths of our farmers use wheat for seed without removing the small grains and the inferior and useless portions.

Much as this is to be regretted, something of the kind must have been predicted by anyone who has observed the customs of our wheat-growers, especially if he had also discovered how commonly the fallacy about the good properties of small and shrivelled grains is upheld in this country. It is however useful to have these tabulated figures, derived from adequate and careful examination, as a weapon to combat this error. It is probably too much to expect of ordinary human nature that the advocates of this fallacy will retract their utterances; a few facts such as are recorded on later pages may, however, silence them and cause them to turn their love for paradoxical statements into some other channel.

*Practice of our Best Growers.*

The evidence of previous grading and cleaning is apparent in the table on pages 6 to 9 in those cases where the three final figures are all very low, thus showing that the smallest grains have




**Figs. 15, 16, 17.**—Showing how the medium quality and poor samples of Purple Straw, Lammas, and other prominent Australian wheats grade up. These should be compared with Figure 13, which shows a perfect sample of a similar class of wheat. In these figures the piles at the left are composed of the largest grains in the sample, while those at the right are composed of the smallest grains in the sample. The poorer the sample of grain the larger the piles at the right. The very poor sample had actually no grains in the left-hand pile, the position of the pile being marked by a single grain. These illustrations together with Figure 13, may be compared with Figures 12, 18, and 19, in which the actual condition of New South Wales seed-wheat is pictured.

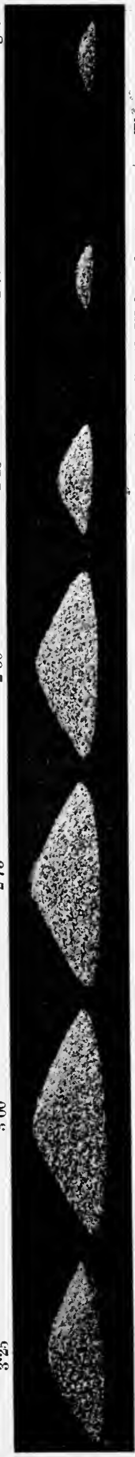



**Fig. 18.**—A very interesting photograph, inasmuch as it is a graphic illustration of the practice of the best 25 per cent. of New South Wales wheat-growers. The average sample of the fifty-seven best lots of seed-wheat collected was graded and placed in piles and photographed to produce this illustration, which should be compared with other similar illustrations given on the adjacent pages. The largest grains are in the left-hand pile, and the smallest grains are in the right-hand pile. It will be seen that the quality of this sample is much below that of a perfectly grown sample of Purple Straw, as shown in Fig 13.

been removed. Here are three such instances :—

| Grades. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Steinwedel .. | 53·2 | 28·0 | 8·7 | 5·8 | 1·8 | ·9 | 1·6 |
| Purple Straw .. | 12·9 | 29·7 | 35·0 | 19·8 | 2·6 | ·1 | ·1 |
| White Lammas.. | 21·3 | 43·7 | 33·9 | 1·2 | .. | .. | .. |

It will be observed that in the White Lammas the small stuff had been completely removed. In the case of the Steinwedel the small grains had been removed, but the "White Heads" and coarse dirt remained to make 1·6 per cent. of the weight. In the grading of the samples all such matters were taken from the various grades and relegated to the tailings, and it is necessary to keep this in mind in estimating from the tables which samples had been previously graded for seed purposes

I take it as unmistakable evidence of grading for seed purposes when all three percentages of the lower grades in the table are very low, as, for instance, in the following case :—

| Grades. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Purple Straw .. | 17·4 | 41·7 | 31·3 | 8·7 | ·3 | ·1 | ·4 |

A Purple Straw that gave such low percentages of tailings and of grades 2·00, 2·25, and 2·50, must have been sifted in order to remove the small seeds, and so make it better for seed purposes.

There are a good number of such instances in the table. If the samples of this type be selected from the table it will be seen that their number is about thirty. I think, however, that about twenty other samples show that something had been done to make them better for seed purposes by the use of the cleaning machine, thus making in all some fifty instances in which there is evidence of an effort on the part of the farmer to improve his seed-wheat by cleaning it or grading it, by which is meant running it several times through a cleaning machine or winnowing machine.


**Fig. 19.**—A very interesting illustration, showing graphically the condition in which the great majority of New South Wales wheat-growers sow their seed. The average New South Wales sample was graded and placed in piles: the largest grains being in the left-hand piles, and the smallest grains in the right-hand piles. On comparison it will be seen that the average condition in which our seed-wheat is sown is considerably below that of the medium sample shown in Fig. 15, and far below that of the seed used by our best growers, as shown in Fig. 18, and very far below that of a perfectly grown sample of the commonest type of New South Wales wheat, as shown in Fig. 13.

It is of interest to see what effect these efforts at grading have had on the seed wheat. I have, therefore, taken fifty-seven cases that show evidence of grading, and I find on averaging them (see p. 18) that they give the following interesting figures, which are graphically illustrated in Figs. 18 and 21 :—

| Grades. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| **Fifty-seven best Samples** .. .. .. | **15·8** | **32·4** | **27·7** | **18·8** | **3·8** | **·8** | **·7** |

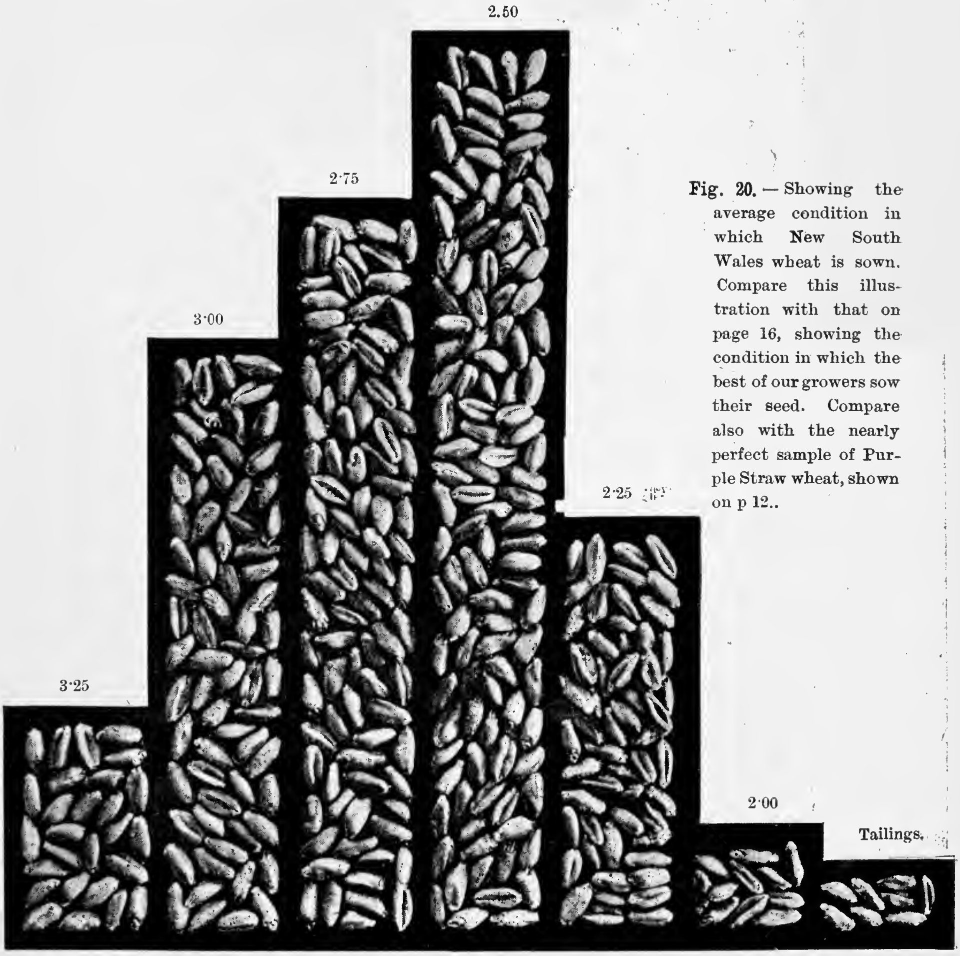



**Fig. 20.** — Showing the average condition in which New South Wales wheat is sown. Compare this illustration with that on page 16, showing the condition in which the best of our growers sow their seed. Compare also with the nearly perfect sample of Purple Straw wheat, shown on p 12..

It will be seen that even these graded samples on the average fall very much short of the normal product of perfectly-grown Purple Straw wheat. If, however, we take the best of the samples shown in the table, we find that they considerably excel the most perfect normal sample that could be grown.

*To What Extent should Farmers Grade their Seed Wheat?*

These figures just quoted, as the result of averaging fifty-seven samples of manifestly-graded samples of seed-wheat as they came from the farmers' hands at sowing-time, show the extent to which our best farmers consider it advisable to re-clean their seed-wheat with a view to improving its qualities. It would, of course, be easy to go on cleaning the seed until it was well nigh impossible to further improve its quality as seed, but the question of expense comes in, and at a certain point the cleaning ceases to be profitable. At what point does additional cleaning become a losing operation? That


**Fig. 21.**–Companion illustration to Fig. 22. This should be compared, also, with the illustrations on page 11. Fig. 21 shows in a striking manner the practice of our best wheat-growers. A useful comparison may be made with Fig. 14, showing a nearly perfect example of Purple Straw wheat, which is in its natural condition.

is the critical question. The answer that our best farmers give is this, as derived from our tables: *An ordinary sample of wheat of the varieties most grown in the State may profitably be cleaned until it reaches the condition represented by the figures last quoted,*—in other words until it reaches the condition shown in Fig. 21 on this page.

In order that this answer may be made as clear as possible, photographs have been made from a sample so cleaned, and the pictures are presented in a variety of ways, so as to give as accurate an idea as possible of the opinion of our best wheat-growers. See illustrations on this and the succeeding pages. The number of these growers, as I have already pointed out, is from one-fifth to one-fourth of our total number. *Would* *it not be wise for the remaining three-fourths to give the most careful heed to this opinion of their confreres,* backed up as it is by their practice, as proved from an impartial examination of their seed taken at the time it was being sown?

A great deal of our wheat is grown under conditions ordinarily called precarious. Our seasons are less reliable than those of many parts of the world where wheat is grown. Hence, on account of this uncertainty of our climate, the vicissitudes that probably confront our wheat crop at the outset of any season, are exceptionally great. Now, we know

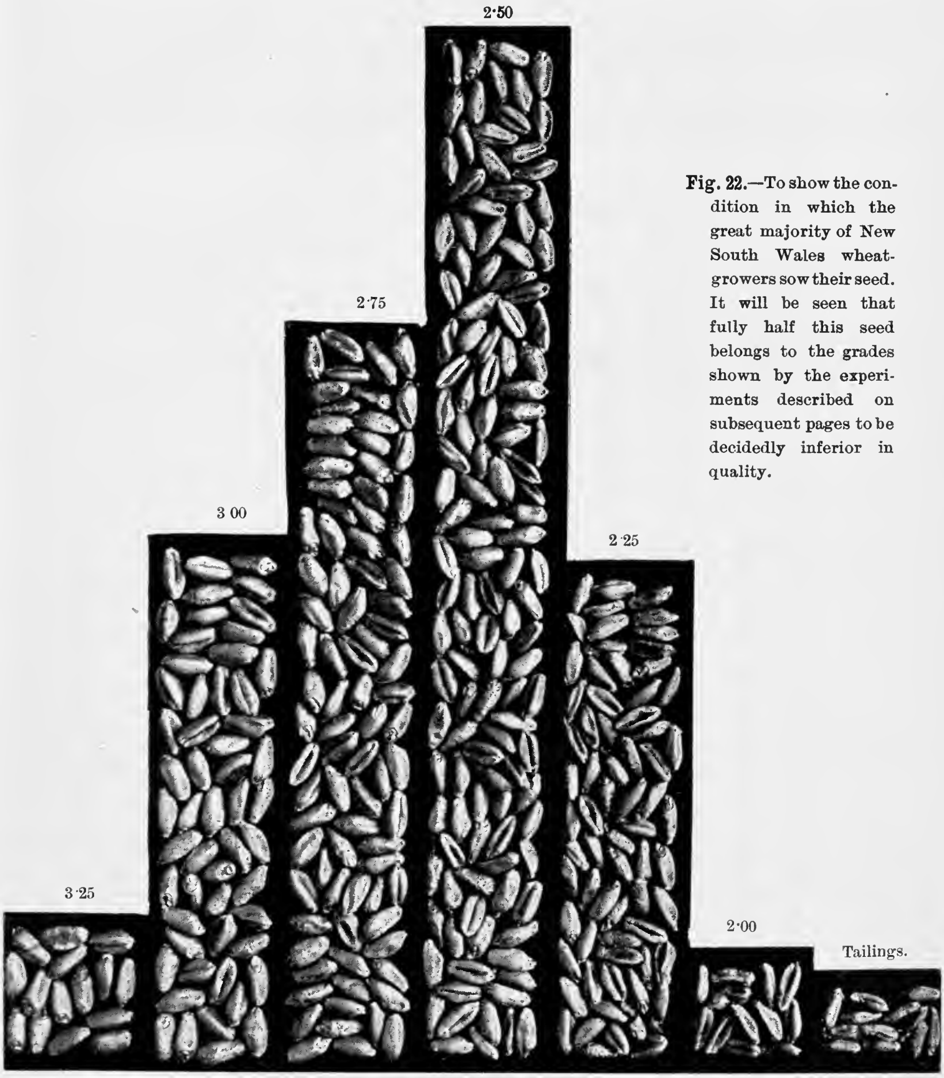



**Fig. 22.**—To show the condition in which the great majority of New South Wales wheat-growers sow their seed. It will be seen that fully half this seed belongs to the grades shown by the experiments described on subsequent pages to be decidedly inferior in quality.

that in tiding over the untoward circumstances of climate small and weak seed stand a poorer chance than large plump seed, a much poorer chance than under favourable climatic conditions. That is the great and special reason why in such a climate as ours we should give particular attention to the quality of our seed. Under our conditions this attention is likely to yield a maximum of profit. The same amount of attention to the same point in a country where the climate is more uniform and reliable would not be likely to be attended with an equal amount of profit.

*Our Usual Practice.*

As opposed to the samples that show evidence of preparation for seed purposes by extra winnowing or sifting, or both, we may examine the remaining three-fourths that do not show such evidences. The average of these samples will show the condition in which three-fourths of our seed wheat is put into the ground. We find this average, graphically illustrated in Fig. 22 on the previous page, to be :—

| Grades. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. |
|---|---|---|---|---|---|---|---|
| Condition in which three-fourths of our seed wheat is sown .. .. .. .. | 4·0 | 16·8 | 24·7 | 33·7 | 15·7 | 3·1 | 2· |

It will be seen that one-fifth is of the 2·25 grade, or smaller, and that half of it is of the 2·50 grade, or smaller. This is a poor showing in comparison with the practice of our best farmers, and a still poorer showing in comparison with the commercial possibilities of the situation, for it must be borne in mind that the average shown even by the *best* portion of New South Wales samples contains too large a proportion of easily and cheaply removable small and low-profit seed.

THE fifty best samples of Seed Wheat submitted.

| No. | % 3·25 | % 3·00 | % 2·75 | % 2·50 | % 2·25 | % 2·00 | % Tailings. | Address. |
|---|---|---|---|---|---|---|---|---|
| 13 | 23·0 | 43·5 | 20·9 | 9·1 | 2·8 | ·4 | ·4 | A. Sleeman .. .. Jerilderie. |
| 26 | 25·6 | 36·8 | 18·6 | 10·8 | 3·8 | 1·7 | 2·6 | Edw. Bowman .. Upper Manilla. |
| 20 | 17·0 | 41·2 | 27·0 | 12·3 | 1·7 | ·3 | ·4 | J. Cockle .. .. Young. |
| 25 | 14·6 | 40·2 | 27·0 | 14·9 | 2·6 | ·4 | ·3 | A. Taylor .. .. Grenfell-road. |
| 34 | 12·9 | 29·7 | 35·0 | 19·8 | 2·6 | ·1 | ·1 | John Westerdale .. Finley. |
| 6 | 31·5 | 43·2 | 15·7 | 5·9 | ·8 | 1·1 | 1·7 | Reuben Ezzy.. .. Millthorpe. |
| 21 | 14·0 | 41·7 | 29·5 | 12·7 | 1·7 | ·3 | ·3 | J. C. Watson .. .. Young. |
| 44 | 6·9 | 24·8 | 32·2 | 27·9 | 7·2 | ·9 | ·3 | Jno. Warren .. .. Dubbo. |
| 24 | 14·0 | 34·7 | 34·3 | 13·8 | 2·7 | ·2 | ·3 | Patrick Kerin .. Marengo. |
| 28 | 20·7 | 37·7 | 21·3 | 13·2 | 3·8 | 1·3 | 2·0 | Mr. French .. .. Neville. |
| 12 | 12·1 | 46·7 | 28·6 | 8·3 | 1·7 | 1·2 | 1·3 | J. D. Baker .. .. Spring Hill. |
| 23 | 16·3 | 38·8 | 28·0 | 12·9 | 2·8 | ·2 | ·3 | S. Caldwell .. .. Young. |
| 14 | 13·7 | 32·8 | 40·8 | 12·3 | ·4 | .. | .. | James Cornell .. Jeir. |
| 43 | 6·5 | 29·8 | 29·3 | 29·8 | 3·8 | ·5 | ·2 | R. Graham .. .. Berrigan. |
| 17 | 17·1 | 43·5 | 25·6 | 10·6 | 1·4 | 1·1 | ·7 | W. M. Masters .. Blayney. |
| 42 | 10·0 | 22·4 | 33·7 | 29·7 | 3·7 | ·4 | ·3 | T. Dugan .. .. Near Dubbo. |
| 10 | 29·5 | 43·4 | 14·7 | 7·6 | 3·0 | 1·1 | ·7 | G. Simmonds.. .. Bective. |
| 33 | 11·2 | 33·7 | 33·1 | 19·1 | 2·2 | ·4 | ·3 | Richard Brown .. Near Tamworth. |
| 11 | 39·8 | 37·8 | 9·9 | 5·4 | 1·3 | 1·6 | 4·2 | Chaffey Bros... .. Moonbi Railway Station. |
| 19 | 13·9 | 47·1 | 24·2 | 11·9 | 2·4 | ·2 | ·3 | E. Taylor .. .. Young. |
| 6 (a) | 17·4 | 41·7 | 31·3 | 8·7 | ·3 | ·1 | ·4 | Jno. Jones, senior .. Nyngan. |
| 45 | 2·0 | 20·0 | 37·0 | 38·0 | 2·3 | ·4 | ·4 | John Robbins.. .. Near Berry Jerry. |
| 48 | 4·0 | 18·0 | 36·1 | 34·0 | 6·2 | 1·7 | .. | C. J. Turner .. .. Coolamon. |
| 2 | 21·3 | 43·7 | 33·9 | 1·2 | .. | .. | .. | James Cornell .. Jeir. |
| 22 | 11·4 | 26·9 | 46·1 | 15·4 | ·1 | .. | .. | James Cornell .. Jeir. |
| 31 | 11·4 | 30·0 | 37·5 | 19·7 | 1·3 | ·1 | .. | Henry Boswell .. Yass. |
| 15 | 15·9 | 44·8 | 26·0 | 10·3 | 1·9 | ·8 | ·3 | T. Quigley .. .. Blayney. |
| 38 | 8·6 | 19·8 | 43·6 | 21·9 | 4·7 | ·9 | ·6 | Patrick Kennedy .. Kialla. |
| 9 | 16·0 | 49·7 | 24·0 | 5·8 | 1·5 | 2·0 | 1·1 | Thomas Martin .. Spring Hill. |
| 8 | 13·9 | 52·1 | 23·8 | 7·1 | 2·3 | ·6 | ·1 | P. McGlynn .. .. Forest Reefs. |
| 49 | 6·4 | 20·4 | 30·5 | 33·8 | 8·2 | ·4 | ·2 | P. H. Osborne .. Duri. |
| 41 | 6·1 | 29·2 | 35·7 | 4·7 | 3·7 | ·2 | ·4 | James Turner .. Adelong Crossing. |
| 18 | 20·0 | 37·2 | 28·6 | 12·0 | 1·9 | ·2 | ·2 | D. Murray .. .. Yass. |
| 3 | 40·8 | 47·2 | 10·5 | 1·5 | .. | .. | .. | Henry Boswell . Yass. |
| 1 | 24·1 | 52·4 | 22·6 | 1·0 | ·1 | .. | .. | W. Hirst .. .. Perth. |
| 29 | 13·4 | 41·7 | 24·5 | 13·0 | 3·8 | 1·2 | 2·5 | Peter Floyd .. .. Lucknow. |
| 32 | 17·6 | 36·9 | 24·0 | 16·6 | 2·9 | ·6 | 1·5 | Chaffey Bros... .. Moonbi Railway Station. |
| 5 | 51·5 | 29·8 | 9·6 | 6·0 | 2·1 | ·7 | ·5 | G. Simmonds.. .. Bective. |
| 7 | 53·2 | 28·0 | 8·7 | 5·8 | 1·8 | ·9 | 1·6 | W. A. Chaffey .. Nemingha House. |
| 35 | 18·6 | 34·4 | 22·7 | 13·6 | 7·3 | 2·7 | ·7 | Thos. Pullman .. Moore Creek. |
| 30 | 9·5 | 40·7 | 29·2 | 16·8 | 2·1 | ·5 | 1·1 | James Gordon .. Murrumburrah. |
| 37 | 10·1 | 25·0 | 37·5 | 22·9 | 3·7 | ·5 | ·4 | A. Crowley .. .. Nundle. |
| 39 | 7·9 | 33·8 | 29·5 | 21·2 | 4·8 | 1·2 | 1·6 | H. Pearce .. .. George Plains. |
| 4 | 26·4 | 41·1 | 24·0 | 6·1 | 1·5 | ·6 | ·5 | Mr. Fultz .. .. Glen Innes. |
| 46 | 10·5 | 19·8 | 26·7 | 32·5 | 8·7 | ·9 | ·8 | John Foot .. .. Castle Mountain. |
| 16 | 21·8 | 40·1 | 24·5 | 9·8 | 2·7 | ·8 | ·4 | Mr. Fultz .. .. Glen Innes. |
| 27 | 37·0 | 28·8 | 15·1 | 11·6 | 3·3 | 2·1 | 2·0 | G. Simmonds .. .. Bective. |
| 36 | 20·7 | 24·8 | 30·0 | 16·3 | 3·9 | 2·2 | 2·2 | Edward Bowman .. Upper Manilla. |
| 47 | 4·3 | 18·2 | 35·1 | 35·3 | 4·9 | ·6 | 1·4 | R. W. McGill .. .. |
| 40 | 7·4 | 29·4 | 34·6 | 23·8 | 3·0 | ·6 | 1·3 | John Kelleher .. Grabben Gullen. |

*Relative Fodder Value of Large and Small Grains of Wheat.*

The relative fodder-value of large and small grains of wheat has been a subject of attention on my part for some years. The amount of decisive evidence one way or the other has, however, been unsatisfactory. From such evidence as was known to me, and from reasoning based on this evidence and by reasoning from analogy, I had come to regard small grains as, weight for weight, of somewhat less feeding value than large grains. The following notes on the subject are of a more definite character than anything I have hitherto been able to formulate from my own observations. They serve to render it probable that the difference is not a large one.

If these conclusions are correct, it is well to keep in mind that they justify to some extent the breeding of wheat-varieties for prolificness regardless of the size of their grains.

Similarly it is well to consider in cleaning and grading wheat for seed that what is removed in the shape of small but otherwise sound grain has a feeding-value about equal to that of large plump grain.

It is well known that some of the most prolific varieties of wheat have spikelets carrying four to five grains, of which the upper ones are quite small. If these small grains had, weight for weight, a smaller food-value than the others, it would become a question how far it is advisable to encourage the prolificness of the plant along these lines. If, on the contrary, the fodder-value of these smaller grains is greater than that of the large grains, or equal to it, then there need be little fear in encouraging the production of such small grains.

As a concrete illustration of the principle under discussion, we may take a wheat of the Defiance type. The illustration on page 5 is of such a wheat. The grains are shown as having been removed from one side of the ear, and they are arranged in the order in which they were taken from the various spikelets. It will be seen how much smaller are the upper grains of the more prolific spikelets than the lower ones.

In order to ascertain the relative value of the two sorts of grain, comparisons were instituted between the large and small grains of the same ears and of the same spikelets. It did not seem worth while to compare the small grains of one ear or plant with the large ones of another ear or plant.

Hence, in order to secure material for a just comparison, a large grain and a small grain were taken from each of seven different spikelets. This gave charges of unequal weight, the seven small grains weighing much less than the seven large grains. The disparity was made up by taking three more small grains from the same spikelets. It was not considered best to collect from other spikelets. In a word, the comparison was made between the large and small grains of the same spikelets derived from near the middle of a single ear. This method seemed to throw out, as far as possible, any factors that would nullify the value of such a comparison.

The selected grains were in all cases plump, and of the best quality of their respective sizes, as the accompanying photographs will witness. The illustrations show the two samples examined, the photographs being taken natural-size just before weighing. (See Figs. 23 and 24 on the next page.)

Relative value of the large and small grains of a Defiance Wheat.

| | Large grains. | Small grains. |
|---|---|---|
| *Bran and embryo (dry) ... ... ... | 12·7 per cent. | 12·0 per cent. |
| Bran, dry ... ... ... ... ... | 10·4 ,, | 9·8 ,, |
| Embryo (by differemce) ... ... ... | 2·3 ,, | 2·2 ,, |

These figures represent weights after a rigid microscopic cleansing from all traces of starch and gluten and other possible contents of the flour cells. This leaves the starch, gluten, water, and water-solubles at 88 per cent. for the small grains, and 87·3 per cent. for the large grains, a slight difference in favour of the small grains, providing the amount of water is proportional in the two cases, and also providing the relative proportions of starch and gluten are the same, and are equally digestible and nutritious. These qualifications are too numerous to be altogether satisfactory. It may, however, be said with some certainty that the amount of flour present in the two cases is, for equal

* The term bran is here used to include all layers down to and including the aleuron layer.

weight of grain, very nearly the same. If there were no milling difficulty in extracting the flour, the weights derived by theoretically perfect milling ought to be about the same.

**Fig. 23.**—Natural size photograph of seven large plump Defiance wheat-grains, used in the biological analysis described in the text. These were compared in "fodder value" with the ten small grains removed from the same spikelets, and shown in Fig. 24.

**Fig. 24.**—Natural size photograph of the ten small plump Defiance wheat-grains, used in the biological analysis described in the text. These were compared in "fodder value" with the seven large grains removed from the same spikelets, and shown in Fig. 23.

It seemed to me probable that the areas of the bran would present differences in the two cases, and accordingly the areas were measured, with the following results :—

Area of the bran of seven large grains used in the foregoing examination, and weighing ·261 gram. ... ... ... 465·1 sq. mm.
Area of the bran of ten small grains, used in the foregoing examination, and weighing ·205 gram. ... ... ... 415·6 sq. mm.

The figures 180·5 and 228· represent, approximately at least, the relative flour content of the two samples.

If the bran areas on large and small grains are proportional to the flour content, then we ought to have—

$$180{\cdot}5 : 228 = 415{\cdot}6 : 465{\cdot}1,$$

but this proportion is not true, the last term requiring to be 523·6 to preserve the equality,—an increase of 12·6 per cent.

From this it will be seen that the area of the bran is *greater in proportion on the small grains.* As a small amount of flour is left attached to the bran after milling, it may be surmised that the additional area of bran in the case of small grains is a disadvantage, as carrying away with it to be sold as bran an additional amount of flour, all the more as the bran of the small grains, being a little thinner, will, other things being equal, be less perfectly freed of its flour.

An experiment on similar lines was carried out with a Purple Straw Wheat. Eight small grains, weighing ·318 gram., were compared with seven large grains, weighing ·447 gram.

Relative value of large and small grains of a Purple Straw Wheat.

| | Large grains. | Small grains. |
|---|---|---|
| Bran and embryo (dry) ... ... ... | 13·2 per cent. | 12·3 per cent. |
| Gluten (dry) ... ... ... ... ... | 8·28 ,, | 7·9 ,, |
| Starch (dry) ... ... ... ... ... | Lost. | 67·6 ,, |

In a general way this evidence is corroborative of that derived from the Defiance wheat. The two samples were obtained in the same way, except that the number of grains in the latter two charges is more equal in number. Not much value is attached to the determinations of starch in this case.

As in the Defiance wheat, so again here, it was found on measuring the areas of the grains that the large grains have less area of bran in proportion to the amount of their contents than do the small grains. To keep the proportion the bran area of the large grains would have to be increased 10·9 per cent. As before the bran of the smaller grains was the thinner.

It is perhaps needless to again call attention to the fact that the grains used for this examination were derived from single ears of wheat, and that therefore the comparison has been made between the large and small grains produced by *one and the same plant.* Whether the result of comparing the large grains and the small grains taken at random would give the same result is another matter, though it seems to me probable that large grains from one plant, when compared with small grains from another of the same variety, grown under similar conditions, would give results corresponding with those presented above.

As the bulk of our wheat is of varieties that produce large and small grains in the same ear, it would seem that the results here given may be applied with safety in discussing questions relating to our wheat crops and their conversion into food products.

Some evidence exists that the flour actually produced from large plump grains is of a better quality than that from small plump grains derived from the same plants, for one thing, the gluten content of the flour from the large grains being higher.

**Fig. 25.**—Natural size photograph of seven large plump grains of a Purple Straw wheat, used in the comparative examination described in the text. These were compared in "fodder value" with the eight small grains removed from the same spikelets, and shown in Fig. 26.

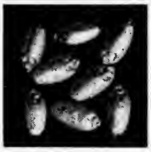


**Fig. 26.**—Natural size photograph of eight small plump grains of a Purple Straw wheat, used in the comparative examination described in the text. These were compared in "fodder value" with the seven large grains removed from the same spikelets, and shown in Fig. 25.

We may supplement these observations on the relative fodder value of large plump grains and small plump grains by saying that shrivelled wheat has a fodder value as chick-feed about equal to that of plump wheat, the fodder value of the shrivelled wheat being reported as the better in some instances. If now we add to this scientific evidence of the good fodder value of shrivelled grains and of small plump grains the well-known fact that the market price of "chick-wheat" is often only a little lower than that of good milling wheat, we see how little ground there is for using wheat tailings as seed on the score of so-called "economy."

## II.—Large and Plump versus Small and Shrivelled Seed.

*The Row System.*

THE tendency of agriculture is such that it must lead to the wider and wider adoption of the row system of experiment. The keynote of agricultural progress is the lessening of the cost of production by a wider and wider use of machines. These machines work in straight lines, at least theoretically, from which it follows that the drill-coulter and its product, *i.e.* a row of plants, comes to represent the unit of agriculture. Each crop is simply so many rows of plants. The row represents the crop reduced to its lowest terms. All the properties of the crop exist in the single row, broadly speaking, and, of course, with exceptions. The exceptions are, however, so few as to exert no great influence on the general statement.

Most experiments are an inquiry into the properties of a small but representative crop, and owing to the costliness of the work the size is reduced as much as is compatible with the end sought. This leads always to a search for the element of which the ordinary crop is simply a multiple. What is this element? We answer—"To-day for the best agriculture it is the single row; and what is true to-day of the best agriculture will in the course of time be true of all agriculture. The wider and wider adoption of machinery appears to make this inevitable."

Though one may not easily find this idea expressed in so many words there is plenty of evidence, in recent agricultural experiment work, of a more extended use of the row system. In the United States it is coming into general use. I speak from personal observation at nearly half the experiment stations in the United States. One needs, however, only to look over the representative views given in the account of these stations as published for the recent Paris Exposition, to see how generally it is adopted. Certain trials that have been going on for many years are being continued on the plot system because they were so begun, but otherwise than this there is a strong tendency, and in my opinion a most laudable tendency, to reduce field experiments as nearly as possible to single rows, and to confine the comparisons to those that can be made between adjacent rows or adjacent long and narrow plots, and to eschew other comparisons. This tendency and that towards the wider introduction of pot experiment work are, I should think, among the most striking tendencies of recent agricultural experiment work.

These remarks are in explanation of the methods adopted in the trials here reported, with reference to the relative value as seed of large, small, and medium-sized wheat grains.

It will be noted that in the tables the reader is directed to make comparisons only between certain rows, these being in all cases rows that were adjacent, and distant from each other two links or about sixteen inches. It may be asked, why not compare other cases? What is the objection to making comparisons between rows two spaces, *i.e.*, four links apart? To these questions I should reply that it is in my opinion unsafe to make such comparisons, because the conditions of growth are so variable. As a single instance

4. 3. 2. 1.

**Fig. 27.**—To show method of testing the qualities of large, medium-sized, and small grains of wheat. Row 1 is from large seed, 2 is from medium-sized seed, 3 is from tailings, while 4 is from extra large and plump seed. The differences in growth are due solely to the varying size of the seed, so far as it was found possible to control the field conditions; and it was found possible to control them to a large extent, as described in the text. The trial here shown is Rattling Jack, 1896.

of this variability of conditions one may cite the difference in the supply of natural water due to various causes. The rain may not fall evenly. Eminent meteorologists assure us that rainfall is very capricious. The rainfall at places only a few feet apart may be quite appreciably different, and under certain conditions of dryness this variation in the fall probably exerts a considerable influence in causing variations in plant growth. Apart from this, it needs no great experience to cause one to question, even when the rain falls evenly, whether it becomes evenly distributed in the soil. Suppose the case of a short shower, in which the precipitation is sharp for a few minutes ; such showers as are not at all uncommon. How is it possible to know that the unavoidable variations in the surface of the soil and variations in the underground condition of the soil do not cause an uneven distribution of this water to the plants of a crop ? Let anyone watch the surface distribution of water during a short shower, as the author has often taken the trouble to do, on ordinary cultivated ground, and he will soon see, if the rainfall becomes sharp, how unevenly the small surface currents distribute the water that afterwards soaks more or less completely into the ground. Thought and observation of this kind have led me to be rather cautious about making comparisons among plants and crops grown under field conditions.

It seems to me that the history of crop experiment work shows a multitude of instances where caution of this kind has remained profoundly unthought of, or else has been thrown to the winds, and I cannot help thinking that much of the admittedly unsatisfactory nature of field experiment work reported is due to this lack of thoughtful caution, combined with a readiness to report the results of a single year's experiments in terms that do not point clearly to the low value that often attaches to an isolated field experiment.

The late Sir John Laws once said to the author, in a conversation on the underlying principles of agricultural experiment work, that he early formed the habit of thinking long over an agricultural theory or experiment before expressing an opinion. One sees in that remark a grain of the wisdom that has made Rothamstead so great a landmark in the history of agriculture. No doubt it was this "long thought" that led to the absence of rash expressions of opinion connected with Rothamstead work.

Most of us might take a leaf from Sir John's book in this respect. To think long and to say little, to repeat experiments again and again so as to be able to compare and verify over and over, and yet say little ; to make endless excursions among the logical pitfalls that are the special danger of the interpreter of field experiments, and yet to say little ; or, as Sir John Laws put it, "to think long" before expressing a definite opinion on an agricultural experiment or theory,—this must certainly be the best possible course to adopt.

Reasoning thus I have been led to abstain from calling attention to any comparisons other than those it is possible to make between the adjacent rows of the seed-wheat experiments now to be described.

*Seed Wheat: Large Plump versus Small Shrivelled Seed.*

The first of the systematic trials to ascertain the relative seed value of large plump grains and small and shrivelled grains were undertaken in 1894. The results of these trials are given in the following table :—

FIRST TRIAL—LARGE PLUMP VERSUS SMALL SHRIVELLED SEED.

| No. | Sown. | (Approximate) Grade. | Length of Row. | No. of Plants that grew. | Lb. Harvested. | | Grain. | Straw. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Grain. | Straw. | Bu. to Acre. | Cwt. to Acre. | |
| | | | | *Zealand.* | | | | | |
| 1 | May 4 .. | 300 | 1·21 ch. | 91 | 2·41 | .... | 16·60 | .... | Comp. No. 2. |
| 2 | ,, .. | 200 | ,, | 106 | 2·09 | .... | 14·40 | .... | Comp. No. 1. |
| | | | | *Zealand.* | | | | | |
| 3 | May 4 .. | Plump .... | 1·21 ch. | .... | 2·22 | .... | 15·30 | .... | Comp. No. 4. |
| 4 | ,, .. | Shrivelled . | ,, | .... | 2·13 | .... | 14·68 | .... | Comp. No. 3. |
| | | | | *Hudson's Early Purple Straw.* | | | | | |
| 5 | May 6 .. | 300 | 1·26 ch. | 111 | 4·72 | .... | 31·22 | .... | Comp. No. 6. |
| 6 | ,, .. | do. Shriv. | ,, | 107 | 3·72 | .... | 24·60 | .... | Comp. No. 5. |
| | | | | *Rattling Jack.* | | | | | |
| 7 | May 10.. | 300 | 0·95 | 65 | 2·44 | .... | 21·40 | .... | Comp. No. 8. |
| 8 | ,, .. | Shrivelled . | 0·75 | 75 | 2·81 | ... | 24·65 | .... | Comp. No. 7. |
| | | | | *White Velvet.* | | | | | |
| 9 | May 19.. | 300 | 1·10 ch. | 97 | 1·69 | .... | 12·80 | .... | Comp. No. 10. |
| 10 | ,, .. | Shrivelled . | ,, | 80 | 1·34 | .... | 10·15 | .... | Comp. No. 9. |

This set of experiments is interesting chiefly as the initial set of the whole series, and as the one that gave direction to all the following sets. The difficulty of securing anything like exactness in the grading of the samples planted gave rise to the adoption of the sieves with accurately constructed millimetre meshes,* and to the methods of

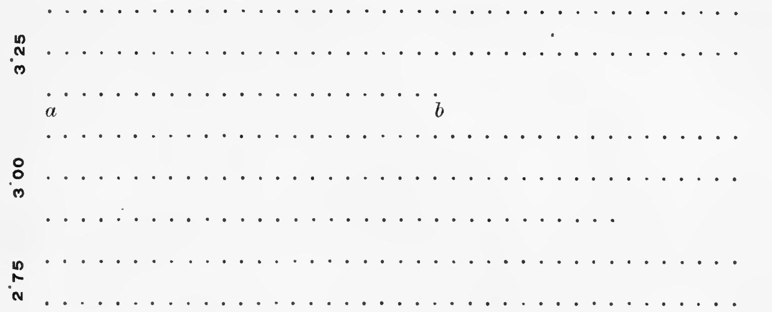



**Fig. 28.**—Diagram to represent the method of planting the rows. The first three rows, 2 links apart with plants 1 link apart in the rows, are of the 3·25 grade. The third row is incomplete because of insufficient seed, and hence only the portion *a* to *b* could be compared with the corresponding portion of the first row of the 3·00 grade plants. Most of the fractional rows reported in the tables arose in this manner.

grading described below. The present samples of seed were hand-picked, and the grade numbers inserted in the table are only approximate, as they were derived afterwards by comparison with graded samples. The land was newly cleared and very patchy, and in this respect not in very good condition for wheat, or for experiment purposes. The season was one of the best ever experienced on the Wagga Farm. The spring rains at the time of sowing were abundant, and throughout the season the conditions were favourable to the growth of wheat. The crops of the district were unusually good. It was the year of the flood of the Murrumbidgee River.

The object of the experiments was to try good plump grains alongside rust-shrivelled ones, the latter, of course, being at the same time smaller than the former. In the four cases where the smaller seeds are marked shrivelled, they were so from the effects of rust, having been selected for the purpose of these trials from rusty plants the previous season.

Summing up, we may say that the plump seed gave the best return of grain in four cases out of five, and that the average excess was 18·52 per cent. taking the lower yield as the basis of computation, while in the single case in which the shrivelled seed exceeded the yield of the plump, the excess was 15·19 per cent. The straw was not weighed : had it been weighed it probably would have been shown, as in subsequent years, that the total marketable product was greatest from the large and plump seeds in practically all cases. This opinion was formed when it was too late to examine the straw, and this was what led to weighing the straw in subsequent years.

The number of trials was too small to be completely satisfactory.

*How the various sizes of seed were prepared for the second and subsequent trials.*

The method adopted to obtain seed for the comparative tests gave seven grades, each grade being composed of seeds very much alike in size, and, consequently, also in weight. These are the seven grades so frequently mentioned in the first part of this report, and illustrated in Figs. 4 to 10. The seeds might have been selected by weight instead of by size, or they might have been selected by a process taking account of both size and weight. The method adopted—that of sieving—is, however, nearly the same as that by means of which seed-wheat should be prepared on the large scale, and this fact was what decided the method of selection.

The following three points are worthy of note in connection with the process of selection by means of the sieves here used. They have a definite bearing on the subject, and should be studied carefully by the reader who wishes to understand the details of the investigation.

(1.) As the various transverse diameters of wheat grains are unequal, the grains will stop, or not stop, on a mesh of a certain size, according as they happen to present one or the other diameter towards the mesh. This would lead to unequal grading if a sample of grain were simply passed once through the sieve. In order to get gradings that are as nearly as possible comparative, it is, therefore, necessary to continue passing the sample through the

* These sieves are shown and explained in Figs. 2 and 3.

sieve until all the grains will invariably pass through. These repeated sievings give each grain a chance to present its largest transverse diameter to the mesh, and so ultimately to remain in the sieve and be saved in that grade if possible. This repeated sieving will, however, introduce a very serious error if the meshes of the sieves be not quite accurate. If, for instance, there is one mesh in a sieve that is a little larger than the others one might keep on sieving until all the grains had had a chance to pass through this particular mesh, in which case it is evident that the whole sample would become wrongly graded. The repeated sieving is very tedious, and to really reach a stage at which no grain will fail to pass, requires a very long time. It has, therefore, been the writer's practice to have the samples passed through each grade sieve a certain number of times according to the exactness required. Thus, in a certain instance where moderate accuracy would suffice, the samples would be passed five times through. In other instances they would be passed ten times through, and so on. Of course, in a given experiment all samples would be treated alike. As to the size of the meshes and their accuracy, in the absence of any standard an arbitrary one based on metric measures was adopted, as explained elsewhere; and to ensure accuracy the author himself made and adjusted the meshes of the sieves employed, and periodically inspected them in order to ensure regularity in the gradings. See pages 2 and 3, and Figs. 2 and 3.

(2.) A shrivelled grain is always smaller than it would have been if it had grown properly, so that in the process of grading here employed such grains fall into lower grades than they would have fallen into had they grown properly. From this it happens that in all the comparisons here presented we have to a greater or less extent, yet often to a small and insignificant extent, trials between plump and shrivelled grains, that is provided there were any shrivelled grains in the samples being tested, as was usually, in fact almost invariably, the case. Of course this refers to grains shrivelled from whatever cause. In certain cases specially noted the cause of the shrivelled condition was known, and the observations were directed specially towards the behaviour of such cases. It is believed that in most cases the shrivelled condition of the grains was due to a variety of causes, including all of the common causes of shrivelling.

(3.) All varieties of wheat, and especially some of them, present grains that in comparison with their fellows are flat, and such grains pass on in the method of grading here employed to lower grades than their real weight and size would entitle them to occupy. On the other hand the same varieties also present roundish grains that stop in higher grades than they should by strict right occupy. I think these two opposite qualities may just about neutralise each other in all the grades except the highest and lowest; in these, however, it seems probable than an appreciable difference in yield is caused, namely, the yield of the highest will be relatively lowered and the yield of the lowest will be relatively raised. These remarks apply to normal seeds. Where the seeds are much shrivelled they often pass on to the tailings, and there present themselves as grains, apparently much larger than the average of the tailings on account of their tendency to present to the eye their largest rather than their narrowest contour. Such grains, of course, were laid out for large-sized ones, but for some reason they have failed to fill out, though they may sometimes contain a good-sized embryo. I have no doubt that this fact will explain to some extent the results of the comparisons between the tailings and the 200 grade, in which comparisons there appears a smaller superiority of the 200 than would be naturally expected, considering the results of the other comparisons.

### *Shrivelled Grain.*

It is impossible to give a perfectly accurate definition of the term "shrivelled seed." It is, nevertheless, necessary in a discussion of this subject, to make it clear what degree of imperfect growth is meant by the term as used in various connections.

What is meant by saying that shrivelled seed is poor seed or the reverse? Probably the cause of the whole discussion on the value of shrivelled wheat-seed has been the fact that extremely inferior-looking seed will actually germinate and, to a certain extent, grow and bear a crop. To one who does not understand the physiology of plant growth, this phenomenon may seem wonderful, but to the initiated it is in no degree remarkable. The fact that seed "as light as chaff" has been sown and has produced a crop of grain has, nevertheless, given rise to considerable surprise, a good deal of discussion, and, unfortunately, much wrong practice.

From this it follows that the term "shrivelled seed," as sometimes used in this connection, means seeds that are much shrivelled, so shrivelled as to be easily blown away by the wind. I do not, however, confine the term in this manner. By shrivelled seed, I mean seed that is in any marked degree shrivelled; and in order to give the discussion more definiteness, drawings of seeds variously shrivelled are inserted (see p. 1), and these are referred to in the text in such a manner as to render mistake unlikely.

### Second Trial.

The second set of trials in connection with the relative seed value of large, medium sized, and small grains of wheat was undertaken in 1895. The tabulated results of these trials are given below. (See page 27.)

It will be seen that the experiments include 117 trial rows containing twenty-three varieties of wheat, representative of all the types that are largely grown in the State. The trials cover about seventy different comparisons between equal numbers of seeds of varying grades or sizes, the comparison being between the yields of grain and straw from larger grains on the one side and smaller grains on the other.

The season was an average season, and the land was typical Riverina wheat land with perhaps a tendency to vary more than usual towards freshly-decomposed granite. The rows were placed side by side, and occupied, with the other rows among which they were distributed, a space 2 chains wide and 3 chains long. The land sloped gently toward the west, and improved in quality from top to bottom. The "small-seed" rows were in all cases on the down-hill side, so that whatever difference in fertility there was from the gradual change for the better at the lower end of the plot was in favour of the small seeds. This small balance in favour of the small seeds would be trifling in amount, as the rows compared were never more than 2 links apart, and I have, therefore, disregarded it. There is no way of satisfactorily estimating its amount, and it is, accordingly, necessary to content oneself with the general statement of its existence and the insignificance of its amount.

It must be borne in mind, however, that the various pairs of rows were, as a rule, not adjacent to each other, so that the reader must guard against the impression that in the case of any variety he is reading the records of a *succession* of rows. In the table the various rows are numbered in succession for convenience of reference; but the actual growth was in a different order. There is no chance of error in reading if the reader simply notes what comparisons are to be made, and, as before pointed out, this is only permissible in the case of two rows growing next each other. Sometimes the middle row of three is compared with each of the two adjacent rows.

The rows were cared for by hand during the entire season. There was no cultivation beyond that necessary to keep down the weeds; but this was an amount that must be taken into consideration in interpreting the results. The weeds were pulled by hand, or were cut out with a hand hoe. There was no desire to cultivate, but simply a desire to give the trial rows, as nearly as possible, identical conditions. If the weeds would have grown uniformly, they would have been allowed to grow. As they would not grow uniformly, but would grow more in one place than another, and thus rob one row more than another, it was thought best to keep them down with as little disturbance to the soil as possible.

This removal of the weeds is, it seems to me, decidedly in favour of the smallest seeds, as the trials show that nearly if not quite all adverse conditions are more severe on the smallest seeds. Hence relieving the smallest seeds from the competition of weeds was a greater favour to them than to the largest seeds. I do not consider that this matter was of much importance in comparisons of adjacent rows from seed above the 250 grade or thereabouts, but I think that the tailings and the 200 grade benefited considerably by this treatment as compared with the larger grades.

If there be objection to assuming that the method adopted would really favour the smaller seed, there can hardly be any objection to assuming that at least there was no favour shown the large seed, unless, indeed, it be assumed that culture favours large seed more than it does small seed, an assumption so far removed from probability that I think it may be safely disregarded.

If the method followed was neutral so far as relative yield is concerned, then in calculating how much a farmer can afford to spend in improving his seed we have a simple proportion. If, for instance, the yields here given are twice those the farmer is accustomed to get, then the extra yield here shown to be due to the use of large plump seed has only to be divided by two to give the figures upon which the farmer may proceed.

An examination of the tables will at once show that under the conditions of the trials there was inferior germination and growth of the smallest seeds, or perhaps it would be better to confine the statement to that part which relates to growth. The table pretends to show nothing as to the precise amount of germination that took place, the statistics being confined to the number of plants that actually grew and presented themselves at harvest-time in a condition in which it was possible to cut and weigh them. It may be as well to state, however, that the plants missing at harvest-time were almost wholly instances of failure to properly germinate, at any rate in the cases of the smallest grains. If these lost plants appeared above ground, they were weak seedlings that could not compete with ordinary conditions, and so succumbed. The care exercised was such that it was very rare indeed for a plant to be injured by the method adopted to keep down the weeds. Where a plant disappeared it may be taken for granted that it was from "natural" causes.

*How the yields were compared.*

In the following tables, generally speaking, the comparisons are made between the yield of plants grown from seed of one grade and the yield from seed of the grade next below; but this is not always the case. In some instances the yield from the largest seed (Fig. 4) is compared with the yield from the smallest seed (Fig. 10), but such instances are exceptional. Grade 200 was necessarily always compared with the tailings; so also 225 could be compared only with the grade immediately below or with that two steps below. As we progress to higher and higher grades there is an ever-increasing chance that the comparison may be between widely-different grades; but, as before remarked, the aim in this statement of trials was to compare, as far as convenient, each grade with that one or two steps below it, and this result was, in general, secured, as will be seen on examining the tables in detail. A rather different and simpler system was adopted in the third and subsequent trials.

Perhaps, the best general statement of the results may be made by saying that the 325 grade proved itself better in capacity to grow and to yield both grain and straw than the 300 grade; that in a similar manner the 300 grade proved itself superior to the 275 grade, which in turn proved superior to 250 grade, and so on to the bottom of the list. We have to make an exception in the case of the 225 grade, where, in fact, the number of trials is too small to be decisive.

However, even this statement of the superiority of each grade over those immediately below it, and by implication and in fact, over *all* below it, is not a statement that needs no explanation or qualification, for it will be observed that the relative superiority of the 200 grade while it is decisive for the season in question is not so great as that of other grades. This is due to two facts—first, the comparison was always with the grade immediately below, while in the other grades, in some instances, the comparisons were extended to grades two and three steps below; second, the tailings with which the 200 was always compared is a miscellaneous lot of seed that passes the two-millimetre mesh, but may, nevertheless, contain some really rather large seed, owing to the fact that some seeds in every lot are so flat that they pass on to the grades lower than their real size would warrant. Now, while this fact operates throughout the system of seeding obtained by the process of grading adopted, I am inclined to think that it operates most strongly in the case of the tailings where there is no further attempt to grade, and where, therefore, these extra flat seeds collect that should pass on to lower grades, if such existed.

TABLE of Yields of Grain and Straw. (Second Trial.)

| No. | Sown. | Grade. | Length of Row, in Links. | No. of Plants that grew. | Lb. Harvested. | | Grain. | Straw. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Grain. | Straw. | Bu. to Acre. | Cwt. to Acre. | |
| | | | | | *Algerian.* | | | | |
| 1 | May .. | 325 | 192 | 182 | 4·09 | 7·13 | 17 72 | 18·54 | Comp. No. 2. |
| 2 | ,, .. | 275 | 192 | 164 | 3·52 | 6·50 | 15·25 | 16·90 | ,, Nos. 1 and 3. |
| 3 | ,, .. | 250 | 192 | 149 | 4·47 | 7·00 | 19·37 | 18·20 | ,, No. 2. |
| | | | | | *Allora Spring.* | | | | |
| 4 | 6 May .. | 250 | 192·5 | 172 | 6·46 | 7·00 | 27·99 | 18·20 | Comp. No. 5. |
| 5 | 5 June .. | 200 | 192·5 | 162 | 6·11 | 6·63 | 26·48 | 17·24 | ,, Nos. 4 and 6. |
| 6 | 5 ,, .. | Tls. | 192·5 | 141 | 6·06 | 5·00 | 26·26 | 13·00 | ,, No. 5. |
| | | | | | *Allora Spring 2nd.* | | | | |
| 7 | 5 June .. | 250 | 192·5 | 179 | 6·10 | 6·06 | 26·43 | 15·76 | Comp. No. 8. |
| 8 | 5 ,, .. | Tls. | 192·5 | 157 | 5·44 | 3·81 | 23·57 | 9·91 | ,, No. 7. |
| | | | | | *Australian Talavera.* | | | | |
| 9 | May .. | 300 | 192 | 169 | 6·06 | 7·88 | 26·26 | 20·49 | Comp. No. 11. |
| 10 | ,, .. | 250 | 192 | 169 | 7·74 | 9·00 | 33·54 | 23·40 | ,, No. 11. |
| 11 | ,, .. | 275 | 192 | 161 | 6·19 | 7·56 | 26·82 | 19·66 | ,, Nos. 9 and 10. |
| | | | | | *Bearded Quartzlee.* | | | | |
| 12 | 5 June .. | 275 | 192·5 | 179 | 6·02 | 4·88 | 26·09 | 12·69 | Comp. No. 13. |
| 13 | 5 ,, .. | 250 | 192·5 | 177 | 6·07 | 5·75 | 26·30 | 14·95 | ,, No. 12. |
| 14 | 5 ,, .. | 250 | 99 | 95 | 3·60 | 3·19 | 30·31 | 16·11 | ,, No. 15. |
| 15 | 5 ,, .. | Tls. | 99 | 90 | 3·59 | 2·75 | 30·23 | 13·89 | ,, No. 14. |
| 16 | 4 ,, .. | 275 | 192·5 | 178 | 6·00 | 5·50 | 26·00 | 14·30 | ,, No. 17. |
| 17 | 4 ,, .. | 250 | 192·5 | 174 | 5·95 | 5·38 | 25·78 | 13·99 | ,, No. 16. |
| 18 | 4 ,, .. | 250 | 192·5 | 180 | 6·78 | 6·06 | 29·38 | 15·76 | ,, No. 19. |
| 19 | 4 ,, .. | Tls. | 192·5 | 166 | 5·90 | 5·00 | 24·58 | 13·00 | ,, No. 18. |

TABLE of Yields of Grain and Straw. (Second Trial)—*continued.*

| No. | Sown. | Grade. | Length of Row, in Links. | No. of Plants that grew. | Lb. Harvested. Grain. | Lb. Harvested. Straw. | Grain. Bu. to Acre. | Straw. Cwt. to Acce. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *Blount's Lambrigg, Hay.* | | | |
| 20 | 1 June .. | 200 | 192 | .... | .... | 5·19* | .... | 13·49 | Hay, comp. No. 21. |
| 21 | 1 ,, .. | 275 | 192 | .... | .... | 7·88 | .... | 20·49 | ,, ,, Nos. 20 & 22. |
| 22 | 1 ,, .. | 200 | 192 | .... | .... | 7·63* | .... | 19·84 | ,, ,, No. 21. |
| | | | | | | *Canning Downs.* | | | |
| 23 | 6 June .. | 325 | 102 | 94 | 4·66 | 2·25 | 38·07 | 11·03 | Comp. No. 24. |
| 24 | 6 ,, .. | 300 | 102 | 91 | 3·57 | 1·63 | 29·17 | 7·99 | ,, No. 23. |
| 25 | 6 ,, .. | 275 | 192·5 | 175 | 6·50 | 3·38 | 28·17 | 8·79 | ,, No. 26. |
| 26 | 6 ,, .. | Tls. | 192·5 | 159 | 6·38 | 2·56 | 27·65 | 6·66 | ,, No. 25. |
| 27 | 6 ,, .. | 300 | 192·5 | 119 | 6·15 | 3·31 | 26·65 | 8·61 | ,, No. 28. |
| 28 | 6 ,, .. | 275 | 192·5 | 174 | 6·69 | 3·63 | 28·99 | 9·44 | ,, No. 27. |
| 29 | 6 ,, .. | 250 | 192·5 | 175 | 7·56 | 4·00 | 32·76 | 10·40 | ,, No. 30. |
| 30 | 6 ,, .. | Tls. | 192·5 | 149 | 7·60 | 3·31 | 32·93 | 9·44 | ,, No. 29. |
| 31 | 6 ,, .. | 300 | 192·5 | 163 | 7·99 | 4·19 | 34·62 | 10·89 | ,, No. 32. |
| | 6 ,, .. | 275 | 192·5 | 169 | 7·23 | 4·94 | 31·33 | 12·85 | ,, No. 31. |
| | | | | | | *Early Baart.* | | | |
| 33 | May .. | 325 | 75 | 64 | 3·76 | 3·25 | 41·74 | 21·65 | Comp. No. 34. |
| 34 | ,, .. | 300 | 75 | 68 | 2·94 | 2·50 | 32·63 | 16·65 | ,, No. 33. |
| 35 | ,, .. | 300 | 192·5 | 169 | 6·96 | 6·56 | 30·16 | 17·06 | ,, No. 36. |
| 36 | ,, .. | 275 | 192·5 | 164 | 6·74 | 6·38 | 29·21 | 16·59 | ,, Nos. 35 and 37. |
| 37 | ,, .. | 225 | 192·5 | 175 | 6·69 | 6·31 | 28·99 | 16·41 | ,, Nos. 36 and 38. |
| 38 | ,, .. | 200 | 192·5 | 165 | 7·72 | 6·38 | 33·45 | 16·59 | ,, No. 37. |
| | | | | | | *Early Para.* | | | |
| 39 | May .. | 275 | 192 | 166 | 6·61 | 6·06 | 28·64 | 15·76 | Comp. No. 40. |
| 40 | ,, .. | 200 | 192 | 156 | 5·32 | 5·00 | 23·05 | 13·00 | ,, No. 39. |
| 41 | ,, .. | 200 | 192 | 152 | 6·24 | 5·69 | 27·04 | 14·79 | ,, No. 42. |
| 42 | ,, .. | Tls. | 192 | 137 | 4·85 | 4·25 | 21·02 | 11·15 | ,, No. 41. |
| | | | | | | *Golden Drop.* | | | |
| 43 | 5 June .. | 300 | 102 | .... | 2·83 | 3·00 | 23·12 | 14·70 | Comp. No. 44. |
| 44 | 5 ,, .. | 275 | 102 | 85 | 2·90 | 3·06 | 23·69 | 14·99 | ,, No. 43. |
| 45 | 5 ,, .. | 275 | 192·5 | 177 | 6·77 | 6·63 | 29·34 | 17·24 | ,, No. 46. |
| 46 | 5 ,, .. | Tls. | 192·5 | 148 | 5·92 | 5·63 | 25·65 | 14·64 | ,, No. 45. |
| | | | | | | *Gross's Prolific.* | | | |
| 47 | May .. | 300 | 192 | 177 | 6·11 | 6·88 | 26·48 | 17.89 | Comp. No. 48. |
| 48 | ,, .. | 275 | 192 | 176 | 6·18 | 6·69 | 26·78 | 17·39 | ,, No. 47. |
| 49 | ,, .. | 275 | 192 | 179 | 6·29 | 6·25 | 27·26 | 16·25 | ,, No. 50. |
| 50 | ,, .. | 250 | 192 | 182 | 6·08 | 6·13 | 26·35 | 15·94 | ,, No. 49. |
| 51 | ,, .. | 250 | 192 | 175 | 5·87 | 6·25 | 25·44 | 16·25 | ,, No. 52. |
| 52 | ,, .. | 200 | 192 | 176 | 5·37 | 5·63 | 23·27 | 14·64 | ,, No. 51. |
| 53 | ,, .. | 200 | 192 | 168 | 5·62 | 5·44 | 24·35 | 14·14 | ,, No. 54. |
| 54 | ,, .. | Tls. | 192 | 174 | 6·56 | 5·63 | 28·43 | 14·64 | ,, No. 53. |
| | | | | | | *Hudson's Early Purple Straw.* | | | |
| 55 | May .. | 300 | 123 | 117 | 5·62 | 5·69 | 38·10 | 23·13 | Comp. No. 56. |
| 56 | ,, .. | 200 | 123 | 104 | 4·36 | 4·88 | 29·56 | 19·84 | ,, No. 55. |
| 57 | ,, .. | 200 | 123 | 98 | 4·80 | 4·38 | 32·54 | 17·80 | ,, No. 58. |
| 58 | ,, .. | Tls. | 123 | 85 | 4·87 | 5·25 | 33·02 | 21·34 | ,, No. 57. |
| | | | | | | *King's Jubilee.* | | | |
| 59 | 6 June .. | 325 | 63 | 51 | 2·60 | 1·69 | 34.40 | 13·42 | Comp. No. 60. |
| 60 | 6 ,, .. | 300 | 63 | 61 | 2·14 | 1·56 | 28·31 | 12·39 | ,, No. 59. |
| 61 | 6 ,, .. | 300 | 192·5 | 170 | 6·57 | 4·63 | 28·47 | 12·04 | ,, No. 62. |
| 62 | 6 ,, .. | 275 | 192·5 | 154 | 6·18 | 5·31 | 26·78 | 13·81 | ,, No. 61. |
| 63 | 6 ,, .. | 275 | 177 | 170 | 6·97 | 4·44 | 32·83 | 12·54 | ,, No. 64. |
| 64 | 6 ,, .. | 250 | 177 | 157 | 6·29 | 4·75 | 29·63 | 13·42 | ,, No. 63. |
| 65 | 6 ,, .. | 250 | 107 | 91 | 4·15 | 3·25 | 32·33 | 15·19 | ,, No. 66. |
| 66 | 6 ,, .. | Tls. | 107 | 82 | 3·96 | 2·63 | 30·85 | 12·29 | ,, No. 65. |
| | | | | | | *Marshall's No. 3.* | | | |
| 67 | 3 June .. | 200 | 192·5 | 171 | 5·66 | 4·81 | 24·53 | 12·51 | Comp. Nos. 68 and 69. |
| 68 | 3 ,, .. | Tls. | 192·5 | 156 | 5·28 | 3·41 | 22·88 | 8·87 | ,, No. 67. |
| 69 | 3 ,, .. | 300 | 192·5 | 178 | 6·52 | 5·56 | 28·25 | 14·46 | ,, No. 67. |
| 70 | 3 ,, .. | 300 | 192·5 | 186 | 6·55 | 5·56 | 28·38 | 14·46 | ,, No. 71. |
| 71 | 3 ,, .. | 200 | 192·5 | 175 | 5·85 | 4·38 | 25·35 | 11·39 | ,, Nos. 70 and 72. |
| 72 | 3 ,, .. | Tls. | 192·5 | 177 | 6·19 | 4·69 | 26·82 | 12·19 | ,, No. 71. |
| | | | | | | *Marshall's No. 8.* | | | |
| 73 | May .. | 300 | 192 | 180 | 6·28 | 7·75 | 27·21 | 20·15 | Comp. No. 74. |
| 74 | ,, .. | 275 | 192 | 176 | 5·78 | 7·63 | 25·05 | 19·84 | ,, Nos. 73 and 75. |
| 75 | ,, .. | 225 | 192 | 175 | 5·68 | 7·19 | 24·61 | 18·69 | ,, Nos. 74 and 76. |
| 76 | ,, .. | 200 | 192 | 171 | 6·08 | 7·69 | 26·35 | 19·99 | ,, Nos. 75 and 77. |
| 77 | ,, .. | Tls. | 79 | 61 | 2·35 | 3·31 | 24·79 | 20·96 | ,, No. 76. |

TABLE of Yields of Grain and Straw. (Second Trial)—*continued.*

| No. | Sown. | Grade. | Length of Row, in Links. | No. of Plants that grew. | Lb. Harvested. Grain. | Lb. Harvested. Straw. | Grain. Bu. to Acre. | Straw. Cwt. to Acre. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Red Straw.* | | | | | |
| 78 | 4 June .. | 275 | 192·5 | 176 | 6·85 | 5·31 | 29·68 | 13·81 | Comp. No. 79. |
| 79 | 4 ,, .. | 200 | 192·5 | 166 | 6·65 | 5·50 | 28·82 | 14·30 | ,, Nos. 78 and 80. |
| 80 | 4 ,, .. | Tls. | 192·5 | 157 | 7·04 | 5·06 | 30·51 | 13·16 | ,, No. 79. |
| | | | | *Talavera de Bellevue.* | | | | | |
| 81 | 1 June .. | 300 | 97 | 92 | 2·41 | 2·38 | 20·70 | 12·27 | Comp. No. 82. |
| 82 | 1 ,, .. | 275 | 97 | 93 | 2·53 | 2·75 | 22·75 | 14·18 | ,, No. 81. |
| 83 | 1 ,, .. | 275 | 75 | 70 | 2·22 | 2·69 | 24·64 | 17·94 | ,, No. 84. |
| 84 | 1 ,, .. | 200 | 75 | 69 | 1·83 | 2·06 | 20·31 | 13·73 | ,, Nos. 83 and 85. |
| 85 | 1 ,, .. | Tls. | 75 | 61 | 1·88 | 1·69 | 20·87 | 11·27 | ,, No. 84. |
| | | | | *Velvet Pearl.* | | | | | |
| 86 | May .. | 300 | 192·5 | 170 | 7·11 | 4·88 | 30·81 | 12·69 | Comp. No. 87. |
| 87 | ,, | Pigmy | 192·5 | 129 | 55·6 | 3·50 | 25·09 | 9·10 | ,, No. 86. |
| 88 | ,, .. | 250 | 192·5 | 173 | 5·92 | 4·44 | 25·65 | 11·54 | ,, No. 89. |
| 89 | ,, .. | 200 | 192·5 | 156 | 5·79 | 4·13 | 25·09 | 10·74 | ,, Nos. 88 and 90. |
| 90 | ,, .. | Tls. | 192·5 | 122 | 5·37 | 3·56 | 23·27 | 9·26 | ,, No. 89. |
| | | | | *White Lammas.* | | | | | |
| 91 | 3 June .. | 325 | 192·5 | 187 | 6·14 | 9·06 | 26·61 | 23·55 | Comp. No. 92. |
| 92 | 3 ,, .. | 300 | 192·5 | 179 | 5·44 | 8·31 | 23·57 | 21·61 | ,, No. 91. |
| 93 | 3 ,, .. | 300 | 110 | 101 | 3·13 | 4·38 | 23·71 | 19·91 | ,, No. 94. |
| 94 | 3 ,, .. | 275 | 110 | 102 | 2·79 | 3·81 | 21·14 | 17·32 | ,, No. 93. |
| 95 | 3 ,, .. | 275 | 127 | 118 | 3·59 | 4·75 | 23·55 | 18·70 | ,, No. 96. |
| 96 | 3 ,, .. | 225 | 127 | 121 | 4·25 | 5·44 | 27·88 | 21·42 | ,, No. 95. |
| 97 | 3 ,, .. | 300 | 158 | 139 | 5·23 | 6·44 | 27·56 | 20·38 | ,, No. 98. |
| 98 | 3 ,, | 200 | 158 | 146 | 4·34 | 5·31 | 22·87 | 16·81 | ,, Nos. 97 and 99. |
| 99 | 3 ,, .. | Tls. | 158 | 137 | 5·34 | 5·63 | 28·14 | 17·82 | ,, No. 98. |
| | | | | *White Naples.* | | | | | |
| 100 | May .. | 275 | 97 | 90 | 2·51 | 2·88 | 21·56 | 14·85 | Comp. No. 101 |
| 101 | ,, .. | 225 | 97 | 86 | 2·54 | 2·75 | 21·82 | 14·18 | ,, No. 100. |
| | | | | *White Tuscan.* | | | | | |
| 102 | 3 June .. | 275 | 145 | 141 | 4·67 | 5·31 | 26·84 | 18·31 | Comp. No. 103. |
| 103 | 3 ,, .. | 200 | 145 | 137 | 4·31 | 4·75 | 24·77 | 16·38 | ,, Nos. 102 & 104 |
| 104 | 3 ,, .. | Tls. | 145 | 131 | 5·51 | 4·69 | 31·67 | 16·17 | ,, No. 103. |
| | | | | *White Velvet.* | | | | | |
| 105 | May .. | 300 | 192 | 168 | 8·75 | 6·63 | 37·92 | 17·24 | Comp. No. 106. |
| 106 | ,, .. | 275 | 192 | 176 | 8·25 | 5·75 | 35·75 | 14·95 | ,, No. 105. |
| 107 | ,, .. | 275 | 192 | 176 | 7·44 | 5·63 | 32·24 | 14·64 | ,, No. 108. |
| 108 | ,, .. | 200 | 192 | 181 | 6·26 | 4·63 | 27·13 | 12·04 | ,, No. 107. |
| 109 | ,, .. | 200 | 192 | 177 | 6·60 | 4·75 | 28·60 | 12·35 | ,, No. 110. |
| 110 | ,, .. | Tls. | 192 | 159 | 6·35 | 4·06 | 27·52 | 10·56 | ,, No. 109. |
| | | | | *Zealand.* | | | | | |
| 111 | May .. | 325 | 192 | 167 | 7·75 | 10·00 | 33·58 | 26·00 | Comp. No. 112. |
| 112 | ,, .. | 300 | 192 | 164 | 6·10 | 8·00 | 26·43 | 20·80 | ,, No. 111. |
| 113 | ,, .. | 275 | 182 | 171 | 6·29 | 7·06 | 28·81 | 19·49 | ,, No. 114. |
| 114 | ,, .. | 200 | 182 | 137 | 4·37 | 5·75 | 20·01 | 15·81 | ,, Nos. 113 & 115 |
| 115 | ,, .. | Tls. | 182 | 138 | 5·27 | 6·50 | 24·13 | 17·86 | ,, No. 114. |
| | | | | *Marshall's No. 8.* | | | | | |
| 116 | May .. | 200 | 192 | 175 | 5·13 | 7·50 | 22·23 | 19·50 | Comp. No. 117 |
| 117 | ,, .. | Tls. | 192 | 175 | 5·10 | 6·88 | 22·10 | 17·89 | ,, No. 116. |

SUMMARY OF GROWTH. (Second Trial.)

The rate of germination and growth is shown by the fact that—

| | | | | | |
|---|---|---|---|---|---|
| Out of | 816 | grains of the | 325 grade | 91·3 | per cent. grew. |
| ,, | 3,032 | ,, | 300 ,, | 90·4 | ,, |
| ,, | 4,376 | ,, | 275 ,, | 90·5 | ,, |
| ,, | 2,495 | ,, | 250 ,, | 90·1 | ,, |
| ,, | 608 | ,, | 225 ,, | 91·6 | ,, |
| ,, | 3,494 | ,, | 200 ,, | 87·1 | ,, |
| ,, | 3,848 | ,, | Tailings | 80·3 | ,, |

By this is meant that this percentage of the grains produced plants that could be cut and weighed, though the plants did not in all cases mature seed. The harvesting was done with a sickel, the plants being cut close to the ground and as evenly as possible. If the plant had died when a seedling, and before it had produced a stalk, it would not enter into the calculation. Mere dead blades of young seedlings were not counted, and no attempt was made to weigh such. There were very few such cases. The counting was done at harvest time. Uncertain cases were of very rare occurrence. If a plant survived the first few weeks it nearly always reached a growth that was harvested, and if there was no grain on the plant the straw was cut and weighed just the same.

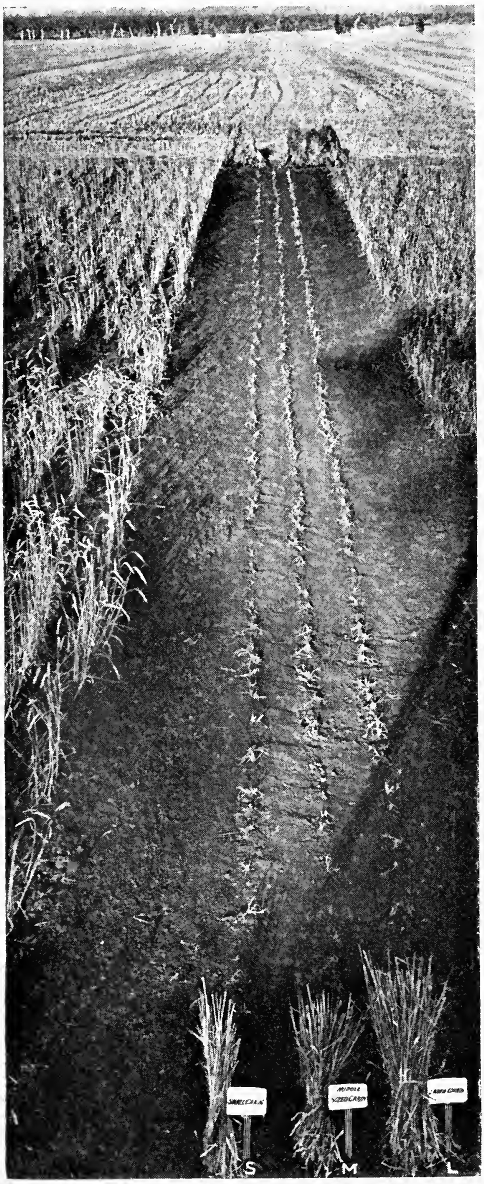



**Fig. 29.**—Photograph of three rows of experiment wheat after harvest. The rows from large, medium-sized, and small grain are lettered respectively L, M, and S. The picture shows the relative amounts of straw from the various rows, and the greater proportion of "misses" of the smaller seed.

Few notes were taken on the germination, for the reason that they would have been of rather uncertain value. If no plant appeared at the place where a seed had been sown, that would be no proof that the seed had not germinated, though it would be evidence *tending* to show that it had not germinated. The plantlet might have been killed by disease or by some insect. A considerable number of examinations convinced me that most of the cases of this sort were really cases of failure to germinate ; but it will be at once seen that any attempt to settle definitely in such a case whether the seed failed to germinate or was killed off by disease would have involved considerable difficulty.

Nevertheless, some attention was given to this feature of the experiment, with the result of showing that so far as observation in the spring could be reasonably carried, it apparently showed a lower germination on the part of the smaller seeds—certainly a lower plant-producing power. I am inclined to believe that these observations (see the table on page 31) prove the *germinating* power of the small and shrivelled seeds to be less than that of others ; but I hesitate somewhat in the matter, because of results already published by others tending to show that the germinating power of rust-shrivelled seed is actually greater than that of plump seed. As before remarked, these counts of the plants as they appeared above ground are not thoroughly reliable evidence as to the germinating power of the seed, and for several reasons. In the first place, one cannot be certain that plants may not yet appear after the count is made ; some good seeds even are very slow in germinating. Then, again, the plantlet may have been good—and yet have failed to reach the surface because it was nipped by some underground insect.

It should be borne in mind that the number of plants that appeared above ground in these experiments was probably greater than would occur in ordinary field practice because of the extra care bestowed upon the planting and culture, this care being necessary in order to remove as far as possible all disturbing factors that might cause inequalities in the conditions under which the various seeds were grown. It is also right to again call attention to the fact, or at least what seems to me to be the fact, that these conditions were such as to favour the small seeds more than the large seeds. All this is a separate matter from the inferiorities of ordinary tailings due to the accumulation in them of diseased seed. All the grains used in these trials were derived from selected healthy plants. This is more fully explained elsewhere. With these few remarks, we may now examine the following table of apparent germination :—

Apparent Germination of Large, Medium-sized, and Small Grains, as shown by the appearance above ground of Plants three weeks after Sowing, 1896. The figures represent the number of failures in 200 seeds planted.

| Variety. | Large. | Medium. | Small. | Variety. | Large. | Medium. | Small. |
|---|---|---|---|---|---|---|---|
| Algerian .. .. .. | 18 | 25 | 45 | Steinwedel .. .. | 6 | 7 | 23 |
| Marshall's No. 3 .. | 16 | 17 | 35 | Australian Talavera .. | 3 | 2 | 10 |
| Golden Drop .. .. | 8 | 19 | 51 | Quartzlee (Beardless).. | 8 | 3 | 13 |
| Canning Downs .. | 7 | 19 | 44 | Early Para. .. .. | 7 | 6 | 9 |
| White Tuscan .. .. | 14 | 13 | 38 | Farmer's Friend .. | 23 | 37 | 54 |
| King's Jubilee .. .. | 10 | 17 | 30 | White Velvet . .. | 0 | 42 | 65 |
| Blount's Lambrigg .. | 21 | 25 | 55 | Hudson's E.P. Straw | 13 | 20 | 28 |
| Allora Spring .. .. | 21 | 22 | 44 | Tardent's Blue .. | 20 | 33 | 41 |
| White Lammas.. .. | 7 | 11 | 17 | Red Straw .. .. | 15 | 21 | 28 |
| Early Baart .. .. | 10 | 13 | 46 | Marshall's No. 3 .. | 11 | 17 | 21 |
| White Lammas (Young) | 3 | 7 | 22 | Grosse's Prolific .. | 7 | 12 | 30 |
| Velvet Pearl .. .. | 11 | 22 | 44 | Marshall's No. 3 .. | 14 | 17 | 18 |
| White Naples .. .. | 62 | 60 | 71 | | | | |
| Bearded Quartzlee .. | 11 | 15 | 45 | Total .. .. | 363 | 540 | 988 |
| Talavera de Bellevue .. | 13 | 22 | 30 | | | | |
| Budd's Early .. .. | 3 | 9 | 24 | | | | |
| | 4 | 7 | 7 | Average .. .. | 12·5 | 18·6 | 34·1 |

These figures may be easily converted to percentages of failure by dividing by two. It will be noted that nearly three times as many small grains failed as large ones, and that the actual failure of the small grains amounted in this case to about one-sixth.

A considerable number of weaklings appeared, especially among the plants from small and shrivelled seeds, and these, after languishing for a few weeks, died. The soil was rather patchy, and in a considerable number of instances plants were rendered sterile by diseases due to unfavourable soil conditions. There was almost no loss through loose smut and bunt.

So far as comparisons of yield were concerned, the soil losses just spoken of were largely rendered nugatory by the row system. The other losses, such as accidents, smut, and bunt, fell irregularly, and were allowed for, if possible, but these losses were of too trifling an amount to cause any anxiety as to the reliability and usefulness of the calculations. The plots were in careful hands all the time, and I never saw experiments carried out under any better field conditions, if the patchiness be excepted. The experiment seed was prepared by myself, and its sowing was under my personal supervision, and all the notes were made by myself from frequent observation. The harvesting and so forth was done under my personal supervision, and I attended personally to all the weighings and calculations. The plots were under the competent supervision of the late Mr. John Coleman, who took great pains to preserve the plots from the least interference, and when I was absent kept me informed as to progress of the growth. The grains were sown in rows two links apart, and the grains were in all cases sown one link apart in the rows in the manner described in my pamphlet on "Agricultural Experiment Work." There were buffer plants at the ends of the rows in this lot of trials as in all others.

### Summary of Comparisons. (Second Trial.)

If we take as the yield of each trial the sum of the weights of the grain and of the straw, we find that in all cases the various grades have excelled in their production the smaller grades with which they have been compared, if we except grade 225, and even this exceptional result seems due beyond doubt to the small number of trials—only two, both cases giving a substantial excess to the lower grade. If we class the trials according to the size of the larger of the grades used in the comparison, we may make the following general statement:—

| | | | | |
|---|---|---|---|---|
| 325 | excelled in | 100 | per cent. | of trials. |
| 300 | ,, | 78·6 | ,, | ,, |
| 275 | ,, | 75 | ,, | ,, |
| 250 | ,, | 100 | ,, | ,, |
| 225 | ,, | none | ,, | ,, |
| 200 | ,, | 53·8 | ,, | ,, |

This statement, however, does not tell the whole story, for we find that, as in most unequal contests, the victories of the better contestant are the more decisive. Thus—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 325 | when excelling did so by 21·1 per cent. excess, and was never excelled. | | | | | | | |
| 300 | when excelling did so by | 12·5 | per cent. excess; | when excelled | it was | only by | 5 | per cent. |
| 275 | when excelling did so by | 14·7 | ,, ,, | ,, | ,, | only | 12·3 | per cent. |
| 250 | ,, ,, | 13·8 | | | | | | |
| 225 | | | ,, ,, | ,, | ,, | ,, | 7·7 | ,, |
| 200 | ,, ,, | 14·5 | ,, ,, | ,, | ,, | ,, | 11·6 | ,, |

*From this I conclude that the yield of wheat-plants under the conditions of these particular experiments, as well as the power to grow to a harvestable size, is a function of the size of the seed, and varies directly with the size of the seed.*

If, instead of taking the sum of the weights of the grain and straw as the criterion of yield, we take the grain alone, we arrive at the following:—

| | | | | | | |
|---|---|---|---|---|---|---|
| The | 325 | grade | excelled in | 100 | per cent. | of the trials. |
| ,, | 300 | ,, | ,, | 69 | ,, | ,, |
| ,, | 275 | ,, | ,, | 72·2 | ,, | ,, |
| ,, | 250 | ,, | ,, | 87·5 | ,, | ,, |
| ,, | 225 | ,, | ,, | none | ,, | ,, |
| ,, | 200 | ,, | ,, | 42·9 | ,, | ,, |

As these general statements, however, fail to give a perfectly correct idea of the extent of the superiority of the large seeds, we may add—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 325 | when excelling did so by | 22·7 | per cent., and was never excelled. | | | | | |
| 300 | ,, ,, | 13·8 | ,, | when excelled | it was | only by | 3·9 | per cent. |
| 275 | ,, ,, | 11·8 | ,, | ,, | ,, | ,, | 12·5 | ,, |
| 250 | ,, ,, | 7·0 | ,, | ,, | ,, | ,, ,, | ·5 | ,, |
| 225 | | | ,, | ,, | ,, | | 11·2 | ,, |
| 200 | | 8·2 | ,, | ,, | ,, | | 13·0 | ,, |

If, instead of taking the sum of the weights of the grain and straw as the criterion of yield, we take the straw alone, we arrive at the following:—

| | | | | | | |
|---|---|---|---|---|---|---|
| The | 325 | grade | excelled in | 100 | per cent. | of the trials. |
| ,, | 300 | ,, | ,, | 69 | ,, | ,, |
| ,, | 275 | ,, | ,, | 75 | ,, | ,, |
| ,, | 250 | ,, | ,, | 100·0 | ,, | ,, |
| ,, | 225 | ,, | ,, | none | ,, | ,, |
| ,, | 200 | ,, | ,, | 71·4 | ,, | ,, |

As these general statements do not give a perfectly correct idea of the extent of the superiority of the large seeds, we may add that—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 325 | when excelling did so by | 20·0 | per cent. | | | | |
| 300 | ,, ,, | 14·6 | ,, | when excelled it was | only by | 10·0 | per cent. |
| 275 | ,, ,, | 16·2 | ,, | ,, | ,, | 11·6 | ,, |
| 250 | ,, ,, | 20·6 | ,, | | | | |
| 225 | | | ,, | ,, | ,, | 4·0 | ,, |
| 200 | ,, ,, | 20·2 | ,, | ,, | ,, | 9·9 | ,, |

I have referred to the losses due to little understood and inexplicable soil conditions, and have said that they were rendered nugatory by the row system. By this, I mean that when a patch of such varying soil appeared, it invaded in about equal degrees the various experiment rows, and thus caused about equal losses to the adjacent rows being compared. In a few instances, where it was apparent that this invasion was not of an equal character, the length of the rows was reduced at harvest time by cutting out the doubtful parts. There were but few cases where this discretion had to be exercised; it was exercised as sparingly as possible. The case had to be one of the most manifest injustice to one or the other of the contestants before I ordered any interference. It will be seen from the measurements of the rows (the normal length was about 192·5 links), this discretion was not often exercised. It should be added that in most of the cases where the row harvested is less than 192·5 links long, it is because there was insufficient seed of one of the contestants to fill a whole row. This will be better understood by reference to the diagram illustrative of the arrangement of the experiments. (Fig. 28, p. 24.) The fragments of rows were due to the fact that the supply of seed did not fill exactly a number of full rows, and the seed was too valuable to be wasted, its production having cost a considerable amount of expert labour.

It will be seen that the results given in the tabulated weighings of grain and straw relate solely to the plants that grew, this being probably the test that most nearly meets the requirements of practice. I have recorded the number of plants that grew in each case, but have concluded, for the present at any rate, to make no attempt to interpret the figures.

The conditions of the trials were field conditions, modified to meet the requirements of exact experiment. That the yields exceed those of actual agricultural practice of the region where they were conducted is due to careful planting in measured drills and to the attention already described as having been given to the prevention of weeds.

Returning now to the percentages of growth, it will be seen that from the 325 grade down there is a regular diminution in the power of the seed to produce plants under field conditions. The number of plants is so great, running as it does into thousands, and the number of varieties is so great, reaching as it does above twenty widely different sorts, and the dates of sowing are so various and the soil conditions are so varied, including as they do patchiness and a general variation from one end of the area to the other in the manner described elsewhere, that this variation in the power to produce plants appears to be proved to be a function of the size of the seed. So far as one season's work can go, I do not see how it is possible to reach any other conclusion than that the inherent power in a grain of wheat to produce a yield of grain or straw is some direct function of the size of the grain, and that the larger the grain the better the resulting plant will be, independent of any conditions that appeared during the particular season under discussion. The number of trials of the 325 and 225 grades is rather too few to be quite satisfactory; and I am inclined to think that a larger number of trials of these grades might have slightly modified the percentages of growth of these grades as given.

At this point, I would like to once more call attention to the fact that the conditions of the experiment were such as make me believe that the small, and therefore weak seeds, and the shrivelled and therefore weak seeds, were decidedly favoured. The careful planting and the keeping down of the weeds would, it seems to me, give relatively greater benefit to the weaklings than to the others. It is, therefore, reasonable to suppose that under ordinary field conditions,—as, for instance, when the grain is broadcast and the weeds are given full swing,—the percentages of growth would be lower still for the smaller grades than here recorded, lower in reality and lower in proportion.

I must remark, for the benefit of those who have never had an opportunity to observe the behaviour of wheat plants growing in drills, that the interpretation of the numbers given in the tables needs to make allowance for a certain extra growth due to lack of competition when a plant fails anywhere in the drill. In such case, the two plants next the vacant space are given more soil room and are freed from the efforts of a competitor on one side, and they consequently often grow a little better. This is an observation easily made, and the fact is well known no doubt to many, but it might be overlooked by others if no mention was made of it. This factor may have helped the rows with the greater number of "misses" more than it helped the other rows. It certainly would do so in some instances.

Thus, when it is said that one grade yielded 178 plants and the adjacent grade yielded nly 163 plants, it must not be assumed that the yields would tend to become as 178 to 163, for this is so only to a certain extent, owing to the fact that the plants in the maller lot profited considerably more by the death of their companions in the same row.

Doubtless, also, this same influence extended from one row to another, but it was only to a very limited extent. It was, in fact, so small and so uncertain a factor that I had to abandon all attempts to settle its value. It was most certainly very small—too small to exert an influence that would be more than barely appreciable. It is, in fact, quite remarkable how little influence even powerful factors exert beyond the distance of a few inches in most seasons in the soil used for these experiments. For instance, a heavily-manured row will fail to have more than a very faint effect on a check row two links away and without manure.

**Fig. 30.**—All the straw from the large, medium, and small sized seed experiments of 1896-7, arranged, not on the ground on which it was grown, which was impossible, but assembled on another experiment area where it could be effectively displayed. The left-hand row of stooks came from the large seeds, and weighs 180 lb., the middle row from medium-sized seeds, and weighs 151 lb., while the right-hand row came from small seeds, and weighs 118 lb. This is an assemblage of straw from more than twenty different varieties.

### Third Trial.

The third and most satisfactory and symmetrical set of trials as to the relative value as seed of large, medium-sized, and small grains of wheat was begun in 1896. The tabulated results are given below.

The conditions under which this set of trials was conducted were in most respects very similar to those of the sets already discussed. The soil, though poorer, was of the same general nature, *i.e.*, was patchy, and varied also in a gradual manner from part to part of the plot. In this case, however, there was no uniformity in the gradual changes such as were mentioned in the second case. It will be remembered that in the former cases the soil improved in quality from one end of the plot to the other in such a manner as to slightly favour in all cases the smaller grades, though the amount of this trifling advantage to the smaller grades could not be measured. In the present instance, the gradual variations in the soil would sometimes favour the larger grades, and sometimes the smaller. As before, these differences were quite impossible to estimate, beyond the general statement that they were so small as to be quite safely neglected, considering the extent of the trials.

In this third set of quantitive trials th. amount of seed available was greater, and, in consequence, the size of the trial rows was increased, and the length in all cases, exclusive of the buffer plants at the ends, was two chains.

Only four grades of seed were used, extra large, *i.e.*, grade 325 ; large, *i.e.*, grade 300 ; medium, *i.e.*, grade 250 ; and small, *i.e.*, the tailings. These were in all instances planted in the order named in three or four successive rows, at the ends of the corresponding "stud plots" devoted to the production of seed wheat. This was a more satisfactory arrangement than that of the previous year. It can hardly be said, however, that this arrangement introduced any new element as compared with the first two trials, except that of omitting the use of the intermediate grades 275, 225, and 200.

The season was regarded as an average one ; not so good as the previous season.

Table of Yields of Grain and Straw. (Third Trial.)

| No. | Sown. | Grade. | Length of row in links. | No. of plants that grew. | Lb. harvested. | | Grain. | Straw. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Grain. | Straw. | Bushels to acre. | Cwt. to acre. | |
| | | | | *Algerian.* | | | | | |
| | ...... | Large .. | 200 | 181 | 1·80 | 3·08 | 7·50 | 7·70 | Compare No. 2. |
| | ...... | Medium .. | 200 | 174 | 1·43 | 2·32 | 5·96 | 5·88 | ,, Nos. 1 and 3. |
| | ...... | Small .. | 200 | 155 | 1·06 | 1·80 | 4·42 | 4·50 | ,, No. 2. |
| | | | | *Allora Spring.* | | | | | |
| 4 | ...... | Large .. | 200 | 163 | 1·91 | 2·20 | 7·96 | 5·50 | Compare No. 5. |
| 5 | ...... | Medium .. | 200 | 160 | 1·54 | 1·72 | 6·42 | 4·30 | ,, Nos. 4 and 6. |
| 6 | ...... | Small .. | 200 | 130 | 1·11 | 1·22 | 4·63 | 3·05 | ,, No. 5. |
| | | | | *Australian Talavera.* | | | | | |
| 7 | ...... | Very large | 200 | 185 | 2·04 | 2·68 | 8·50 | 4·70 | Compare No. 8. |
| 8 | ...... | Large .. | 200 | 193 | 1·88 | 2·92 | 7·83 | 7·30 | ,, Nos. 7 and 9. |
| 9 | ...... | Medium .. | 200 | 187 | 1·65 | 2·50 | 6·88 | 6·25 | ,, Nos. 8 and 10. |
| 10 | ...... | Small .. | 200 | 177 | 1·20 | 1·75 | 5·00 | 4·38 | ,, No. 9. |
| | | | | *Bearded Quartzlee.* | | | | | |
| 11 | ...... | Large .. | 200 | 184 | 4·90 | 6·15 | 20·42 | 12·88 | Compare No. 12. |
| 12 | ...... | Medium . | 200 | 175 | 4·08 | 4·85 | 17·00 | 12·43 | ,, Nos. 11 and 13. |
| 13 | ...... | Small .. | 200 | 146 | 2·77 | 3·10 | 11·54 | 7·75 | ,, No. 12. |
| | | | | *Beardless Quartzlee.* | | | | | |
| 14 | ...... | Large .. | 200 | 179 | 1·90 | 2·22 | 7·92 | 5·55 | Compare No. 15. |
| 15 | ...... | Medium .. | 200 | 183 | 1·70 | 1·92 | 7·08 | 4·80 | ,, Nos. 14 and 16. |
| 16 | ...... | Small .. | 200 | 162 | 1·20 | 1·27 | 5·00 | 3·17 | ,, No. 15. |
| | | | | *Blount's Lambrigg.* | | | | | |
| 17 | ...... | Large .. | 200 | 176 | 2·04 | 2·70 | 8·50 | 6·75 | Compare No. 18. |
| 18 | ...... | Medium .. | 200 | 164 | 1·73 | 2·18 | 7·21 | 5·45 | ,, Nos. 17 and 19. |
| 19 | ...... | Small .. | 200 | 131 | 1·30 | 1·82 | 5·42 | 4·55 | ,, No. 18. |
| | | | | *Budd's Early.* | | | | | |
| 20 | ...... | Large .. | 200 | 187 | 1·60 | 1·86 | 6·67 | 4·45 | Compare No. 21. |
| 21 | ...... | Medium .. | 200 | 175 | ·80 | 1·00 | 3·33 | 2·50 | ,, Nos. 20 and 22. |
| 22 | ...... | Small .. | 200 | 153 | ·52 | ·60 | 2·17 | 1·50 | ,, No. 21. |

TABLE of Yields of Grain and Straw. (Third Trial)—*continued.*

| No. | Sown. | Grade. | Length of row in links. | No. of Plants that grew. | Lb. harvested. Grain. | Lb. harvested. Straw. | Grain. Bushels to acre. | Straw. Cwt. to acre. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Canning Downs.* | | | | | |
| 23 | ...... | Large .. | 200 | 177 | 1·43 | ·96 | 5·96 | 2·60 | Compare No. 24. |
| 24 | ...... | Medium .. | 200 | 159 | ·99 | ·65 | 4·13 | 1·63 | ,, Nos. 23 and 25. |
| 25 | ...... | Small .. | 200 | 139 | ·53 | ·40 | 2·21 | 1·00 | ,, No. 24. |
| | | | | *Early Baart.* | | | | | |
| 26 | ...... | Very large | 200 | 181 | 2·77 | 3·42 | 11·54 | 8·55 | Compare No. 27. |
| 27 | ...... | Large .. | 200 | 186 | 3·39 | 4·10 | 14·13 | 10·25 | ,, Nos. 26 and 28. |
| 28 | ...... | Medium .. | 200 | 186 | 2·89 | 3·48 | 12·04 | 8·70 | ,, Nos. 27 and 29. |
| | ...... | Small .. | 200 | 146 | 1·90 | 2·28 | 7·92 | 5·70 | ,, No. 28. |
| | | | | *Early Para.* | | | | | |
| 30 | ...... | Large .. | 200 | 188 | 3·05 | 3·46 | 12·71 | 8·45 | Compare No. 31. |
| 31 | ...... | Medium .. | 200 | 187 | 1·95 | 2·12 | 8·13 | 5·30 | ,, Nos. 30 and 32. |
| 32 | ...... | Small .. | 200 | 172 | 2·10 | 2·12 | 8·75 | 5·30 | ,, No. 31. |
| | | | | *Farmer's Friend.* | | | | | |
| 33 | ...... | Large .. | 200 | 169 | 3·70 | 4·75 | 15·42 | 11·88 | Compare No. 34. |
| 34 | ...... | Medium .. | 200 | 148 | 2·90 | 3·57 | 12·08 | 8·93 | ,, Nos. 33 and 35. |
| 35 | ...... | Small .. | 200 | 132 | 2·30 | 2·74 | 9·58 | 6·85 | ,, No. 34. |
| | | | | *Golden Drop.* | | | | | |
| 36 | ...... | Large .. | 200 | 193 | 2·20 | 2·48 | 9·17 | 6·20 | Compare No. 37. |
| 37 | ...... | Medium .. | 200 | 184 | 1·75 | 1·82 | 7·29 | 4·55 | ,, Nos. 36 and 38. |
| 8 | ...... | Small .. | 200 | 150 | 1·10 | 1·48 | 4·58 | 4·70 | ,, No. 37. |
| | | | | *Hudson's Early Purple Straw.* | | | | | |
| 39 | ...... | Very large | 200 | 183 | 3·34 | 3·82 | 13·92 | 9·55 | Compare No. 40. |
| 40 | ...... | Large .. | 200 | 187 | 3·54 | 4·19 | 14·75 | 10·48 | ,, Nos. 39 and 41. |
| 41 | ...... | Medium .. | 200 | 174 | 2·78 | 2·99 | 11·58 | 7·48 | ,, Nos. 40 and 42. |
| 42 | ...... | Small .. | 200 | 165 | 2·30 | 2·51 | 9·58 | 6·28 | ,, No. 41. |
| | | | | *King's Jubilee.* | | | | | |
| 43 | ...... | Large .. | 200 | 188 | 3·38 | 3·53 | 14 08 | 8·83 | Compare No. 44. |
| 44 | ...... | Medium .. | 200 | 174 | 3·09 | 3·23 | 12·88 | 8·08 | ,, Nos. 43 and 45. |
| 45 | ...... | Small .. | 200 | 158 | 2·18 | 2·37 | 9·08 | 5·93 | ,, No. 44. |
| | | | | *Marshall's No. 3.* | | | | | |
| 46 | ...... | Very large | 200 | 183 | 2·12 | 2·18 | 8·83 | 5·45 | Compare No. 47. |
| 47 | ...... | Large .. | 200 | 181 | 2·17 | 2·28 | 9·04 | 5·70 | ,, Nos. 46 and 48. |
| 48 | ...... | Medium .. | 200 | 175 | 1·70 | 1·76 | 7·08 | 4·40 | ,, Nos. 47 and 49. |
| 49 | ...... | Small .. | 200 | 179 | 1·62 | 1·70 | 6·75 | 4·25 | ,, No. 48. |
| | | | | *Marshall's No. 3, W.S.* | | | | | |
| 50 | ...... | Very large | 200 | 190 | 2·14 | 2·30 | 8·92 | 5·75 | Compare No. 51. |
| 51 | ...... | Large .. | 200 | 179 | 1·95 | 2·07 | 8·13 | 5·18 | ,, Nos. 50 and 52. |
| 52 | ...... | Medium .. | 200 | 177 | 1·98 | 2·90 | 8·25 | 7·25 | ,, Nos. 51 and 53. |
| 53 | ...... | Small .. | 200 | 157 | 1·30 | 1·34 | 5·42 | 3·35 | ,, No. 52. |
| | | | | *Marshall's No. 8.* | | | | | |
| 54 | ...... | Very large | 200 | 186 | 2·24 | 2·68 | 9·33 | 6·70 | Compare No. 55. |
| 55 | ...... | Large .. | 200 | 186 | 2·27 | 1·82 | 9·46 | 4·55 | ,, Nos. 54 and 56. |
| 56 | ...... | Medium .. | 200 | 177 | 1·27 | 1·53 | 5·29 | 3·83 | ,, Nos. 55 and 57. |
| 57 | ...... | Small .. | 200 | 172 | 1·30 | 1·50 | 5·42 | 3·75 | ,, No. 56. |
| | | | | *Rattling Jack.* | | | | | |
| 58 | ...... | Very large | 200 | 182 | 2·31 | 2·52 | 9·63 | 6·30 | Compare No. 59. |
| 59 | ...... | Small .. | 200 | 166 | 1·10 | 1·15 | 4·58 | 2·88 | ,, No. 60. |
| 60 | ...... | Medium .. | 200 | 185 | 1·08 | 1·10 | 4·50 | 2·75 | ,, Nos. 59 and 61. |
| 61 | ...... | Large .. | 200 | 194 | 1·87 | 2·00 | 7·79 | 5·00 | ,, Nos. 58 and 60. |
| | | | | *Red Straw.* | | | | | |
| 62 | ...... | Large .. | 200 | 183 | 2·85 | 2·98 | 11·88 | 7·45 | Compare No. 63. |
| 63 | ...... | Medium .. | 200 | 175 | 2·64 | 2·79 | 11·00 | 6·98 | ,, Nos. 62 and 64. |
| 64 | ...... | Small .. | 200 | 170 | 2·30 | 2·31 | 9·58 | 5·78 | ,, No. 63. |
| | | | | *Steinwedel.* | | | | | |
| 65 | ...... | Large .. | 200 | 185 | 2·58 | 3·10 | 10·75 | 7·75 | Compare No. 66. |
| 66 | ...... | Medium .. | 200 | 188 | 2·40 | 2·70 | 10·00 | 6·75 | ,, Nos. 65 and 67 |
| 67 | ...... | Small .. | 200 | 165 | 1·69 | 1·25 | 7·04 | 3·13 | ,, No. 66. |

TABLE of Yields of Grain and Straw. (Third Trial)—*continued.*

| No. | Sown. | Grade. | Length of row in links. | No. of Plants that grew. | Lb. harvested. Grain. | Lb. harvested. Straw. | Bushels to acre. | Cwt. to acre. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Talavera de Bellevue.* | | | | | |
| 68 | ...... | Very large | 200 | 183 | 3·37 | 4·90 | 14·04 | 12·25 | Compare No. 69. |
| 69 | ...... | Large .. | 200 | 185 | 3·07 | 4·68 | 12·79 | 11·70 | ,, Nos. 68 and 70. |
| 70 | ...... | Medium .. | 200 | 170 | 2·83 | 4·40 | 11·79 | 11·00 | ,, Nos. 69 and 71. |
| 71 | ...... | Small .. | 200 | 164 | 1·99 | 3·10 | 8·29 | 7·75 | ,, No. 70. |
| | | | | *Tardent's Blue.* | | | | | |
| 72 | ...... | Large .. | 200 | 182 | 2·77 | 4·93 | 11·54 | 12·33 | Compare No. 73. |
| 73 | ...... | Medium .. | 200 | 164 | 2·67 | 4·83 | 11·13 | 12·08 | ,, Nos. 72 and 74. |
| 74 | ...... | Small .. | 200 | 154 | 1·88 | 3·90 | 7·83 | 9·75 | ,, No. 73. |
| | | | | *Velvet Pearl.* | | | | | |
| 75 | ...... | Large .. | 200 | 182 | 3·75 | 4·25 | 15·63 | 10·63 | Compare No. 76. |
| 76 | ...... | Medium .. | 200 | 167 | 3·50 | 3·85 | 14·58 | 9·63 | ,, Nos. 75 and 77. |
| 77 | ...... | Small .. | 200 | 144 | 2·30 | 2·45 | 9·58 | 6·13 | ,, No. 76. |
| | | | | *White Essex.* | | | | | |
| 78 | ...... | Very large | 200 | 188 | 1·70 | 2·12 | 7·08 | 5·30 | Compare No. 79. |
| 79 | ...... | Large .. | 200 | 194 | 1·40 | 1·73 | 5·83 | 4·33 | ,, Nos. 78 and 80. |
| 80 | ...... | Medium .. | 200 | 186 | 1·40 | 1·88 | 5·83 | 4·70 | ,, Nos. 79 and 81. |
| 81 | ...... | Small .. | 200 | 177 | 1·20 | 1·58 | 5·00 | 3·95 | ,, No. 80. |
| | | | | *White Lammas.* | | | | | |
| 82 | ...... | Very large | 200 | 189 | 2·48 | 3·20 | 10·33 | 8·00 | Compare No. 83. |
| 83 | ...... | Large .. | 200 | 196 | 2·38 | 3·17 | 9·92 | 7·93 | ,, Nos. 82 and 84. |
| 84 | ...... | Medium .. | 200 | 186 | 1·63 | 2·10 | 6·79 | 5·25 | ,, Nos. 83 and 85. |
| 85 | ...... | Small . | 200 | 172 | 1·65 | 2·05 | 6·88 | 5·13 | ,, No. 84. |
| | | | | *White Naples.* | | | | | |
| 86 | ...... | Very large | 200 | 148 | 2·60 | 3·84 | 10·83 | 9·60 | Compare No. 87. |
| 87 | ...... | Large .. | 200 | 135 | 2·30 | 3·50 | 9·58 | 8·75 | ,, Nos. 86 and 88. |
| 88 | .... | Medinm .. | 200 | 138 | 2·20 | 3·37 | 9·17 | 8·43 | ,, Nos. 87 and 89. |
| 89 | ...... | Small .. | 200 | 119 | 1·50 | 2·35 | 6·25 | 5·88 | ,, No. 88. |
| | | | | *White Tuscan.* | | | | | |
| 90 | ...... | Large .. | 200 | 181 | 2·28 | 2·47 | 9·50 | 6·48 | Compare No. 91. |
| 91 | ...... | Medium .. | 200 | 183 | 1·88 | 2·28 | 7·83 | 5·70 | ,, Nos. 90 and 92. |
| 92 | ...... | Small .. | 200 | 155 | 1·35 | 1·60 | 5·63 | 4·00 | ,, No. 91. |
| | | | | *White Velvet.* | | | | | |
| 93 | ...... | Large .. | 200 | 166 | 2·50 | 2·80 | 10·42 | 7·00 | Compare No. 94. |
| 94 | ...... | Medium .. | 200 | 157 | 2·81 | 3·06 | 11·71 | 7·65 | ,, Nos. 93 and 95. |
| 95 | ...... | Small .. | 200 | 116 | 1·60 | 1·80 | 6·67 | 4·50 | ,, No. 94. |
| | | | | *Zealand.* | | | | | |
| 96 | ...... | Very large | 200 | 184 | 1·09 | 1·92 | 4·54 | 4·80 | Compare No. 97. |
| 97 | ...... | Large .. | 200 | 195 | 1·10 | 1·40 | 4·58 | 3·50 | ,, Nos. 96 and 98. |
| 98 | ...... | Medium .. | 200 | 191 | 1·02 | 1·34 | 4·25 | 3·35 | ,, Nos. 97 and 99. |
| 99 | ...... | Small .. | 200 | 187 | ·92 | 1·23 | 3·83 | 3·08 | ,, No. 98. |

SUMMARY of Growth. (Third Trial.)

The rate of germination and growth is shown by the fact that :—

| | | | | | |
|---|---|---|---|---|---|
| Out of 2,400 | grains of the | extra large | or 325 grade | 90·0 | per cent. grew. |
| ,, 5,800 | ,, | large | or 300 ,, | 90·9 | ,, |
| ,, 5,800 | ,, | medium | or 250 ,, | 87·0 | ,, |
| ,, 5,800 | ,, | small | or tailings | 77·8 | ,, |

by which is meant that this percentage of the grains produced plants that could be cut and weighed, though the plants did not in all cases produce seed. The harvesting was done as in the previous set. As before, the straw was tied up and weighed in the field, where it rested on the ground. It is therefore necessary to call attention to the fact that the straw may not have been in *precisely* the same condition of dryness in the two years, and that therefore this fact should be borne in mind in any attempt to compare the results of the one year with the other. I have full confidence that any difference due to this cause may be safely neglected, but there is no experimental or other proof of this. In both cases the weighings were made during a spell of dry weather. In both cases all the weighings of straw were made and checked during the middle part of one and the same day so as to eliminate any chance of error due to the hygroscopic qualities of the straw.

In the weighings and in the previous care of these trials I had the highly valued aid of my assistant, Mr. E. M. Grosse, as well as that of Mr. R. Hirst who, under the training of the farm management, had become a very useful workman.

The plots were under the general charge of Mr. George Valder, whose devoted interest was of great value, not only in securing accurate supervision, but also in spreading an interest in the work by calling the particular attention of many hundreds of visitors to the facts ocularly demonstrated by the trials.

SUMMARY of Comparisons. (Third Trial.)

If we take as the yield of each trial the sum of the weights of the grain and of the straw, we find that in general the various grades have exceeded in their productiveness the smaller grades with which they have been compared, so that if we class the trials according to the larger of the grades used in the comparison, we may make the following general statement:—

The very large or 325 grade excelled in 66·7 per cent. of the trials.
,, large or 300 ,, in 89·7 ,, ,,
,, medium or 250 ,, in 93·1 ,, ,,

This statement, however, fails as in the previous trials to tell the whole story, for the reason that the excess of yield in the majority cases is much greater than in the minority cases. Thus,

The very large or 325 grade when excelling did so by 14·7 per cent.; if excelled it was by only 8·5 per cent.

The large or 300 grade when excelling did so by 30·4 per cent.; if excelled it was by only 12·3 per cent.

The medium or 250 grade when excelling did so by 44·5 per cent.; if excelled it was only by 3·5 per cent.

In these statements the basis of the percentage calculation is the weight of the yield of the lower of the two contestants.

If instead of taking the sum of the weights of the grain and straw as the criterion of yield, we take the weight of the grain alone, we arrive at the following:—

The very large or 325 grade excelled in 58·3 per cent. of the trials.
,, large or 300 ,, in 93·1 ,, ,,
,, medium or 250 ,, in 86·2 ,, ,,

As before, we find, however, that the victories of the large seed are more decisive than those of the small seed, and this must be taken into account in estimating the superiority of the larger grades. We find that:—

The 325 grade when excelling did so by 12·9 per cent.; when excelled it was only by 6·6 per cent.

The 300 grade when excelling did so by 26·5 per cent.; when excelled it was only by 7· per cent.

The 250 grade when excelling did so by 40·5 per cent.; when excelled it was only by 3·3 per cent.

If instead of taking the sum of the weights of the grain and straw as the criterion of yield, we take the weight of the straw alone, we arrive at the following:—

The very large or 325 grade excelled in 66·7 per cent. of the trials.
,, large or 300 ,, in 89·7 ,, ,,
,, medium or 250 ,, in 93·1 ,, ,,

But here, again, we find that the victories of the large grades are much more decisive than those of the small grades, and this must not be forgotten in estimating the superiority of the large grades. Examination of the tables proves that:—

325 grade when excelling did so by 19·2 per cent.; when excelled it was only by 10·8 per cent.

300 grade when excelling did so by 29·6 per cent.; when excelled it was only by 19·4 per cent.

250 grade when excelling did so by 40·7 per cent.; when excelled it was only by 4·5 per cent.

The land on which the trials were carried out was newly cleared land that had never before been cropped. It had been ploughed up some little time before sowing, but it was not in first-class condition for wheat-growing. It was too green and it was too patchy.

There was no attempt made to secure any particular yield. A higher yield might have been obtained by placing the drills nearer together, but this would have greatly increased the labour of attending to the weeds, as a workman would be too cramped among rows so near together, and would have had to work more slowly, and there would have been a larger number of accidents.

### Fourth Trial.

Table of Yields of Grain. (Fourth Trial.)

| No. | Sown. | Grade. | Length of row in links. | No. of Plants that grew. | Lb. harvested. | | Bushels to acre. | Cwt. to acre. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Grain. | Straw. | | | |
| | | | | *Hudson's Early Purple Straw.* | | | | | |
| 1 | June .. | Large .. | 400 | .... | 4·96 | .... | 10·33 | .... | Compare No. 2. |
| 2 | ,, .. | Medium .. | 400 | .... | 4·16 | .... | 8·67 | .... | ,, Nos. 1 and 3. |
| 3 | ,, .. | Small .. | 400 | .... | 3·32 | .... | 6·92 | .... | ,, No. 2. |
| | | | | *Allora Spring.* | | | | | |
| 4 | June .. | Large .. | 400 | .... | 3·60 | .... | 7·50 | .... | Compare No. 5. |
| 5 | ,, .. | Medium .. | 400 | .... | 3·52 | .... | 7·33 | .... | ,, Nos. 4 and 6. |
| 6 | ,, .. | Small .. | 400 | .... | 2·06 | .... | 4·29 | .... | ,, No. 5. |
| | | | | *White Velvet.* | | | | | |
| 7 | June .. | Large .. | 400 | .... | 3·98 | .... | 8·29 | .... | Compare No. 8. |
| 8 | ,, .. | Medium .. | 400 | .... | 4·45 | .... | 9·27 | .... | ,, Nos. 7 and 9. |
| 9 | ,, .. | Small .. | 400 | .... | 3·17 | .... | 6·60 | .... | ,, No. 8. |

### Discussion of the Various Trials.

In these experiments the trial was always made between equal numbers of seeds. This is of course a different matter from trials between equal bulks of seed, or between equal weights of seed. As stated elsewhere, the reason for adopting the present method was that the method usually practised in improving wheat for seed is that of grading by means of sieves, and the grades thus secured are, as nearly as practice allows, simply seeds of so many different sizes. It seemed, therefore, that it was the relative value as seed of equal numbers of these sizes that it would be most useful to know.

In order to give data by means of which it will be possible to, in some measure, reason from one system of comparison to another, I have graded some samples of wheat and counted the grains in equal bulks, and also weighed equal numbers of seeds. These comparisons have given the following results :—

Number of Grains contained in equal weights of Purple Straw Seed-wheat of various Grades.

| Grade. | 3·25 | 3·00 | 2·75 | 2·50 | 2·25 | 2·00 | *Tailings. |
|---|---|---|---|---|---|---|---|
| No. of grains .. .. .. | 348 | 369 | 402 | 463 | 579 | 715 | 1,000 |

Number of Grains contained in equal volumes of Seed-wheat of various Grades.

| Grade. | 3·25 | 3·00 | 2·75 | 2·50 | 2·25 | 2·00 | *Tailings. | Variety Name. |
|---|---|---|---|---|---|---|---|---|
| No. of grains .. .. .. | 381 | 408 | 459 | 550 | 684 | 793 | 1,000 | Purple Straw. |
| ,, .. .. .. | 303 | 313 | 355 | 441 | 587 | 736 | 1,000 | Allora Spring. |
| ,, .. .. .. | 284 | 311 | 372 | 463 | 585 | 731 | 1,000 | Hudson's E. P. Str. |

From these figures we may derive the following approximate statements, which are easily carried in the mind :—

1. The 2·50 grade—that is, the medium grade—contains half as many grains in a given volume as the tailings.
2. The 3·25 grade—that is, the largest grade—contains one-third as many grains in a given volume as the tailings.

* These tailings contained no split grains, "white-heads," or dirt.

*Poor Quality of Crops from Small and Shrivelled Seed.*

Bearing these facts in mind, we have now to consider a question of some importance, and that is the relative value of the grain crops from large and small grains, irrespective of the weights or sizes of the crops. Are the crops obtained from small seeds as good in quality as those from large seeds? It appears that this question is one that has been seldom thought of, and it is one that has not been satisfactorily tested, so far as I am aware.

It will be seen from the tests conducted with reference to the absolute value of large and small grains from the same ear of wheat that there is some ground for considering the two of about equal fodder value. This is a different matter from the comparison of large and small grains from different plants, and it differs still more widely from the comparison of large and small grains that are from different plants which are different in size and in the size of their grains, because of their having sprung from large and small seed respectively. It may not be wholly profitless, however, to discuss this question even on this somewhat remote experimental basis, especially as it will be seen that the structure of the grains of small size, as connected with their value as fodder, is such in the comparison cited that it seems reasonable to suppose the same structure would enter into small grains of any sort; I refer to the thinness of the bran, and the relative proportion of flour, &c.

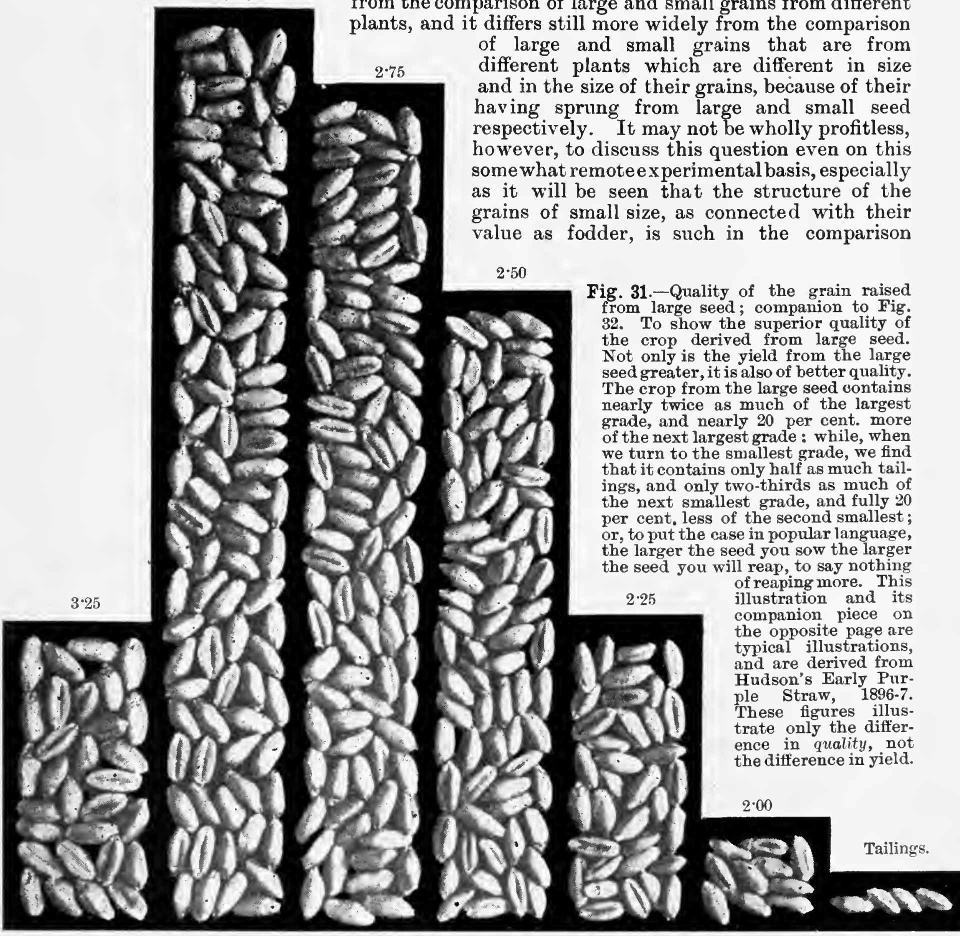



**Fig. 31.**—Quality of the grain raised from large seed; companion to Fig. 32. To show the superior quality of the crop derived from large seed. Not only is the yield from the large seed greater, it is also of better quality. The crop from the large seed contains nearly twice as much of the largest grade, and nearly 20 per cent. more of the next largest grade; while, when we turn to the smallest grade, we find that it contains only half as much tailings, and only two-thirds as much of the next smallest grade, and fully 20 per cent. less of the second smallest; or, to put the case in popular language, the larger the seed you sow the larger the seed you will reap, to say nothing of reaping more. This illustration and its companion piece on the opposite page are typical illustrations, and are derived from Hudson's Early Purple Straw, 1896-7. These figures illustrate only the difference in *quality*, not the difference in yield.

If this be so, then the absolute feeding value of crops of grain from large and from small seed would be about equal, weight for weight.

As to the market value, however, the case stands differently, for if the crop of grain from small seed is smaller in size than from large seeds, its market value will be smaller for two reasons. First, the small size of the grains will lower the market value irrespective of the use to which it is to be put, the buyer (really representing the miller) always preferring the sample that presents the better appearance. Again, though this is admittedly but another phase of the same idea, the miller gives to small grains an inferior milling value, and this leads to a lower price in proportion to the number of small grains in the sample, said small grains putting the miller to the expense of their removal and separate disposal.

How do the crops from large and small grains compare with each other with reference to the size of the grains? Are the grains in the crop from large seed, larger or smaller than in the crop from small seed? I am able to answer that the crops from the smaller seeds do not grade up so well as those from the larger seeds, but I am sorry not to be able to go further than this. The men at work upon this problem were removed from the work, and the full results were never obtained. This serious loss I am only able to counteract by the statement that, from "general observation" and a few trials, I feel sure that the crops from the smaller seeds are nearly always, if not always, from a market point of view, inferior to those from the larger seeds. Let anyone look at the illustration on page 148, which is entirely typical of the results of these trials, and he will not be surprised to hear the opinion expressed that the plants in the row planted with small seeds yielded not only less grain, but that the grain yielded was of smaller size, and hence of lower market value.

The best I can do in this connection is to apologise, and express regret that such an obvious question, and one whose answer was actually in hand, should have been allowed to go partially unanswered.

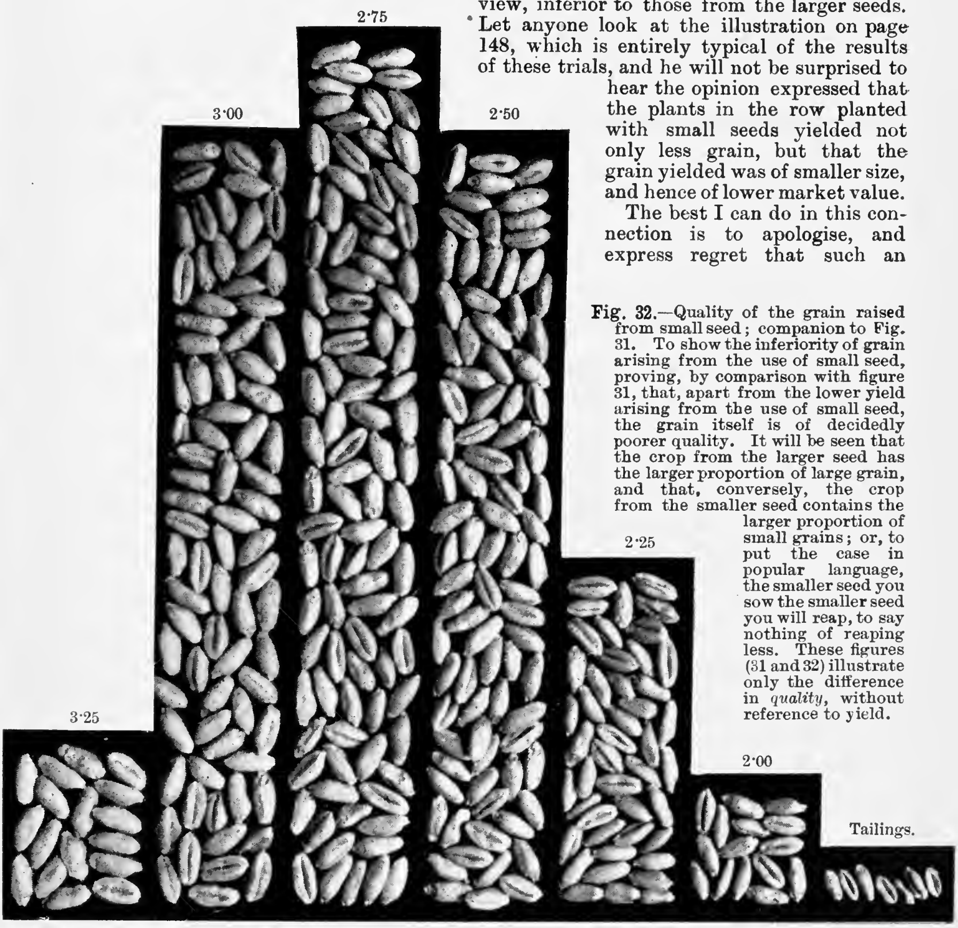



**Fig. 32.**—Quality of the grain raised from small seed; companion to Fig. 31. To show the inferiority of grain arising from the use of small seed, proving, by comparison with figure 31, that, apart from the lower yield arising from the use of small seed, the grain itself is of decidedly poorer quality. It will be seen that the crop from the larger seed has the larger proportion of large grain, and that, conversely, the crop from the smaller seed contains the larger proportion of small grains; or, to put the case in popular language, the smaller seed you sow the smaller seed you will reap, to say nothing of reaping less. These figures (31 and 32) illustrate only the difference in *quality*, without reference to yield.

In spite of this I am glad to be able to say I have evidence that the grain yielded from plants grown from small and shrivelled seed is almost invariably inferior from a grading point of view, and that the difference is a very perceptible one—one such as to lower the market value of the grain. It will be seen from the adjacent figures and illustrations that the evidence assembled is of an unmistakable character, in spite of the fact that I am unable at the present time to give averages for several years such as alone can establish a perfectly satisfactory basis for practice. (See Figs. 31 and 32.) The examples cited are typical ones, but I cannot be certain how near they are to being average cases. The grading and the illustrations prove that there is a pronounced difference in the quality of the grain-crops from large and small seeds, the balance being in favour of the large grain. The illustrations represent equal quantities of grain; that is, there is the same bulk of grain shown in Fig. 31 as in Fig. 32. The quality of the grain shown in Fig. 31 is manifestly the better.

The figures and illustrations do not tell the whole story, however, for apart from the manner in which the samples grade up there is the difference in the appearance of the samples. The sieves separate the grains according to size alone, taking no account of plumpness. As a matter of fact, when two samples, one grown from small seed and the other from large seed, are placed side by side, it is usually possible to see that the sample derived from the large seed is the plumper and better sample. The difference is a rather small one, but is usually distinctly perceptible, and is one that would not be overlooked by an experienced buyer of wheat.

This defect in plumpness has to be added to that of size shown in the illustrations to fully appreciate the inferior market quality of the grain derived from small seed.

*Hence we have in a grain-crop derived from small seed not only a lower yield of grain, but a decided inferiority in quality.*

As might be expected from all this, the weight per bushel of the grain crop from small seed is less than that from large seed. As derived from numerous tests made during these experiments the difference is a small one, but it is very constantly in favour of the crop derived from the large grain, which is found to weigh from a small fraction of a pound up to a pound a bushel more than that derived from the small grain.

TABLE SHOWING SUPERIORITY OF CROPS OF GRAIN FROM PLANTS FROM LARGE SEED.

| Grade. | White Velvet. | | | Allora Spring. | | | Hudson's Early Purple Straw. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Large. | Medium. | Small. | Large. | Medium. | Small. | Large. | Medium. | Small. |
| | % | % | % | % | % | % | % | % | % |
| 3·25 | 18·6 | 13·9 | 12·4 | 11·2 | 6·6 | 9·1 | 17·4 | 11·9 | 12·3 |
| 3·00 | 34·4 | 38·7 | 27·7 | 32·1 | 27·5 | 26·7 | 40·1 | 38·7 | 38·7 |
| 2·75 | 32·2 | 31·6 | 38·1 | 39·3 | 47·5 | 45·0 | 27·8 | 31·0 | 30·4 |
| 2·50 | 12·7 | 12·6 | 17·0 | 15·2 | 15·7 | 17·0 | 11·9 | 13·6 | 13·7 |
| 2·25 | 1·5 | 2·3 | 3·7 | 1·7 | 1·9 | 1·5 | 2·1 | 3·8 | 3·4 |
| 2·00 | ·3 | ·6 | ·9 | ·4 | ·4 | ·3 | ·5 | ·7 | ·9 |
| Tailings. | ·2 | ·2 | ·3 | ·3 | ·2 | ·4 | ·2 | ·4 | ·5 |

In this table the three crops of grain are arranged under the variety name in three columns—the crop from the large seed in the first column, the crop from the medium-sized seed in the second column, the crop from the small seed in the third column. Thus, under the name White Velvet, we find three columns, entitled large, medium, small. In the first column, opposite each grade number, will be found the percentage by weight of that grade in the sample of grain yielded from the planting of large seed. Similar results are found in the second and third columns for the crops from the plantings of medium-sized and small seeds. Reading horizontally in the three columns, it will be seen that the sample yielded from the planting of large seed contained 18·6 per cent. of the 3·25 grade; while the sample from the medium seed contained only 13·9 per cent.; and the sample from the small seed only 12·4 per cent. Similar figures are tabulated for the other varieties, *i.e.*, Allora Spring and Hudson's Early Purple Straw.

These figures, showing the greater proportion of large grains in the crops raised from large seed, are indicative of a higher market value for those crops. It is not necessary to grade the samples in order to detect this difference, as it can be easily seen at a glance. The grading, however, enables us to measure the difference and show that just in proportion as the seed is large and plump so will be the predominance of large seed in the progeny.

*Tailings Used in the Trials Better than Ordinary Tailings.*

In making comparisons between the results recorded in these pages and the results to be obtained from the practice of sowing tailings, or in other words, sowing small and shrivelled seed, it is necessary to keep in mind that the seed here experimented with was in all cases whole seed, none of it was cracked or split or unhealthy. On the other hand, the samples of small and shrivelled seed that have been used and lauded, or at least excused in practice, usually contain a considerable proportion of split, diseased, and useless material. This is due to the fact that the wide use of the stripper leaves in our wheat a considerable proportion of split grains, and these accumulate in the tailings. Examinations I have made lead me to the conclusion that 10 to 20 per cent. of the tailings, such as are not unfrequently kept and used for seed purposes, is composed of split grains that are valueless as seed. Such split grains, together with other diseased, useless, and more or less foreign matter, occasionally compose 30 to 40 per cent. of the bulk of the tailings from ordinary cleaning machinery.

These observations, which are based on actual counts of measured quantities of tailings, throw considerable light upon the contention frequently heard from those who advocate or condone the use of poor quality seed-wheat,—the contention, namely, that although the seeds are smaller in these tailings there are so many more of them that their small size is made up for by this increase in numbers,—for it must be remembered that the apparent increase in the number of seeds in ordinary tailings, due to the smaller size of the seeds, has to be diminished by the bulk of this worthless and foreign matter before we arrive at the true number of seeds, and that this diminution amounts in different samples to from 5 to 40 per cent. From my observations and measurements I should be inclined to set the average at somewhere between 10 per cent. and 20 per cent.

This allowance has to be made before beginning to compare the results of these experiments with the arguments advanced for using tailings as seed, for the small and shrivelled seed in all these trials was freed from such split and foreign matter. Every seed sown was a perfect seed of the size set down in the photographs of tailings (Figs. 10, 14, 21, 22, 31 and 32), and had the advantage in all cases of being derived from healthy plants. None of the small and shrivelled seed used in these trials could have been derived from plants diseased in any manner except from attacks of rust. In certain instances, seed was purposely selected from plants that had suffered from rust, but such cases do not compose more than a small percentage of the trials. It is almost impossible to secure plants absolutely free from rust; so that in nearly all cases the plants furnishing the seed bore a very small quantity of rust, but it was a very small quantity indeed in the great majority of cases. The healthiness of the tailings used in these trials comes about from the fact that the seed for the experiments was derived from the plants selected out of a large number as being the best for seed purposes. The selection was made by examining each plant most carefully, diseased and imperfect plants being rigidly excluded, except in the cases mentioned.

It will therefore be seen that it is impossible to attribute the results of the trials recorded in the tables to diseased seed. If any suggestion can be entertained in this connection it is that the germination and growth here recorded is higher than would be the case with ordinary seed-wheat. I cannot help believing that here again the conditions of the trials favour the small seeds as compared with ordinary practice, because I have come to the conclusion that the diseased seeds that are not unfrequent in ordinary seed-wheat accumulate in ever increasing number in the smaller grades, so that, for instance, if an ordinary sample of wheat be cleaned and graded, its diseased seed will appear in greater percentage in the smaller grades, simply for the reason that such diseased seeds are of smaller size than their healthy companions. This conclusion is one that I have formed from the examination of a large number of examples of seed-wheat, and I think, inasmuch as the seed of small size used in these trials was almost invariably derived from most carefully selected healthy plants, that the germination and growth displayed by them is in excess of what would be found in ordinary practice.

The weight per bushel of the small grains of a given sample is less than that of the large grains from the same sample.

These facts furnish the basis for instructive comparisons with the relative yields given in the tables of trials of large and small grains.

*Irregularity of Stand from Ungraded Seed.*

If the reader will turn to page 22 and examine the illustration there given of the difference in size of the plants that grow from large, small, and medium-sized seed, he will, I am sure, be struck by the contrasts. The plants from the small seeds are a large fraction of a foot shorter than those from large seeds. This is part of their general inferiority. If such plants derived from large and from small seeds were mixed together in a common crop, and this is precisely what occurs in the great majority of our wheat crops, it is very easy to see that the harvest operations would be more difficult and less successful than they would be if the crop was more uniform in height; for if the low-growing heads are to be reached with the stripper, then the tall plants must be taken at a disadvantage, because so much straw has to be taken with them; and if the stripper is worked for the high-growing heads, then some of the lowest are missed. If the reaper and binder is being used, there is still a difficulty, which does not cease until after the sheaves are put through the thresher. I am inclined to think that the difficulties and losses resulting from irregularity in the growth of a crop are under-estimated, and looked upon as unavoidable. The use of graded seed will tend to reduce irregular growth, and thus help to avoid these difficulties.

All this is quite separate from the fact of inferior yield from ungraded seed, and constitutes an additional argument for the use of graded seed.

### *Are Gigantic Grains Defective?*

I have sometimes heard it said that the very largest seeds are not the best to sow. Whether this is part and parcel of the belief sometimes expressed in the good qualities of small seeds, I cannot say. I have sometimes come across gigantic grains, whose size was due to a fungus disease, and this has led me to think that there might possibly be something in the idea that monstrously large seed—in the case of wheat, that is—might be of poor quality. In the present series of trials there is nothing to countenance this idea. So far as I can see, the larger the seed the larger the yield, though the advantage grows relatively less as we go up the scale of grades, and as the cost of securing sufficient of the larger grades increases with the increase in the size of the seed, the profitableness of using only the very largest seeds is thus diminished.

It should be borne in mind that the author gives room here to little opinion as to the absolute value of the crops raised from large seed. He has concerned himself mainly with the market value. It may be that the use of the very largest seed, and the consequent striving always after size, will lead to a lower absolute quality in the product. This is a matter that it would be very interesting to inquire into carefully, not only with regard to wheat, but also with regard to crops of every nature, the question being, "Does the constant striving after large size and fine appearance tend to bring us towards a limit beyond which there is an absolute loss of product, loss of quality, loss in absolute value"? This question is certainly one that may be asked with a show of reason, and one that it would be well to have answered, but is one that will give the wheat producer of the present very little trouble. He has his living to make, and the market value is his touchstone, no matter how absurd the basis of that value may be.

There are, so far as I can see, no circumstances in which it is advisable in this State to sow small seed-wheat on land suitable for wheat-growing if it is reasonably possible to secure large, plump seed. The most that can be said is that if we knew beforehand that the season was to be of a certain favourable character, the prospective loss of yield from the use of pinched and small seed would not be so great as it would otherwise be. As, however, we never know what the season is going to be, I fail to see how we can advise the use of small and shrivelled seed, even if it entailed under such favourable circumstances a gain instead of a loss, simply because we cannot predict the seasons. Are we to use small and pinched seed season after season on the off chance that if a good season comes along we shall not lose quite as much as usual? That is really the absurdity into which the argument about the good qualities of small seed seems to resolve itself.

*I take it for granted that a given piece of land will bear to the best advantage at one time only a certain number of plants, and that it should always be the object of the farmer to have the land bear that number of plants, and to have the plants as thrifty and productive as possible, and if these suppositions are true, I cannot see that it will be anything but a loss to supply these plants by sowing small, shrivelled, and, therefore, inferior seed.*

Those who defend the sowing of small seed have a stock argument in the saying that there are so many more grains in every bushel of small seed that the resultant crop will be just as good—some even go so far as to say better. The argument that a bushel of small seed contains more grains breaks down at a number of points. In the first place, the argument seems to assume that the cost of the seed is a factor of the highest importance in the question. This is not so. The cost of small and inferior seed, although it is less, is not very much less. The difference is too small to be any great argument against large seed. As before pointed out, there is some reason to suppose that the actual fodder value of a bushel of small grain is about as great as that of a bushel of large grain. This from experimental grounds. If we turn to market values, we find chick-wheat often quoted only a fraction lower than good milling wheat.

The argument for small seed, based on the extra number of seeds per bushel, is capable of reversal. Suppose we say that although the bushel of large wheat contains a smaller number of grains, still the grains are larger, and will produce better plants. As a bare statement, that is just as strong as the one of which it is a reversal.

It may be asked in respect to the assertion that the bushel of small seed produces more plants, if the object is to secure more plants, what is the objection to securing this number by the use of a larger amount of good seed, thus covering the ground with the necessary number of plants, which in this case will be of the very best character instead of the starvelings due to the use of small seed ?

The grading of seed is almost wholly neglected by farmers in some of the newer of the great agricultural countries, and this very fact is one that is sometimes pointed out in defence of not grading the seed. I have heard it said, in substance, by a well-known teacher of agriculture—a man whose word is respectfully listened to by thousands of farmers—that there could not be much in using graded seed, or farmers would not so generally neglect the matter. Add to this that one may find, in almost any farmers' meeting of any size, advocates of small and pinched seed, and we have, indeed, a strange state of affairs. One might pertinently ask this teacher of agriculture how, if a practice is to be its own sufficient defence, any improvement is ever to take place, and inquire of the advocates of pinched seed why Dame Nature does not provide all her plants with pinched and puny seed, if they are so much better.

The truth is that, other things being equal, plump seed is much better than shrivelled seed, and that where the results obtained from shrivelled seed are better than those obtained from plump seed, the result is due to other factors than the quality of the seed. A farmer some day sows some badly-pinched seed and reaps from it a good crop, and, possibly, concludes that pinched seed is as good as any, either unaware or forgetting to note that the conditions have been such that almost anything would have grown well. He may

3·25 3·00 2·75 2·50 2·25 2·00 Tailings.

**Fig. 37. Fig. 38. Fig. 39. Fig. 40. Fig. 41. Fig. 42. Fig. 43.**

Figures showing the size of the grains belonging to each grade yielded by the sieves shown in Figures 23 to 28. The proper grade numbers are placed above each illustration.

even sow plump seed in the same season, and get a poorer harvest from it than from the shrivelled seed, and in this case feel highly fortified in his good opinion of pinched seed. The mistake he makes is in attributing his result to the one obvious difference of seed, entirely forgetting a score of other things that would help to account for the difference in result. Anyone who will take a sample of seed and grade it, as shown in the illustration above, and sow the same in drills side by side, can easily convince himself that the produce of a wheat plant depends in a marked degree upon the size of the seed from which it springs. The plants from grade 200, for example, will be much inferior to those from grade 325.

It may be asked if the yield from large plump seed is always greater than from small and shrivelled seed, how the contrary idea ever came to have any circulation whatever, but we have to remember that any paradoxical sounding statement may be easily put into circulation if it be gravely and plausibly made. Newspapers and other publications furnish abundant examples of this fact; and it is unnecessary to go into reasons for the fact.

It sometimes happens that a good crop is secured from poor seed. In such cases good seed would have given a still better crop, but this fact is overlooked. Sometimes these good crops from poor seed are alongside crops from good seed, and the latter are not so good as the former. Some people are cheerfully willing under such circumstances to make comparisons, regardless of the difference in soil, cultivation, rainfall, &c., and may come to the wrong conclusion that the poor seed is responsible for the superiority of the better crop.

If a wheat-grower reaps a paying crop from small seed he has in the course of ordinary farming no means of knowing how much better the crop would have been if the seed had been larger ; and on the other hand, if he reaps only a poor crop from good large plump seed, he again has no means of knowing how much poorer the crop would have been if the seed had been poor and small. In the absence of this knowledge, he is not unlikely to come to a wrong conclusion as to the relative values of large plump and small shrivelled seed. There are two ways in which this baleful uncertainty may be dissipated—either through faith in the experience and advice of those who have studied the matter long and carefully, or by arriving at the truth through individual experiment. The second course is one that I would unhesitatingly recommend, if there exists the slightest doubt under the first head. The cost of the experiment is so trifling, and the result so convincing, that I venture to think that after three or four years of experiment, there will no longer be room for doubt as to the truth. Let any doubter who is inclined to the use of small or shrivelled seed, repeat each year a single experiment of the sort pictured in Fig. 27, p. 148, selecting the seed by hand, according to the sizes shown in Fig. 31, or anyone of the other similar figures in this report. The experiment need not cost him more than a few shillings each year. One hundred to two hundred seeds of each size is sufficient. At an entire cost of 30s. to 40s., spread over several years, he may acquire that faith in the good qualities of large plump grains as seed that will have a permanent value to him a hundredfold greater than the cost of the experiment.

On some soils naturally unsuitable to wheat the growth is too rank for the production of good crops of grain. Under such circumstances, the yield of grain from the stunted plants derived from shrivelled seed may be greater than that from larger and better seed ; but this applies to grain alone, and not to the actual marketable yield of product. In such cases, even, it must not be forgotten that very thin sowing of good seed gives as good results as any plan if proper methods of culture are followed.

It may be that field trials of large and small seed sown side by side in the most careful manner will give results favouring the poor seed. Such puzzling instances may be seen among the tables of comparisons presented in the foregoing pages. These results only serve to show how little we know of the actual conditions of our soils. Instead of the extra yield from the poor seed being due to the seed, it is due to other factors in the experiment, as is most conclusively proved by the repetition of the experiment year after year, when it will be found that, in the vast majority of cases, the larger and plumper the seed, the better the yield.

These various considerations seem to me to account for whatever vogue has been secured by this tale of the good qualities of small and pinched seed.

It has been before remarked, but may be here repeated, that the trials upon which we base the present discussion were carried out on lands similar in character to large areas of this State where wheat is grown, and though one should be cautious in making such statements, I think it safe to say that the results here set down would have been similar if carried out on typical wheat land almost anywhere in the Riverina, or in those parts of the west where wheat is successfully grown. I feel all the more sure of this because the trials were continued through five years of widely varying character, varying from that of 1894–5, one of the best ever known in the Wagga district, to that of 1897–8, one of the worst ever experienced on the Wagga Farm, the drought being so bad that year that some of the gum trees on the Sister Hills died from dryness—an almost unprecedented occurrence. Again, the trials were carried out on newly cleared land ; on land that had been cleared one, two, or three years ; on "green" land ; on fallowed land ; on land in rotation. The land, too, though coming under the general descriptive terms, typical Riverina wheat land, was of a somewhat varying character, being in some of the trials composed of more decomposed granite than in others.

The results of the trials have left no room for doubt as to the superiority of large, plump seed under all these conditions. If the small and shrivelled seed have, in a few instances, yielded more than the larger seed, it has always been evident that it would be the height of folly to attribute the fact to the small or shrivelled character of the seed. The superior yield of the small seed in these exceptional cases was due to unknown factors in the soil, and I have no doubt this would also account for most, if not all, of the alleged successes of small and shrivelled seed.

In making a comparison between the results of these trials and the arguments of the advocates of the use of tailings for seed it is necessary to keep the following various factors in mind :—

1. That the small seed used in these trials was from specially selected healthy plants, and was, therefore, of the best quality, and free from disease.
2. That the conditions of culture under which these trials were made were probably such as favour the small seeds more than the larger seeds.
3. That the trials were between equal numbers of seeds.
4. That every particle of the tailings here used was genuine seed—there was no chaff, diseased or split seed, or foreign matter.
5. That the trials were made with accurately graded seed five years in succession, under conditions representative of the bulk of our wheat areas.

Or, to put the matter from the other side,—

1. Ordinary tailings contain a considerable proportion, amounting sometimes to 50 per cent., of chaff, split grain, diseased grain, and worthless foreign matter.
2. That the conditions of ordinary culture would probably be proportionally less favourable to the small seeds.
3. That, apart from the chaff, &c., in ordinary tailings, there is present considerable diseased grain, owing to the fact that in any given sample there is a tendency during the cleaning for such diseased matter to collect among the smaller grades.

Finally, it should be borne constantly in mind that in making any comparison as to yield we should take into account not only the grain, but also the straw, and remember that the *quality* of the crops from large seed is always markedly superior, regardless of amount.

A brief examination of the figures given in the tables will guard the reader against the conclusion that the lower yield of the plants from small seed is due wholly to the fact that the small seeds produce a smaller number of plants.

It will be found that where the number of plants from small seed is, say, 85 per cent. of the number from large seed, the yield is only 70 per cent. Evidence of this sort is to be seen throughout the tables, and is a conclusive proof that plants from small seeds are smaller and less productive than plants from large seeds. This fact has an important bearing on the contention that in order to get good crops from small seed, it is only necessary to sow more of such seed per acre. It may be admitted that if it is unfortunately necessary to sow small seed, it is best to sow a large quantity in order to make up for its inferior quality ; but it must be remembered that it is in no case possible to get from small seeds as good a quality of crop, whether of grain or straw, as from large plump seeds under the same circumstances.

### *Age of Seed Experiment.*

In vol. IX, at p. 186, the writer made the following statement as to the rate at which seed wheat deteriorates in quality through keeping from year to year :—

"These experiments arose from the fact that I could get no satisfactory evidence of the rate at which wheat deteriorates in value as seed. Opinion varies all the way from belief in the vitality of seed found in Egyptian mummies to doubt as to the value of seed grown year before last. As I have saved seed each year for some years, I determined the vitality of the samples by the row system. My seed having been kept in an uniform manner, was eminently suitable material for this experiment. Of course this year's work only constitutes a beginning. I may say, however, that the results of this season alone show that if seed-wheat be kept in a warm dry place, it deteriorates in seed value very little in five years. This suggests the feasibility of keeping good seed over from season to season, so as to have a supply on hand against a season when all the wheat, being ill-grown, is inferior for seed. The cost of storing and the interest on the value of the stored seed would be less than the additional value of extra good seed in a season when all other seed is inferior, at least within certain limits. I may adduce as an illustration of this, that it would have been advantageous if seed at Wagga, 1894–5, had been reserved for 1895–6–7. If in reply it be asked, 'Why not procure seed from another district?' My answer would be that I now have fairly satisfactory evidence that seed from another district is not likely to be advantageous on a well-conducted farm, unless, in addition to the seed being very well-grown, the district be also similar in soil and climate, and that these facts increase the difficulty and cost of getting such seed."

*Conserving seed for future use.*

The relative advantages of conserving seed from extra good years, and of procuring it from a distance may be compared as follows. The cost of conserving includes :—

1. Vermin-proof receptacle (cost, interest on outlay, deterioration, insurance).
2. Interest and insurance on the conserved seed, and deterioration, if any.

The cost of securing from another district includes :—

1. Freight and hauling.
2. Extra on the price—*i.e.*, profit to the seller.
3. To which must be added risks difficult to enumerate or valuate.

As a vermin-proof bin to hold 250 bushels can be constructed for under £5, upon which the annual charges need not exceed 5s. for deterioration, repairs, insurance, and interest, and as the interest, insurance, and deterioration on 250 bushels of wheat produced on the spot, and valued at 2s. per bushel, need not exceed £1 per annum, it will be seen that the expenses on the storage side of the question are such as to compare favourably with those on the other side. Probably, in most cases, if the object was to provide against one bad season in four or five, the balance would be in favour of the system of conserving one's own seed. I should, however, hesitate to recommend this conservation of seed wheat to careless unobservant growers, though I think there would be money in it for the wide-awake wheat growers.

*Cost and utility of Graded Seed.*

Apart from the advantage to be gained from the use of graded seed of uniform size, there is the advantage gained from the fact that uniform seed can be sown more evenly from the drill in case that method of sowing is adopted, as it undoubtedly should be.

No farmer should allow himself to forget that all the various items of cost in connection with grading and selecting seed are much reduced *by selecting from his crop, before it 's harvested, certain good portions to be taken off specially for seed purposes.* Such portions should be allowed to ripen fully before cutting, and be kept separate, to be cleaned and graded for seed purposes. This precaution of setting aside some of the best parts of the standing crop for seed will reduce the cost of first-class seed by a large percentage, and the resulting seed will be better than could be obtained by any other method whatever. Considering its value, it is marvellous how often this precaution is neglected.

Where the elevator system is in use there are facilities for the preparation of seed-wheat at a minimum cost. The grading machines in use in the elevators are of large size, and their capacity, and the fact that they are run by experts, places their product beyond competition as to price. As to quality, however, there are some drawbacks, principally in the direction of the purity of the sample, there being a great risk that seed from the elevators will be mixed, and more or less diseased, from the fact that none of these machines are treated for fungus diseases—at least, so far as I know, and I have made particular inquiries.

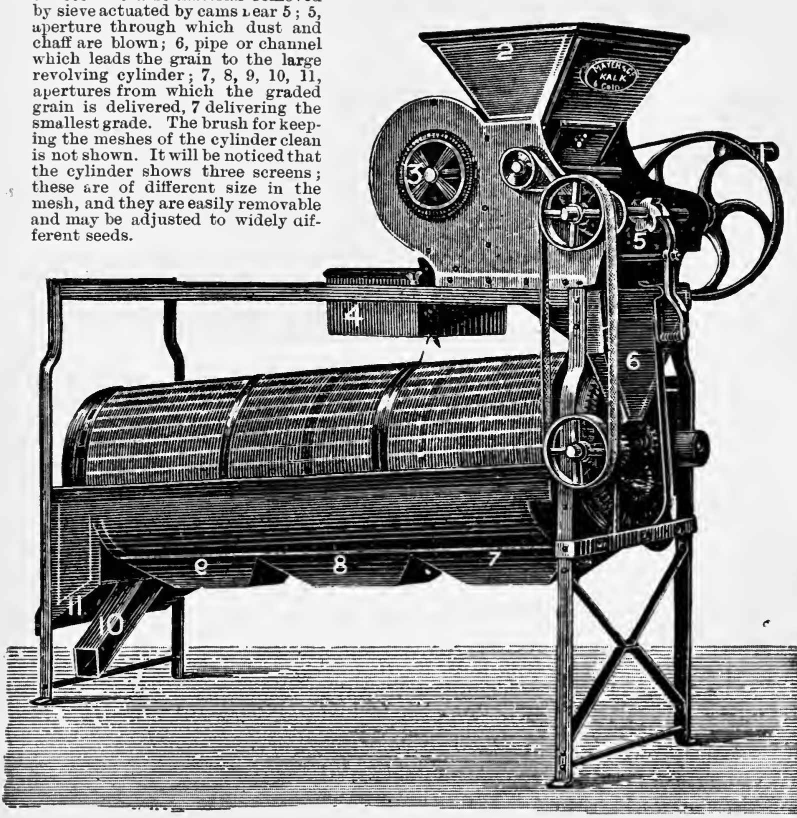
Apart from these considerations, for which remedies may be applied, the use of elevators leads to improvement in the quality of seed-wheat, as anyone may observe in regions where elevators are in use. The smaller country elevators, where they are supplied with cleaning machines, do a considerable business in returning seed-wheat to farmers. The cleaner most in vogue in the United States appeared to me to be that of the Silver Creek Grain-cleaning Company, of Silver Creek, New York. These cleaners are, however, designed especially for rapid work on a large scale, the object being to meet the commercial demands of the elevator owners, and it cannot be claimed for them that they turn out a sample equal to the types with a slower action especially designed for seed grain. Nevertheless, in a region characterised by careless farming, the good effects of elevator seed are manifest.

We have been considering this question of the relative seed-values of large and small grains hitherto wholly from a narrow and strictly and directly utilitarian point of view. There is another and higher point of view that should not be lost sight of, and that is the effect on the wheat industry of the constant effort to secure larger crops through the use of graded seed. Small plants will not produce large seeds, at any rate in the same proportion as large plants, and from this it follows that the constant breeding from the progeny of large and hence healthy plants, that follows on the practice of grading, must be in the long run of great benefit. Though it may be too small to be worth the consideration of the grower, this benefit accumulating by minute and imperceptible increments must be the main foundation for the hope of improvement in the wheat plant. It is needless to point out that all improvements in the quality of the wheat plant—it hardly matters how small they are—will be of vast benefit to the human race as a whole. Leaders in agricultural progress should, and no doubt do, receive from this thought great stimulus, and working as they do on the borderland of economic science where they are shut off from a full appreciation of their efforts and where from the nature of the case they are occasionally grievously misunderstood, they occasionally stand in need of some stimulus of this kind.

## III.—The Grading of Seed-wheat.

As to the method that should be followed in improving an ordinary sample of wheat for seed purposes, opinions may well vary, there are so many methods that may be adopted. The grower may perform the operation himself, or employ a miller to do it for him ; and whether he does it himself or hires it done, there is a great variety of machines adapted to the purpose, all having their various applications and degrees of merit. The cost of

Fig. 33.—1, crank where hand-power is applied; 2, hopper; 3, fan; 4, box to receive coarse material removed by sieve actuated by cams near 5; 5, aperture through which dust and chaff are blown; 6, pipe or channel which leads the grain to the large revolving cylinder; 7, 8, 9, 10, 11, apertures from which the graded grain is delivered, 7 delivering the smallest grade. The brush for keeping the meshes of the cylinder clean is not shown. It will be noticed that the cylinder shows three screens; these are of different size in the mesh, and they are easily removable and may be adjusted to widely different seeds.




labour, the distance from nearest flour mill, the price of wheat, and other factors enter into the problem, and render it impossible to suggest a course of action suitable to all cases. It may however be well to call attention to certain points that are of general application.

It is a well established principle that at a certain point in the cleaning of wheat, a change is desirable in the nature of the machinery employed. Up to the stage at which most of the wheat leaves the farmer's hands for the market it is necessary to use machines having both a blowing and a sifting action, as exemplified in the ordinary winnowing machine. There comes a point soon after this stage, however, beyond which any further use of air currents in the ordinary way is of little value ; hence the operations must be largely confined to sieving. Here is where the New South Wales methods seem to me to be capable of much improvement. We are, in my opinion, too slow in adopting on our farms sifting machinery of the best type, and even fail to appreciate that which we already have available.

*Grading Machinery.*

I recently had an opportunity to examine machinery of this class in operation, in all the leading grain-growing countries of the Northern Hemisphere, as well as an extended opportunity to examine the collection of competitive exhibits of this class at the Paris Exposition, an exhibit that was most completely representative of all the European countries, notably those of Middle Europe, where these machines have reached a high degree of perfection. As the result of thoroughgoing observation and trial that must

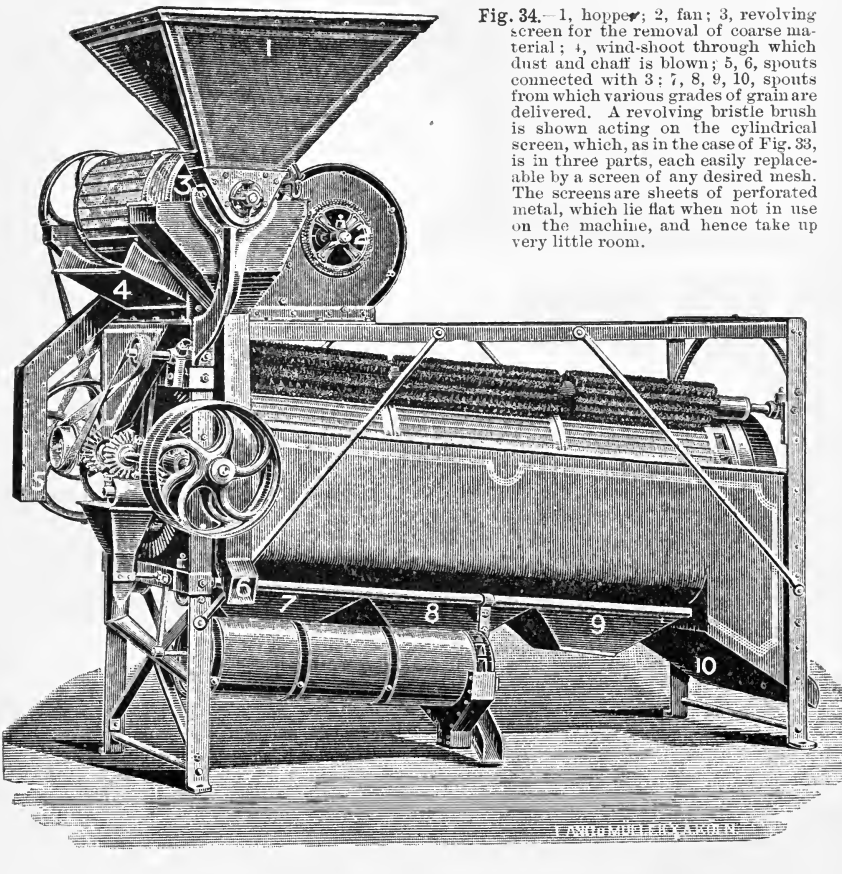



**Fig. 34.**—1, hopper; 2, fan; 3, revolving screen for the removal of coarse material; 4, wind-shoot through which dust and chaff is blown; 5, 6, spouts connected with 3; 7, 8, 9, 10, spouts from which various grades of grain are delivered. A revolving bristle brush is shown acting on the cylindrical screen, which, as in the case of Fig. 33, is in three parts, each easily replaceable by a screen of any desired mesh. The screens are sheets of perforated metal, which lie flat when not in use on the machine, and hence take up very little room.

have covered between forty and fifty different makes of grading machines, the impression left was a strong one that the machinery of this class in use in this State is very much below the best modern type, whether we take for comparison the machinery to be found on our wheat farms or that found in our flour mills, though in this latter respect the comparison is much more in our favour than in the former, from the fact that many of our mills are very well equipped.

I think our merchants would do well to make inquiry among the manufacturers of grading machinery in Hungaria, France, Germany, and America, and stick less closely to English models. If they will do this with an eye solely to merit and cost, I feel sure that they will be able to introduce a better grade of this class of machinery than has ever been sold here, and one that should command sales among farmers because of its efficiency and moderate price.

*Sieves and their Meshes.*

A mechanical difficulty of considerable importance connected with wheat grading machinery is that of keeping the meshes clear. The grains tend to pass through as small a mesh as possible and this tendency causes them to bind in the meshes that are a fraction too small for them, and they thus accumulate in the meshes of the machine and clog its action. The best machines are provided with some mechanical means for meeting this difficulty without breaking the grain, and no machine can now-a-days be considered efficient without some such device.

The meshes of the screens now in use for grain sieves are made of woven wire, of metal rods, or of perforated sheet metal.

The wheat mesh that finds most favour is an elongated mesh made from sheet metal by means of perforating machines. The sieves made in this manner are very accurate and uniform, durable, and not likely to get out of order. They are easy to repair, and have a high degree of efficiency, and are withal as low in price as any other equally good form.

Woven wire meshes have the disadvantage that they are difficult to manufacture in a form sufficiently accurate for the work of grading, and if so made are liable to get out of order unless used with great care. As soon as the wire composing the meshes gets bent of broken, accurate work becomes impossible.

Sieves having meshes made by placing at stated distances metal rods or plates may be made very accurate in the mesh if the rods or plates are supplied with bearings at short distances so as to prevent the possibility of bending. Their disadvantages are the thickness of the mesh, if one may so speak of it—that is to say, the distance the grain has to go in passing through the mesh. If this distance is a sixteenth of an inch or more, there is greater liability that the meshes will clog in use. A second disadvantage is the amount of metal required by the method of construction, which leads to increased cost and makes the machine heavy to handle and harder to run.

The sieves made of thin perforated metal have the most accurate meshes and the thinnest meshes, and do the most accurate work. Since the perfecting of the modern perforating machines, and the adoption of perforated metal plates for a multitude of different purposes, the cost of this class of sieve has been reduced until it now ranks as one of the lowest in price. These perforation sieves are not liable to get out of order. This combination of accuracy, low price, and durability is a powerful one and has led in recent years to a very wide use of this class of sieve. The meshes are thin and as little likely to clog as any that can be constructed. These sieves have the disadvantage of a slightly slower action on account of the fact that the area occupied by the meshes is proportionally smaller than in screens made either of woven wire or metal rods.

Taking it all round, it is difficult to avoid the conclusion that at the present time the perforated metal sieve is the most satisfactory and accurate form for use on the farm.

There is another class of grader in wide use in flour mills that has sometimes been offered to the farming community as a farm implement, and may, therefore, deserve a little notice. It consists of a hollow cylinder, the inner surface of which is studded with pits of such a character as to receive only grain of a certain size. A further sorting mechanism separates these grains from the others, and thus the grading is accomplished. These machines are highly specialised and expensive. They are almost indispensable for certain work necessary in milling and malting, but have not, for the reasons stated, come much into use as a farmer's machine.

The grading accomplished by these machines is very perfect, and it is often by the and other very special machines that the grading will be done for the farmer if he takes his grain to a miller to be graded. These remarks are inserted here lest any novice in the subject should infer that grain can be graded only with the aid of the class of machine specially described in these pages.

*Grading Machines of Various Types.*

In order to illustrate the principles laid down in the foregoing paragraphs, the adjacent illustrations of a grading machine made in Kalk, near Cologne, may be consulted. (Figs. 33 and 34.) It is of a type manufactured in several countries, and is selected because it is one of the best of its kind. It is a hand or power machine, of a size suitable for farmers, and may be had with or without the blower attachment. It is constructed entirely in metal, and is compact and solid. The weight is from 300 ℔. to 600 ℔., according to size.

The capacity is from 5 to 20 bushels per hour, according to size and manner of use; the machine, shown in Fig. 34, is 6 feet long, 6 feet high, and 3 feet wide, has a capacity of 20 bushels per hour, and is advertised at about £25. The smallest size has a capacity of 2 to 5 bushels per hour, and costs £12. The smaller sizes are not always supplied with the revolving brushes for keeping the meshes clear of grains caught and held by friction. As before remarked, some such device as this for keeping the meshes clear is a great addition to this class of machine.

These hand machines are capable of cleaning or grading in a very effective manner from 3 to 6 bushels per hour, employing one man. This means, in this country, a cost of 2d. to 4d. per bushel for labour. At the rate of 1 bushel of seed-wheat per acre, this means the expenditure of from 2d. to 4d. per acre. This is a small expenditure in comparison with the increased yield that may be expected from the improved quality of the seed. In order for the return to repay the labour, it would only be necessary for the yield to be increased by one-twelfth to one-sixth of a bushel per acre of wheat, when the price of wheat was 2s. per bushel All increase of yield above this additional fraction of a peck per acre would be surplus on the labour expended.

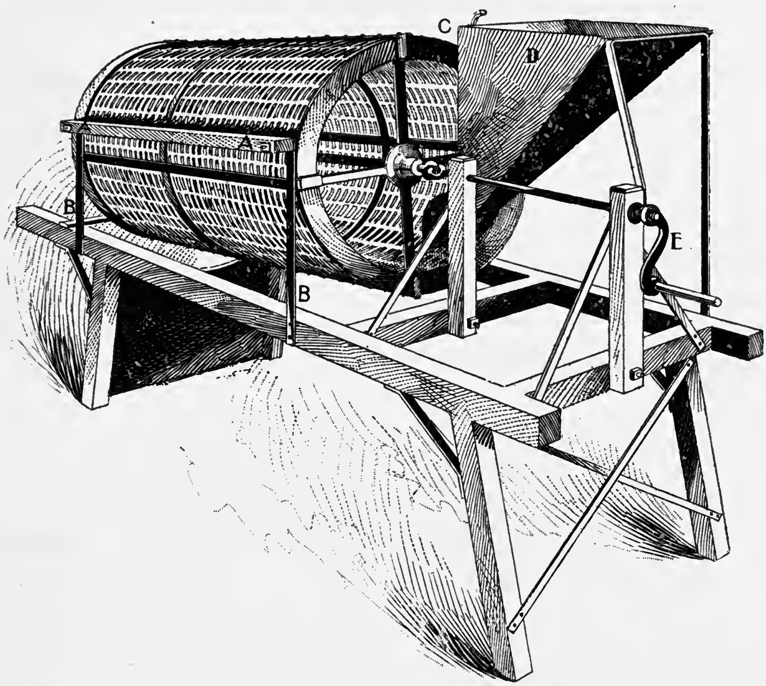



**Fig. 35.**—An Australian form of seed-wheat screen, or grader, suitable for use by farmers. The screen is a cylinder of perforated sheet metal, actuated by the crank, E. A brush, A A, is held against the screen by the springs, B B. The feed from the hopper, D, is regulated by the handle, C. The seed-wheat is caught at the further end of the screen, while the tailings fall on to the floor beneath. The capacity of the machine ranges up to 50 bushels per hour, but of course the quality of the work is not so good at 50 bushels per hour as at 20 bushels per hour; the slower the grading is done, the better it is done. The brush, A A, is an important factor in machines of this class. When, as in this case, only one size of mesh is supplied with the machine, a variety of grading can still be done by working the samples through several times. In this manner three quite distinct grades may be prepared with this machine, at the expense, however, of extra labour. For Australian wheat the mesh should not be less than 2·75 millimetres.

The prices of these machines of moderate capacity vary from £10 or less to £20, and they are so solidly constructed that, with good usage, they will easily last ten to twenty years on an ordinary farm. If we allow £1 or £2 per annum for interest and wear, according to the size of the machine, we have a cost of 1d. to 2d. per acre on a farm of 200 acres. This sum must be added to the actual cost of the labour of grading the grain in order to arrive at the total cost of grading.

It is a common experience of the farmers who take the lead in this direction, that such machines can be made to pay their way in fees from other farmers who require to have their seed graded, but have not the facilities for doing the work themselves. The machines can often be hired out at a remunerative rate.

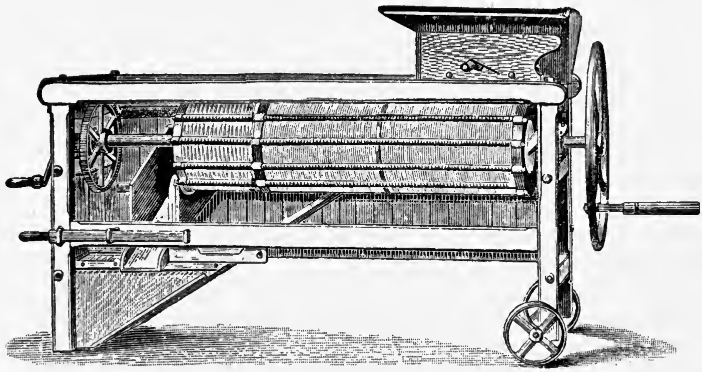


**Fig. 36.**—An English grader in which the meshes are made of wire in such a way as to be *adjustable in width,* without removal. The machine gives four grades of grain and does very good work. At the back near the top is the brush for keeping the meshes clear. This machine may be had with or without a fan.

The price at which wheat can be graded for seed by a miller varies according to the sample to be cleaned, the machinery at hand, and the skill with which it is used. Some foreign seeds are more difficult to remove than others ; some samples clean more slowly than others, owing to the relatively larger proportion of small grain, &c., &c. While some samples can be cleaned for a penny a bushel so as to be fair seed, others will cost two to three times that amount, or even more. To this the miller's profit has to be added. Three pence per bushel would be an average price, 2d. would be low, and few samples would require 4d. These latter prices are the prices to the farmer, and include all costs, even rebagging. The prices assume that the miller has the facilities for the business and the inclination to go into it. If the miller considers grading for seed to be too much of an interference with the regular work of the mill, his price may be higher than those given above. The relative cost of cleaning a small quantity will always be greater than for a large quantity. Millers should always be required to exercise care sufficient to prevent mixing of seed. This is a matter that needs special attention. As a rule the modern machinery designed to handle large quantities of wheat is responsible for a large proportion of the mixing of varieties that is now-a-days so prevalent. The cleaning machinery in use by millers is no exception to the rule, but rather a striking example of it.

The farmer who raises his own seed has it in his power to reduce the cost of his seed-wheat very materially by selecting and harvesting separately the best portions of his crop for seed purposes.

Though we have paused here and there in these pages to examine the flimsy tissue of words that has done service as an argument or excuse for the use of small and shrivelled seed-wheat, it must not be forgotten that the main object, as stated at the outset, is to arrive by experiment at average figures that may be made the basis of definite rules for practice. With this object in view we endeavoured to tabulate and picture the best, worst, and average seed-wheat practice of the State. This furnished a clue as to the answer our best growers would give to the question, "How far is it best to go in improving an ordinary sample of wheat before using it for seed?" The nature of that answer has been clearly indicated, and it is such that if it is to be taken as a guide we must set out to improve our seed by much more care in sieving ; but in doing this we naturally wish to know how far we may go before we pass the limits that will bring in a profit, and at what point the profit reaches a maximum. May we spend up to 1s. per bushel with no fear of incurring a loss, or may we go as far as 2s. per bushel with safety, or as far as 5s. ? How far may we go with safety ? That is a leading question, but there is another that to the ordinary grower is more fundamental, namely, "At what point does the profit reach a maximum ?" For it is evident that as we approach closely to the limit of what we can afford to spend in sieving, the prospective profit begins to decrease, and at the limit ceases altogether.

*How much can the Grower afford to spend in Grading Seed-wheat?*

As before remarked, we have recorded on an earlier page the answer given by our best wheat-growers to the question, "To what extent is it profitable to clean wheat for seed purposes?" Their answer, as represented in their practice, might, I think, reasonably have been expected to be a conservative and very cautious one—one that erred if at all on the side of small expenditure. Let us now seek an answer to this critical question among the tables of growth from large, medium, and small seed. Such a long series of carefully made trials may be trusted to throw considerable light upon this radical problem.

From the evidence given in the first section of this report it is evident that we must take one of the medium grades as representing the average quality of our seed-wheat. In Fig 20, showing the quality of our average seed wheat, it is the 2·50 grade that predominates, though the actual average lies between 2·50 and 2·75. Now this grade is about the same as that denominated "medium" in the various tests as to the relative value as seed of large, medium, and small grains. It follows that what we have to consider is the advantage, if any, of bringing our seed up to the average represented by the large seed used in the trials, namely, the 3·00 grade.

To the question, "Is it possible to bring our seed up to this grade?" we must answer at once, "Yes, easily." A perfectly grown sample of wheat of our commonest variety, grown on ordinary soil, without manure, but with good culture, actually averages better than 3·00. This is shown in our illustration, Fig. 14. A considerable number of the samples of seed-wheat obtained from farmers and reported in our table of the fifty best samples average better than 3·00. With the grading machines described in this report farmers can secure such seed from good average samples of wheat at a cost seldom, if ever, exceeding 6d. per bushel for the labour of sieving. Millers stand ready to grade wheat at a lower price still if they can have it in quantity sufficient to justify the use of their machinery for that purpose. This fact established, we wish to know what additional yield may be expected in return for this extra expenditure of a few pence per bushel on the seed. It is evident that what we have to ask from our tables is, what extra yield may be expected over that given by medium-sized seed, or 2·50 grade, if instead of that grade we sow 3·00 grade.

In the third set of trials the 3·00 grade excelled the 2·50 in about 90 per cent. of the cases, the extra yield of grain being 30 per cent.

In the second set of trials the 3·00 grade excelled in 69 per cent. of the trials, and the extra yield of grain was about 14 per cent. In this set of trials, however, the 3·00 was almost invariably compared with 2·75 instead of 2·50. This would no doubt account for the fact that the excess figures are lower than in the case of the third trial.

In the fourth trial, in two cases out of three, the 3·00 grade excelled the 2·50 grade in yield of grain by about 11 per cent.

In the first or preliminary trial the 3·00 grade excelled the lower grades in four cases out of five, the extra yield of grain being about 18 per cent. In this case the seed with which the 3·00 was compared was not in all instances smaller; in a number of the cases the seed with which it was compared was of about the same size but was shrivelled. It will be remembered that this first trial was made before the introduction of accurate grading.

To this excess of yield on the part of large seed we have to add the fact that there is also an extra yield of straw, and that the quality of the grain from the large seed is considerably better from a market point of view. Furthermore, so far as I am able to see, the nature of the trials was such as to probably favour the smaller grade, as explained elsewhere.

Leaving these latter points out of account, we have an average excess of grain, from the 3·00 grade, equal to about 20 per cent., taking the yield of the lower contestant, or 2·50 grade, as the basis of calculation. These figures represent the average of a succession of seasons, including a very good season, a very bad season, and an average season.

Notwithstanding the very definite results from this series of trials, I think it would be best, in basing practice upon them, to allow a good factor of safety, and we may easily allow this factor of safety to be 50 per cent. without bringing into question the strong advisability of using plump, graded seed of large size. This lands us at the conclusion that we may count with certainty on an extra crop value of 10 per cent. from the use of large, plump, graded seed. If a farmer has an average yield of 10 bushels per acre from the use of the average quality of seed now in use in this State, he may increase his yield from 11 to 12 bushels by the use of seed of the grade shown so frequently in this report under the figures 3·00,—a grade of seed that is within his reach at an expenditure of seldom more than 6d. per bushel for the labour of sieving, and with good practice. including the setting aside of the best portions of his crop for seed, often an expenditure of not more than 3d. per bushel for such labour. To this expense has to be added the interest, insurance, and depreciation connected with the grading machinery. This expense is discussed elsewhere.

## Conclusions.

1. Under field conditions, small and shrivelled wheat-grains do not appear to germinate so abundantly or so strongly as large and plump grains. This defect of small and shrivelled grains appears to be inherent in the grains themselves, and is independent of the season.

2. Under field conditions the plant-producing power of small and shrivelled grains is much below that of large and plump grains. This property is displayed independently of the season.

3. No matter what the nature of the season, the yield from large and plump seed is always greater than that from equal numbers of smaller and shrivelled seed, if the two crops be grown under similar conditions. This applies to the yield of both grain and straw.

4. Apart from the weight of the crop yielded, which is always in favour of the large seeds, the quality of the yield is decidedly better in the case of the plants grown from large and plump seeds, that is to say, the grain yielded from large seed is larger and plumper, and the weight per bushel is greater, and this difference is such as to decidedly affect the market value.

5. The superior yield from large and plump grain is sufficiently pronounced to justify the cost of first-class cleaning of ordinary wheat for seed purposes, and the amount so expended may, without loss to the grower, go in all ordinary cases as high as 10 per cent. of the value of his yield per acre. Allowing his average yield per acre to be ten bushels, and the average value of his wheat to be 2s. 6d. per bushel, and his average quantity of seed per acre to be one bushel, the grower may safely spend 2s. 6d. per bushel in grading his wheat for seed. It seems probable that the maximum of profit will result from that amount of grading that can be done with good machinery for about 6d. per bushel. While the yield per acre will be increased by all the additional grading and cleaning up to a cost of 2s. 6d. per bushel, the profit will not be in proportion, and may cease altogether at the grade of seed produced by the expenditure of 2s. 6d. per bushel.

This conclusion is drawn up on the basis of the yield of grain alone, for the reason that the basis of previous discussions on the subject have been the yield of grain. If the value of the straw be added to that of the grain then the amount of money that can profitably be spent in grading seed-wheat is somewhat increased. Grading for hay is just as profitable as for grain.

6. Allowing the liberal sum of £20 as the price of a seed grader suitable for farm use, and allowing the life of the machine to be twenty years, and allowing 10 per cent. for insurance, interest, and repairs, the regular cultivation of 50 acres of wheat will justify the purchase of such a grader.

7. If the grower does not care to encumber himself with grading machinery, the money that would be thus invested may be profitably spent in having his seed wheat prepared by any miller who has suitable machinery, the cost of such cleaning or preparation usually costing not more than 6d. per bushel at the mill, and very often much less.

8. Considering the healthy and exceptionally good condition of the tailings and smaller grades of seed used in these trials it seems impossible to avoid the conclusion that the inferiority here shown to exist in them is not so great as that actually existing in ordinary tailings, the use of which as seed has been advocated.

9. The foregoing conclusions apply to such land as that used for wheat in the Riverina district, and other important wheat areas of a similar character in various parts of Australia.

10. The advantages of large, plump, graded seed are that—

It is likely to be healthier seed, and therefore more likely to produce healthy plants.

It can be sown more evenly because of its uniform size.

There is a larger percentage of growth, and fewer failures.

The plants from such seeds are larger and thriftier and more resistant to disease, drought, and starvation.

The crops from such seed have a more even growth, and are more economical to harvest and thresh.

The yield per plant, both of grain and straw, is greater from such seed.

The crop of grain grown from such seed has a higher market value because—(*a*) It contains more large grains and fewer small grains. (*b*) It is plumper and better looking. (*c*) It weighs more per bushel.

The continuous use of such seed tends towards a general improvement in the quality of wheat.

The above list of conclusions are not the only deductions that may be made from the experiment tables. For example, the column of observations headed "Number of Plants that Grew" has been left as a bare statement of facts. It is obvious that a lengthy series of calculations can be made with the object of showing the relation of this column to the yield columns. From the general percentages of growth it would be possible to derive a factor which, when applied to the "Plants that Grew" column, would enable us to formulate a correction for the yield column that would tend to eliminate the accident element that exists in the yield column. As, however, through the very cordial co-operation of all the officers concerned, the experiments were under the most careful protection, and, furthermore, were blessed with good fortune in the field, there was very little accident of an obvious nature. The "soil mysteries" also were so evenly distributed as to give very little uneasiness. For these reasons it has not seemed to me worth while at present to make these corrections, it being rather an unnecessary refinement in this case.

It will be noted that as one goes up the scale of grades the increase in yield is a diminishing function. This fact might be presented in the form of a curve—a sort of "curve of profit" from grading—but I have not made the necessary calculations.

There is room, too, for deductions as to the effect of different seasons on the behaviour of various grades of seed, and for a number of other deductions, but for the present these are left to the ingenuity of the studious reader.

# INDEX.

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