THE INSTITUTE OF BREWING RESEARCH SCHEME.

SECOND REPORT ON THE EXPERIMENTS ON THE INFLUENCE OF SOIL, SEASON AND MANURING ON THE QUALITY AND GROWTH OF BARLEY.

1923.

By Sir E. John Russell, O.B.E., D.Sc., F.R.S.

(*Director, Rothamsted Experimental Station, Harpenden.*)

In the first report issued last year a full account was given of the scope of this inquiry and of the methods proposed for adoption. The present report gives the results of the second season's experiments, and shows how far they agree and in what ways they differ from those of last year; field observations which may throw light on any apparent discrepancies are also included. It is as yet too early to attempt any full discussion or to draw general conclusions.

The purpose of the experiments is to ascertain the influence of environmental conditions, such as soil, season and manuring, on the yield and quality of barley.

The experimental scheme comprises five plots, which are as follows :—

1.—No manure.
2.—Complete artificials: 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, 1½ cwt. sulphate of potash per acre.
3.—Artificials without potash: 1 cwt. sulphate of ammonia, 3 cwt. superphosphate per acre.
4.—Artificials without phosphate; 1 cwt. sulphate of ammonia, 1½ cwt. sulphate of potash per acre.
5.—Artificials without nitrogen: 3 cwt. superphosphate, 1½ cwt. sulphate of potash per acre.

For reasons given in the last report it is not yet possible to duplicate plots on the farms. The experiments on each farm are, except where otherwise stated, comparable with those of last year, and the checks described in last year's report show that a considerable degree of probability attaches to the results.

At each centre the barley is grown in its accustomed place in the rotation. This, of course, introduces an element of difference between

the various centres, but it ensures that the experimental conditions are truly representative of those generally obtaining in the district. It would have been possible, of course, to eliminate this difference by arranging for the barley to follow the same prescribed crop in all cases, but this would have added an element of artificiality that would detract greatly from the results.

The centres are practically the same as for last year, and it is much hoped that the farmers now in the scheme will continue. They are:—

Eastern Side—

1.—Rothamsted Experimental Station, Harpenden, Herts.
2.—Beds. Woburn Experimental Farm. Dr. J. A. Voelcker.
3.—Essex. Dunmow.* W. Hasler, Esq., Barnston Lodge Farm (G. Bellfield, Esq.).
4.—Suffolk. Howes Farm, Martlesham. Rt. Hon. E. G. Pretyman, Esq., Orwell Park.
5.—Norfolk. East Dereham. B. Hill, Esq., Hall Farm, Gressenhall.
6.—Norfolk Experimental Station, Newton St. Faith. C. Heigham, Esq.
7.—Lincs. Wellingore. G. H. Nevile, Esq.
8. Lincs. Walcott. C. Bembridge, Esq.
9. Lincs. Cawkwell. Scamblesby. A. E. Davy, Esq.
10.—E. Yorks, Beverley. J. H. Spilman, Esq., Gardham Farm.
11.—East Lothian. Barneyhill. Sir Harry Hope.

Western Side—

12.—Shropshire. Eyton-on-Severn. E. Craig Tanner, Esq.
13.—Shropshire. Newport. Harper Adams College. Dr. C. Crowther.
14.—Stoke-under-Ham. R. A. Clarke & Sons, Chiselborough.
15.—Wiltshire. Warminster. E. S. Beaven, Esq.

Messrs. Eger, of Northolme, and W. H. Edwards, of Milverton, had no suitable land in their barley break this year, but as against these losses a centre was found on the Yorkshire Wolds, where Mr. Spilman laid down an admirable series of plots; another was found in Somerset

* By an unfortunate accident the wrong seed was sown on the Dunmow plots; instead of the selected Beavens Plumage Archer another Beaven barley was grown. The results are therefore excluded from all the general averages and no valuations were made.

at Stoke-under-Ham, where the Messrs. Clarke have rendered valuable service; and new and important types of conditions are being tested at the Norfolk Experimental Station and at the Harper Adams Agricultural College, thanks to the cordial co-operation of the heads of those Institutions.

It is satisfactory to report that the sites are on the whole even better than those of last year and that the farmers showed a keen desire to benefit by their experience so as to improve the experiment wherever that was possible. Moreover the seed and manures were available at a much earlier date, so that farmers were able to sow at the time which they considered best. There were no cross-cropped centres this year; in every case the previous conditions had been uniform.

The Season.

The growing season of 1922 had been hot and dry in its early part, but cold, wet and sunless from July onwards. The season of 1923 differed considerably from this: in spring and early summer it was cold, sunless and dry; from July onwards it was warmer and more sunny, though still as a rule dry until the last fortnight in August, when there was more rain. The data for Rothamsted are given in Appendix II.

The effect of these differences from 1922 was rather curious; yields at the Eastern centres which were not high above sea-level—Dunmow, Orwell Park, Dereham, Walcott and East Lothian—were all substantially less than in 1922; the yields in the centre and west—Warminster, Rothamsted, Woburn and Eyton—remained approximately the same as in 1922, while those of the higher lying Eastern centres—Wellingore and Cawkwell—were above last year's results. The quality at Orwell and East Lothian was distinctly below that of last year, while that of Warminster, Rothamsted, Woburn, Wellingore and Cawkwell was distinctly above it.

The Results obtained.

The figures for yield are given in Table I. In contradistinction with last year there had been no cross-cropping, so that all the results are brought into the one table. It will appear from the subjoined discussion that out of the whole of the 74 plots only four appear to present irregularities, viz., Plots 5 (*i.e.*, the end plot at each centre) at Dunmow, Stoke-under-Ham, Cawkwell and Walcott, which are respectively 11,

25, 12 and 12 per cent. below the unmanured instead of being equal or slightly superior to it. This is evidence that the plots were well chosen and the figures trustworthy.

The yields on the unmanured plot vary from 7·6 to 63 bushels of dressed grain per acre, as against 16·2 and 78·5 for last year, the extremes again being Orwell Park and Barneyhill. As in 1922, Barneyhill far exceeds all other centres in yield. The Orwell Park result is unusually low; next above it come a group of centres, the two in Norfolk, Rothamsted, and Newport, Salop, where the yield is 21½ to 22 bushels.

As in 1922 the effect of the complete fertiliser was to raise the yield excepting only in two cases, Dunmow and Walcott, where, as in last year's experiments, the manures were without important effect. The amount of the increase produced by the complete fertiliser is as follows:—

	Bushels per acre.	Per cent.
Rothamsted	11·4	49
Barneyhill	9·0	14
Eyton-on-Severn	14·2	45
Wellingore	5·0	11
Dereham	5·0	24
Warminster	8·8	25
Newton St. Faith	3·7	16
Beverley	13·5	37
Newport, Salop	8·6	34
Stoke-on-Ham	2·0	9
Woburn	9·5	28
Orwell Park	3·2	38
Cawkwell	3·3	9
Mean	7·5	26

These increases are, on the whole, higher than were obtained last year, when the values were respectively 5·2 bushels and 16 per cent.

As happened last year the most striking effect is that produced by nitrogenous manure; the sulphate of ammonia has acted in no less than 11 out of the 13 centres where there was any response to fertilisers at all. In 10 out of the 13 centres the manure without nitrogen gave no significant increase in crop; the only cases where the gains were appreciable being Barneyhill, Newport and Eyton. Over the whole series the average increment in yield given by 1 cwt. per acre of sulphate of ammonia has been 4½ bushels, as against 5½ bushels last year and 6½ bushels over a general run of soils and seasons. This conformity to the average affords further evidence that the results on the whole are normal and that the centres may be taken as typical. The lack of any

marked response to potash and phosphates without nitrogen is a normal effect and affords additional evidence of the normality and reliability of the results.

The persistence of the effect of nitrogenous fertilisers in increasing yields is certainly remarkable; it needs only a small number of reliable results to give an average increment of the same order of value as that derived from all available results.

The omission of potash has in no case produced any marked falling off in yield; the only measurable effects were a depression of 3·5 bushels at Barneyhill, 5·7 bushels at Dereham, and 5·3 bushels at Orwell. There was apparently a small gain in yield at Beverley (4·5 bushels); two instances were obtained last year also, and as data accumulate it will be possible to decide whether the difference is significant or not, and, if significant, to obtain some light as to its cause.

The omission of phosphate has been without effect in eight cases, while in six it has led to a small depression averaging 3·4 bushels in yield—a mean value from which none of the six greatly deviates. The six apparently responsive centres are Eyton-on-Severn, Dereham, Beverley, Newton St. Faith, Stoke-under-Ham, Woburn.

The general result as far as yield is concerned is that the nitrogenous fertiliser is the only one which has consistently given increases; phosphate has produced only a small effect, and that only in six out of 14 cases, while potash has had even less action. As was the case in 1922 the only predictable effect is that of nitrogen; the potash and phosphate may produce valuable effects, but the action is more influenced by the season than is that of the nitrogenous fertiliser.

The Valuation of the Crops.

The valuation of the barleys grown on the experimental plots was made on January 8th, 1924, in the same manner as last year and by two of the same sub-Committee, namely, Messrs. Reid and Lancaster, with the help of Mr. Wightman, who took the place of Mr. Cherry-Downes, who was unfortunately unavoidably prevented from serving. The valuers are not informed from which farms the samples come. The results are set out in Table 3. The range of values is from 39*s.* 6*d.* to 57*s.*, as compared with 30*s.* to 65*s.* last year; the range is considerably narrower, but the general level of quality is higher. In comparing the valuations made in the last two years and generally in considering the Committee's valuations, it is important to keep in mind that the figures represent market values on the date of valuation. It is obviously

impossible to take seasonal fluctuations in market value into account, and the result of this must be that in seasons where such fluctuations take place the Committee's valuations may not represent the average market values for the season. The important point is that the values given are strictly comparable *inter se*.

Comparison of the figures for the two years shows that the soil factor has persisted to some extent in spite of the marked difference in the seasons.

The order of merit of the centres has been :—

	1922.	1923.
Highest—	Orwell Park.	Rothamsted.
	Barneyhill.	Woburn.
	Wellingore.	Wellingore.
	Eyton.	Barneyhill.
	Rothamsted.	Eyton.
	Dereham.	Cawkwell.
	Cawkwell.	Walcott.
	Walcott.	Orwell Park.
Lowest—	Woburn.	Dereham.

Orwell and Woburn have suffered considerable change, and Rothamsted a distinct though smaller one, but the other centres are not greatly affected in their relative general merits as barley producers.

The effect of the complete manure, as compared with the unmanured samples, has usually not been very marked. Out of the 13 centres the valuation per quarter is the same as for the unmanured plot in six; it is 6*d*. more in two cases and 1*s*. more in two cases. At one centre (Woburn) there is the extraordinary difference of 13*s*.

The plots which received no nitrogen were given an increased valuation in four cases, the same valuation in four cases, and a lowered one in five. The plots without potash had the same valuation as those receiving this fertiliser in ten cases: a lower valuation in one case and a higher valuation in two; those without phosphate were in seven cases valued the same as those receiving phosphate, and in two valued at less. These effects are smaller than were obtained in 1922 when the nitrogenous manure had in some cases a rather harmful effect on valuation, and the phosphate had a more beneficial effect; in neither season, however, had potash any marked influence.

The Value of the Crops to the Farmer.

These values are set out in Table 5 which has been calculated in the same way as last year. The cost of growing the crop without manure

at Rothamsted was £10 14*s.* per acre as against £12* in 1922, and at the centre on lighter soil it was £7 2*s.* per acre against £7 10*s.* in 1922, the difference between the expenditures at the two centres being largely on rent and overhead charges. The cost of the manures was taken at the published quotations (which it should be noted are for 4-ton lots and cash), plus 1*s.* per cwt. for bagging, mixing, etc. The values are:—

	February, 1923. Per acre.
Complete manure (3 cwt. super.; 1 cwt. sulphate of ammonia, 1½ cwt. sulphate of potash)	50*s.*
No potash	30*s.* 6*d.*
No phosphate	36*s.* 3*d.*
No nitrogen	33*s.* 3*d.*

The returns per acre from the grain of the unmanured crops vary from £2 to £19 14*s.*, while the completely manured crops yielded from £2 17*s.* to £22 6*s.* The omission of nitrogen resulted in a loss or a smaller gain at every centre except Newport; the omission of phosphate led to losses in 6 cases out of 12, as also did that of potash. The figures for total money value, therefore, like those of yield, emphasise the consistent advantage of a nitrogenous fertiliser and the seasonal nature of the action of phosphatic and potassic fertilisers. Far more of the plots show a profit than was the case last year even when, as in the table, the whole of the manure is charged to the barley. In point of fact, however, a considerable part of the outlay on potash and phosphates—33*s.* 3*d.* per acre—is properly chargeable to the clover or seeds mixture sown among the barley, which greatly benefits from these two fertilisers. The centres where no profit is shown are Cawkwell, Wellingore, Dereham, Stoke, Orwell Park and Walcott; the two latter results are readily intelligible; the four others present rather interesting technical problems.

What does the Valuer Value?

One of the characteristic features of this investigation is that the barleys and the resulting malts are fully analysed; it may therefore be possible to discover what it is that the valuer puts the price on. Last year's results showed a close connection between valuation and nitrogen content when comparing barleys from different farms; without knowing how much nitrogen was present the valuers had, with few exceptions, graded the barleys in the same order as their nitrogen content, and had on the average taken off 2*s.* 9*d.* per quarter for every additional 0·1 per

* By an error this figure was given as £10 10*s.* in last season's report.

cent. of nitrogen. A much less definite result was obtained this year.

When the centres are arranged in order of average nitrogen content their average valuations are as follows:—

Low Nitrogen.	Average nitrogen. Per cent.	Average valuation. Shillings per quarter.
Beverley	1·34	42·6
Wellingore	1·44	52·4
Cawkwell	1·49	41·5
Warminster	1·49	51·8
Stoke	1·50	46·8
Rothamsted....	1·61	56·6
Eyton	1·70	49·0
Barneyhill	1·71	49·4
Woburn	1·71	54·0
Newport	1·74	42·0
Walcott	1·80	41·5
Orwell Park	1·93	40·0
Dereham	2·00	39·9

Cawkwell and Beverley both receive less than others of similar nitrogen content, and Rothamsted and Woburn both receive more. It will be recalled that Cawkwell last year was similarly valued at a considerably lower figure than corresponded with its nitrogen content; the analyses of the malt, however, agreed with the nitrogen figure in giving this centre a higher value than was awarded by the Committee. It will be interesting to watch whether the fuller analyses of the barley and the malt from the Rothamsted and Woburn samples will justify the higher values given to them.

These results are consistent with the view that nitrogen percentage is correlated with the factors which determine value to a buyer choosing among samples grown on different soils and in different parts of the country. Using the same form of calculation as last year, a decrease of 0·1 per cent. of nitrogen in the grain is associated with a rise of 1*s.* per quarter in the valuation as against 2*s.* 9*d.* last year: taken by itself this figure of 1*s.* would not be significant. The valuations and nitrogen contents of barleys from the individual plots on each farm are shown in Table 8. In all cases except where the barley is valued only at grinding price, the sample with lowest nitrogen had the maximum value, and in most cases the sample with the highest nitrogen had the minimum value. The intervening samples did not as a rule fall into line, but

the total variation in nitrogen content on the plots at a given centre was usually only about 0·2 per cent. and the valuation of the barley was only to the nearest 6*d.* per quarter. Now these differences in nitrogen content on the different plots are the result of the manurial treatment and illustrate the well-known fact that a farmer can on his own farm alter the percentage of nitrogen in the barley grain within certain limits. The variation that can thus be brought about by manuring is much less marked than that resulting from soil type and climate; it amounts in these experiments usually to 0·15 or 0·2 per cent., while that from farm to farm exceeds 0·5 per cent. The question arises whether this artificial alteration has the same value in the eyes of the buyer as the natural alteration brought about by different conditions of soil and climate. The buyer was willing to give an additional 2*s.* 9*d.* per quarter in 1922 and 1*s.* in 1923 for every 0·1 per cent. of nitrogen taken out by variation in natural conditions. Will he be willing to give the same increase in price for each 0·1 per cent. of nitrogen which the farmer is able to take out from the grain by varying his manurial scheme?

The Influence of Manuring on the Nitrogen Content and Valuation of the Grain.

As compared with the unmanured plot the complete manure tends to lower the nitrogen content of the grain; in a few cases the reverse happens and the nitrogen percentage rises. Of the various constituents the nitrogenous fertiliser usually raises the percentage of nitrogen in the grain, the increase being of the order of 0·1 per cent.; it also tends to lower the valuation; in a few cases it lowers the percentage of nitrogen in the grain and then the valuation rises somewhat. In 1922 there had also been, as the result of using nitrogenous fertiliser, an increase in nitrogen content of the grain ranging about 0·1 per cent., the extremes being 0·06 to 0·22. The valuations were usually not affected, but many of the samples were already so low priced that differences in value were of little technical interest. In the case of the better samples (Wellingore and Barneyhill) the increase in average nitrogen content lowered the valuation. Phosphatic fertilisers lowered the percentage of nitrogen in the grain in most cases in 1923, but in three cases only out of eleven in 1922. Curiously enough, this improvement in nitrogen content did not usually in 1923 improve the valuation; only at Cawkwell and Barneyhill was any increased value awarded, and both

centres are this year somewhat exceptional; in 1922, however, the barley receiving phosphate obtained a somewhat increased valuation. The effect of potash was in both years much slighter both on per cent. of nitrogen and on valuation.

It appeared from the 1922 results that the valuer is not prepared to offer the farmer as much for reductions in nitrogen content in grain effected by the use of artificial manures as he does for the same reduction effected by soil or climatic agencies. Taking all the results together, the reduction in value for each additional 0·1 per cent. nitrogen resulting from the manurial treatment averaged 10*d.* per quarter as against 2*s.* 9*d.*, when the variation is effected by natural factors. In 1923 a different result is obtained; the fall in values for each 0·1 per cent. of nitrogen is approximately the same, however the change is brought about. The reduction in value is 1*s.* 3*d.* per quarter when brought about by manuring, and 1*s.* when brought about by soil and season. It is of course of vital importance to ascertain whether the 1922 or the 1923 result is the more normal one; in other words, whether the valuer is or is not less influenced by a difference in nitrogen percentage caused by manuring than he is by the same difference caused by natural agencies. The analytical work now in progress will show whether or not this is the case, and it may at the same time be expected to explain many of the discrepancies in the so-called nitrogen problem.

The Effect of Season on the Relation between Valuation and Nitrogen Content.

Table 6 shows the average nitrogen content and the valuations for the different centres in 1922 and 1923, and columns have been added in which the values are reduced to a basis of grinding value as 100, the cash basis being 30*s.* in 1922 and 40*s.* in 1923. Only in three cases was the nitrogen content greater in 1923 than in 1922, these being Barneyhill, Orwell and Dereham; here the relative valuation decreased. In all others the nitrogen content was the same or more usually less; the relative valuation was the same or more. The detailed order, however, is not the same for changes in valuation as for those in nitrogen content.

TABLE 6.—Comparison of Seasonal Influence and Nitrogen Content—1922 and 1923 at same Centres.

—	Nitrogen Averages.			Valuation;				
				Shillings per quarter.		Relative grinding = 100.		
	1922.	1923.	Difference.	1922.	1923.	1922.	1923.	Difference.
Orwell Park	1·51	1·93	+·42	63·6	40·0	212	100	—112
Dereham	1·65	2·00	+·35	31·0	39·9	103	100	— 3
Barneyhill	1·44	1·71	+·27	48·4	49·4	161	123	— 38
Walcott	1·79	1·80	+·01	30·0	41·5	100	104	+ 4
Rothamsted	1·62	1·61	—·01	32·2	56·6	107	141	+ 34
Cawkwell	1·52	1·49	—·03	29·6	41·5	98	104	+ 6
Eyton	1·92	1·70	—·22	35·2	49·0	117	122	+ 5
Woburn	1·95	1·71	—·24	27·0	54·0	90	135	+ 45
Warminster	1·76	1·49	—·27	37·8	51·8	126	129	+ 3
Wellingore	1·79	1·44	—·35	36·0	52·4	120	131	+ 11

Influence of Manuring on Moisture Content of the Grain.

Reference to Table 7 shows that the average moisture content of the grain from the different farms varied from 15·2 to 19·6 per cent., the order being :—

	Average moisture content.	Average valuation. Shillings per quarter.
Wellingore	15·2	52·4
Barneyhill	16·2	49·4
Orwell Park	16·3	40·0
Eyton	16·6	49·0
Rothamsted....	17·2	56·6
Walcott	17·3	41·5
Stoke	17·6	46·8
Dereham	18·4	39·9
Newport	18·4	42·0
Woburn	18·8	54·0
Cawkwell	18·95	41·5
Beverley	19·2	42·6

The order shows little or no correspondence with the valuation, and it is evident that within narrow limits, round about 17 per cent., moisture is less important than nitrogen in influencing the valuer.

TABLE 1.—*Malting Barley Results*, 1923.

DRESSED GRAIN BUSHELS PER ACRE. (1)

No.	Treatment.	Stiff Soils.		Medium Soils.				Light Soils.				Very Light Soils.		Chalk.	Fen.
		Rothamsted.	Dunmow.	E. Lothian.	Eyton-on-Severn.	Wellingore.	Dereham.	Warminster. (2)	Beverley.	Harper Adams.	Stoke-u-Ham.	Woburn.	Ipswich.	Cawkwell.	Walcott.
1	Nil	21·4	41·3	63·0	33·1	40·8	21·5	{32·0 / 36·7}	36·8	22·0	27·0	33·6	7·6	40·0	50·3
2	All	32·8	41·2	72·0	47·3	45·8	26·5	43·1	50·3	30·6	29·0	43·1	10·8	43·3	48·8
3	Less K	33·9	42·8	68·5	47·6	43·8	20·8	42·3	54·8	33·7	26·2	40·6	5·5	44·8	50·0
4	„ P	33·8	41·7	73·0	44·4	46·4	22·0	—	46·6	30·2	27·0	38·1	11·2	42·8	47·5
5	„ N	19·5	36·8	71·0	40·0	39·2	20·4	35·4	38·6	33·8	19·5	30·5	8·1	35·0	44·1
				TOTAL GRAIN UNMANURED = 100.											
1	Nil	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2	All	149	104	114	145	111	124	125	137	134	109	128	138	109	97
3	Less K	153	108	109	148	106	95	123	150	147	100	121	75	112	104
4	„ P	154	101	116	137	112	100	—	127	135	98	113	143	108	96
5	„ N	90	89	113	119	96	93	103	106	145	75	91	106	88	88
				DRESSED GRAIN UNMANURED = 100.											
1	Nil	100	100	100	100	100	100	100 (3)	100	100	100	100	100	100	100
2	All	153	100	114	143	112	123	125	137	139	107	128	142	108	97
3	Less K	158	104	109	144	107	97	123	149	153	97	121	72	112	99
4	„ P	158	101	116	134	113	102	—	127	137	100	113	147	107	95
5	„ N	91	89	113	121	96	95	103	105	154	72	91	106	87	88

NOTES.—(1.) Bushels of 56 lbs. in all cases.
(2.) Presumably total corn. Percentages worked out on the mean of the two control plots.
(3.) Figures are total grain in this case.

Table 2.—*Effect of Manuring on Yields.*

Change in Bushels per Acre in Plots.

—	Rotham-sted.	Cawkwell.	Dunmow.	Wellingore.	Barney-hill.	Dereham.	Eyton-on Severn.	Beverley.	War-minster.	Stoke-under-Ham	Harper Adams.	Woburn.	Orwell Park.	Walcott.
Omitting Potash....	+ 1·1	+ 1·5	+ 1·6	— 2·0	— 3·5	— 5·7	+ 0·3	+ 4·5	— 0·8	— 2·8	+ 3·1	— 2·5	— 5·3	+ 1·2
„ Phosphate	+ 1·0	— 0·5	+ 0·5	+ 0·6	+ 1·0	— 4·5	— 2·9	— 3·7	—	— 2·0	— 0·4	— 5·0	+ 0·4	— 1·3
„ Nitrogen ..	— 13·3	— 8·3	— 4·4	— 6·6	— 1·0	— 6·1	— 7·3	— 11·7	— 7·7	— 9·5	+ 3·2	— 12·6	— 2·7	— 4·7

Change in Percentage Yield in Plots.

Omitting Potash	+ 5	+ 4	+ 4	— 5	— 5	— 26	+ 1	+ 12	— 2	— 10	+ 14	— 7	— 70	+ 2
„ Phosphate	+ 5	— 1	+ 1	+ 1	+ 2	— 21	— 9	— 10	—	— 7	— 2	— 15	+ 5	— 2
„ Nitrogen	— 62	— 21	— 11	— 16	— 1	+ 28	— 22	— 32	— 22	— 35	+ 15	— 37	— 36	— 9

Table 3.—Valuation per Quarter of 448 lb. as Assessed by Valuation Committee.

	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
No Manure	56 0	41 6	—	52 0	50 0	39 6	48 0	43 0	52 0 and 51 0	47 0	42 0	43 0	40 0	41 6
Complete Manure	57 0	42 0	—	52 0	49 6	40 0	49 0	41 0	52 0	47 0	42 0	56 0	40 0	41 6
No Potash	57 0	41 6	—	53 0	49 6	40 0	49 0	43 0	52 0	47 0	42 0	56 0	40 0	41 6
„ Phosphate	57 0	41 0	—	52 0	49 0	40 0	49 0	43 0	—	47 0	42 0	57 0	40 0	42 0
„ Nitrogen	56 0	41 6	—	53 0	49 0	40 0	50 0	43 0	52 0	46 0	42 0	58 0	40 0	41 0

Table 4.—Valuation at Each Individual Centre.

mplete Manure	+ 1 0	+ 0 6	—	Nil	— 0 6	+ 0 6	+ 1 0	— 2 0	+ 0 6*	Nil	Nil	+ 13 0	Nil	Nil
ting Potash....	Nil	— 0 6	—	+ 1 0	Nil	Nil	Nil	+ 2 0	Nil	Nil	Nil	Nil	Nil	Nil
, Phosphate	Nil	— 1 0	—	Nil	— 0 6	Nil	Nil	+ 2 0	—	Nil	Nil	+ 1 0	Nil	+ 0 6
N[illegible]gen	— 1 0	— 0 6	—	+ 1 0	— 0 6	Nil	+ 1 0	+ 2 0	Nil	— 1 0	Nil	+ 2 0	Nil	— 0 6

Table 5.—Money Values of the Various Crops.

	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
alue of Unmanured—														
Per qr.	56 0	41 6	—	52 0	50 0	39 6	48 0	43 0	52 0 and 51 0+	47 0	42 0	43 0	40 0	41 6
Per acre	155 0	210 0	—	277 0	394 0	114 0	204 0	207 0	239 0 and 204 0	165 0	139 0	182 0	41 0	289 0
Additional per acre for manuring—														
Complete manure	*84 0*	20 0	—	33 0	*52 0*	28 0	*95 0*	*63 0*	*59 0*	13 0	50 0	*121 0*	16 0	— 9 0
No Potash	*91 0*	24 0	—	23 0	30 0	— 5 0	*100 0*	*101 0*	*54 0*	— 3 0	*68 0*	*103 0*	— 10 0	8 0
„ Phosphate	*92 0*	13 0	—	34 0	*53 0*	1 0	*78 0*	*55 0*	—	— 2 0	*50 0*	*91 0*	18 0	— 10 0
„ Nitrogen	— 14 0	— 27 0	—	— 5 0	*41 0*	— 6 0	*50 0*	11 0	9 0	— 46 0	*65 0*	*39 0*	3 0	— 37 0

Figures in italics are those in which a profit is shown.
* Calculated from the mean of the valuations of the two control plots.
† All corn valued as head corn in this case.

Appendix I—List of Centres with Details.

Centre.	Particulars of soil, field and size of plot.	Previous crop and manuring.	Rate of seeding, Date of sowing, 1923.	Date of applying manures.	Date of cutting.	Approximate date of threshing.	Season.
EASTERN SIDE.							
Herts.—							
Rothamsted Experimental Station.	Soil clay with flints, heavy strong soil overlying chalk. 1/25-acre plots.	Winter oats. 1 cwt. sulphate of ammonia.	April 20; 10 pecks per acre	April 17	August 21	December 8	*See* p. 829.
Beds.—							
Woburn Experimental Farm. Dr. J. A. Voelcker.	Sandy loam, junction of lower greensand and Oxford clay, deep, low lying, apt to be wet. Quarter-acre each.	Swedes. F.Y.M.	April 10; 10 pecks per acre	—	Aug. 30-31....	Nov. 17.	—
Essex*—							
Dunmow .... W. Hasler, Esq.	Medium to heavy clay loam. Great Barnston Field, three acres each.	Potatoes: 12 loads F.Y.M. 4 cwt. kiln dust, 1 cwt. sulphate of potash, 1 cwt. sulphate of ammonia, cavings liberally.	Apr. 4 and 5	Apr. 2 and 3	—	Dec. 10	Only one light storm since sowing causing patchy germination on furrows and rough ground.
Suffolk—							
Orwell Park .... E. G. Pretyman, Esq. (Howes Farm, Martlesham).	Light sand on sand, Home Field. Two of four acres. Three of half-acre each.	Mustard (folded by sheep)	Apr. 23; 2 bushels per acre.	Apr. 23	—	Nov. 5	Exceptionally dry.
Norfolk—							
Dereham Hall Farm, Gressenhall. B. Hill, Esq.	Light land overlying gravel, One acre each.	Oats: 10 loads F.Y.M., 1 cwt. sulphate of ammonia.	Apr. 10; 12 pecks per acre.	Apr. 10	Sept. 3	Dec. 19	Very dry
Norwich, St. Faiths Experimental Farm. C. Heigham, Esq.	Light loam overlying chalk. Half-acre each.	Mangolds: 15 loads F.Y.M.	March 29	March 28	—	Nov. 13	Severe drought in June. Rain in July too late.
Lincolnshire—							
Wellingore .... G. H. Nevile, Esq.	Oolite limestone, light loam. About 8 in. soil, 2·55 acres each. Hovel Close Field.	Sugar beet: 10 loads F.Y.M., 3 cwt. super., 2 cwt. kainit, 1 cwt. sulphate of ammonia.	March 19, 20; 10 pecks.	March 22	August 31	Oct. 8 and 9	Dry, following wet February and March. Good later.
C. Bembridge, Esq. .... Walcott.	Black Fen soil with clay and silt subsoil. Plots two acres each.	Wheat, no manuring.	March 31, Apr. 2; 8 pecks per acre.	March 31	—	Dec. 12	Exceptional. *Dry* even in Fenland.
Cawkwell, Scamblesby A. E. Davy, Esq.	Chalk wolds; red, rather heavy loam overlying chalk 6-12 in. down. Straw Close Field. Two acres each.	Thin crop of turnips eaten off with cake by sheep; 3 cwt. fish manure, 2 cwt. super.	March 23 .... (approx.)	March 23 .... (approx.)	Sept. 5	Nov. 7	No rain after sowing till May 24.
Yorkshire—							
Beverley, Etton.... .... J. H. Spilman, Esq.	Wold land, rather heavy loam over chalk. Plots four acres each.	Mixed green crop (mustard and rape). Eaten off by sheep. Originally sown to oats, which failed and were knocked up.	Apr. 18 and 19; 12 pecks	Apr. 14 and 15.	Sept. 3	Nov. 1	Wet and cold. Many frosty nights.
East Lothian—							
Barneyhill .... Sir Harry Hope	Red loam, Green Road Field. One acre each.	Swedes: 12 cwt. home-mixed complete artificials.	April 11; 10 pecks per acre.	Apr. 10	Aug. 30	Oct. 20	Cold. High winds May and June.
WESTERN SIDE.							
Shropshire—							
Harper Adams College, Newport.	Sandy loam overlying lower Trias. Field X North. Plot half-acre each.	Swedes and mustard eaten off by sheep. 2 cwt. super., 1 cwt. steamed bone flour, 2 cwt. kainit.	March 27	April 3	Aug. 30	Jan. 3, 1924	April generally good growing period, warm and forcing. May cold and wet.
Eyton-on-Severn ... E. Craig Tanner, Esq.	Trias red medium loam. Gravelly. Old turf five years ago. One acre each.	Winter oats. Slag	March 14; 9 pecks per acre.	April 3	—	—	Good season with sufficient rain.
Somerset—							
Stoke-under-Ham, Chiselborough. Messrs. R. A. Clarke & Sons.	Inferior oolite, light sandy soil. One acre each.	Oats and vetches seeded. Self-sown after crop fed off by sheep.	April 24; 8 pecks per acre.	April 24	Aug. 16	Oct. 20	Rain immediately after sowing; then hot weather, bringing barley up well in nine days. One shower of rain only from sowing to harvest.
Wiltshire—							
Warminster .... E. Beaven, Esq.							

* Not Plumage Archer, 1922.

TABLE 7.—*Mois*

Treatment.	Rotham-sted.	Cawkwell.	Wellingore.	Barney Hill.	Dereh
	Moisture. Per cent.	Moisture. Per cent.	Moisture. Per cent.	Moisture. Per cent.	Moistu Per ce
No Manure	16·36	19·10	15·30	16·15	18·
Complete Manure	17·04	18·54	15·34	15·98	18·
No Potash	17·80	18·68	15·26	15·92	18·
No Phosphate	17·98	19·10	15·06	16·50	18·
No Nitrogen	17·00	19·32	14·94	16·36	18·
Means	17·24	18·95	15·18	16·18	18·

TABLE 8.—*Nitrog*

Treatment.	Rothamsted.		Cawkwell.		Dunmow.		Wellingore.		Barney Hill.		Dereham.	
	Per cent. Nitrogen	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.
		s.		*s.*		*s.*		*s.*		*s.*		*s.*
No Manure	1·707	56	1·405	41½	2·233	—	1·489	52	1·587	50	1·945	39½
Complete Manure	1·544	57	1·356	42	2·368	—	1·464	52	1·684	49½	1·994	40
No Potash	1·549	57	1·575	41½	2·217	—	1·435	53	1·820	49½	2·059	40
No Phosphate	1·578	57	1·568	41	2·365	—	1·443	52	1·740	49	2·013	40
No Nitrogen	1·648	56	1·533	41½	2·205	—	1·379	53	1·726	49	2·015	40

ure per cent. in Grain.

m.	Eyton-on-Severn.	Beverley.	Stoke-u.-Ham.	Harper Adams.	Woburn.	Orwell Park.	Walcott.
re. t.	Moisture. Per cent.	Moisture. Per cent.	Moisture. Per cent.	Moisture. Per cent.	Moisture. Per cent.	Moisture. Per cent.	Moisture. Per cent.
0	16·64	19·05	17·76	18·48	19·38	16·86	17·02
6	16·54	19·36	17·41	18·98	17·90	15·94	16·64
4	16·78	18·90	17·78	18·74	17·70	15·96	16·98
4	16·34	18·82	17·50	18·20	17·72	16·22	17·64
	16·48	19·68	17·46	17·64	18·72	16·44	18·06
	16·56	19·16	17·58	18·41	18·80	16·28	17·27

per cent. and Price.

Eyton-on-Severn.		Beverley.		Warminster.		Stoke-u.-Ham.		Harper Adams.		Woburn.		Orwell Park.		Walcott.	
Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.	Per cent. Nitrogen.	Price.
	s.		*s.*	*s.*			*s.*		*s.*		*s.*		*s.*		*s.*
1·818	48	1·293	43	1·527	52	1·494	47	1·615	42	1·916	43	1·983	40	1·869	41½
				1·504	51										
1·634	49	1·337	41	1·464	52	1·396	47	1·786	42	1·774	56	1·934	40	1·815	41½
1·645	49	1·379	43	1·464	52	1·536	47	1·767	42	1·694	56	1·891	40	1·806	41½
1·794	49	1·385	43	—	—	1·548	47	1·744	42	1·609	57	1·989	40	1·794	42
1·590	50	1·302	43	1·387	52	1·518	46	1·800	42	1·536	58	1·858	40	1·726	41

APPENDIX II.—Weather of Harvest Year, September, 1922-23, Rothamsted.

The characteristic features of this period were first, a very dry autumn and, second, a marked deficiency of sunshine and, to a lesser extent, of rainfall, over the spring and early summer. After the harvest of 1922 was gathered, the autumn was very favourable for work on the land. Throughout October and up to the middle of November the rainfall was distinctly below the average; in October only 0·76 in. of rain fell, and there was practically no drainage through the 60-in. gauge except on the last day of the month. The sunshine registered amounted to 140 hours, being 32 in excess of the average. The first half of November gave rise to similar conditions, after which the weather broke and the last fortnight was wet, but not particularly cold. The weather in December was mild on the whole, with sunshine and mean temperature above the average, although 17 ground frosts were experienced. During these months only one small fall of snow occurred, and the prevailing winds came from westerly directions.

Similar mild, fairly dry conditions continued throughout January. The rainfall for this month was 1 in. below the average, the sunshine was slightly in excess of the normal, and the mean temperature was over 3 deg. F. above the average. There were 20 ground frosts but no snow.

The weather definitely changed in February, nearly 4 in. of rain fell—over double the usual amount—and the drain gauge figures show that the soil was saturated during the period. Sunshine was naturally deficient, and the frequent overcast days gave this month a gloomy character, although the weather was not particularly severe. There was no snow, and the mean temperature was above the average in spite of a number of east winds.

March repeated the February conditions, and there was in addition a marked reduction in the number of hours sunshine for this month—76 hours compared with the 112 hours average.

The spring and early summer—April, May, June—were abnormal. The rainfall was below average, especially in June, when only 0·6 in. fell. In spite of this dry weather—usually associated over this period with increased sunshine, the insolation was markedly deficient; in both April and May this deficiency totalled nearly 50 hours, while in June, in spite of one period of summer weather, the total was no less than 88 hours below normal.

The reduction in hours of sunshine was very striking; in fact, over the first six months of 1923 it amounted to a deficit of no less than 225 hours (an average reduction of 1¼ hours per day), and it marks the lowest total obtained for this period since 1891, when this station began sunshine records.

The months of July and August showed a change for the better, and the crops benefited considerably, making up some of the arrears of growth. The weather was sunny and warm, and although the rainfall for July was 1·3 in. above the average, no less than 3 in. of the total 3·8 in. fell on three days. The remaining 0·8 in. was fairly evenly distributed in gentle warm showers over the month. The first fortnight of August was a period of drought and the crops suffered somewhat, especially the shallow-rooted ones. The latter half of the month was rainy, but the barley harvest was not seriously checked.

Appendix III.—Farmers and Rothamsted Staff Reports on Growing Crops.

PLOTS.

1.—No Manure. 3.—No Potash.
2.—Complete Artificial. 4.—No Phosphate.
5.—No Nitrogen.

Rothamsted—

1923.

May 28*th*.—All plots looking equally well, apparently for a good plant.

June 23*rd*.—1 plant looks thinner than rest; individual plants poor in appearance, unhealthy dark colour, result of much cold weather. Mildew just appearing.

2.—Appreciable improvement on 1, but still poor in colour.

3.—Indistinguishable from 2.

4.—As for 2 and 3.

5.—Very similar to 1. Mildew noticeable.

July 1*st*.—1.—Thin, shows little inclination to tiller.

2.—Tillering good, plot as a whole inclined to be patchy. Colour improving.

3.—Growth most advanced morphologically. Tillering comparable with 2.

4.—Not so advanced as 2 in any respect.

5.—Poor still, very glaucous in appearance.

July 9*th*.—1.—Thin in comparison with completely manured, gaps noticeable. Only a few ears out of sheath.

2.—Straw not very long, but 50 per cent. of ears out of sheath.

3.—Straw about same as 2. Crop standing less thickly. 80 per cent. of ears out of sheath.

4.—Slightly less advanced than 2, otherwise very closely comparable.

5.—Slightly more advanced than 1, but with very few ears out of sheath.

NOTE.—Dry weather has kept the mildew completely in check.

July 21*st*.—1.—Ear thin and short, not completely out of sheath.

2.—In full ear 2 inches long.

3.—A little shorter in the ear than 2. Less dense in blade and straw.

4.—Showing inappreciable differences from 2.

5.—Thin short ear not completely out of sheath.

Harvesting.

Aug. 21*st*.—1.—Thin crop with short ears.

2.—Good crop on the whole.

3.—Nice even crop, not as thick as 2.

4.—Similar to 3.

5.—No better than 1.

Woburn—

Crop came up nicely.

Early June.—1.—Patchy in appearance.

2.—Very good-looking plot.

3.—Not so good as 2. Darker in colour.

4.—Less good than 3.

5.—Much less vigorous than 2, 3 or 4.

Mid. July.—1.—Signs of later ripening than manured plots 2, 3 and 4.

2.—Maintains best appearance of all.

3.—Shows signs of improvement.

4.—Maintains about the same position as before

5.—Signs of later ripening than 2, 3 and 4, but will be earlier than 1.

Harvest.—1.—Contained fair proportion of green and only partially ripe straw.

2-5.—Dead ripe.

Dunmow—

Early season.—Very little difference visible Plot 1 (unmanured) seems the poorest.

Orwell Park—

May 19th.—No apparent difference in plots.

Dereham—

May 7th.—No difference apparent.

August 20th.—Barley here caught by moderately dry weather. All crops small. Plot 2 best before drought and still leads by a little.

Wellingore—

Early season.—Plots receiving nitrogen maintain a better colour. Very little difference noticeable otherwise. No phosphate the best, if anything.

September 10th.—Plots harvested, but stubbles show that all plots receiving nitrogen were laid to a greater or less extent, Plot 4 (no phosphate) being the worst. Actually this had the same yield as Plot 2, which had stood up better. Plot 1 (untreated) appeared to have a bigger crop than that receiving potash and phosphates (Plot 5), but the threshing results showed that the excess was only 1½ bushels.

Walcott—

Early season.—No appreciable differences visible.

Cawkwell—

June 4th.—Looking well on the whole, but a little gappy. Plots 3 (no potash) and 4 (no phosphate) the best. Plot 1 (untreated) the poorest.

September 11th.—Plots 3 and 5 stood up best.

Beverley (Furrows Field, Gardham)—

Early season.—Plot 3 (no potash) appeared best. Plot 5 (no nitrogen) poorest. Differences very slight indeed.

September 12th.—Crop now harvested; striking effect of nitrogen visible.

East Lothian—

Harvest.—Complete dressing (Plot 2) best. No manure (Plot 1) poorest. The barley looked well throughout the season.

Harper Adams College—

May 15th.—All the manured plots look stronger and thicker on the ground than Plot 1, and the remainder of the field, which is unmanured. Plots 3 (no potash) and 4 (no phosphate) look the strongest.

Eyton-on-Severn—

Early season.—Plot 5 appears best. Plot 1 slightly the poorest. There is no perceptible difference between Plots 2, 3 and 4.

July 14th.—Crop looking well—heading out well.

Plot.

1.—Not shot so well as 2.

2.—Best of all, distinctly higher, much more out than rest.

3.—Not shot quite so freely, and is least out of all the set.

4.—A little higher in the straw and a little greener than 5.

5.—Very good—more forward than 4.

Chiselborough—

Early season.—No differences.

July 17th.—All looking well—in excellent condition. No differences visible.

St. Faiths—

Early season.—Plot 2 and Plot 3 (complete and no potash) equally better than any others.

Plot 1 poorest.

August 20th.—"No manure" short in straw.

"Complete" is down a little in places,* otherwise looks much the same as the others. Remaining plots look alike.

* Mr. Heigham suggests that in short-necked varieties the casualties, through not getting clear of sheath are greater than in long-necked varieties.

Appendix IV.—Crop Results and Valuations.

Centre.	Treatment.	Dressed grain.		Tail corn.	Value per acre.		Totals.
		Bush. per acre.	at per qr.	lb. per acre.	Head corn.	Tail at 30*s*.	
			s.		*s.*	*s.*	*s.*
Rothamsted	Nil	21·4	56	81	150	5	155
	Complete Manure....	32·8	57	78	234	5	239
	Less Potash	33·9	57	69	241	5	246
	„ Phosphate	33·8	57	84	241	6	247
	„ Nitrogen	19·5	56	59	137	4	141
	Complete with M/Potash	37·3	58	95	270	6	276
	Complete with M/Amm.	35·7	58	91	259	6	265
Cawkwell	Nil	40·0	41½	28	208	2	210
	Complete Manure....	43·3	42	42	227	3	230
	Less Potash	44·8	41½	35	232	2	234
	„ Phosphate	42·8	41	56	219	4	223
	„ Nitrogen	35·0	41½	35	181	2	183
Dunmow	Nil	41·3	—	70	—	—	—
	Complete Manure....	41·2	—	187	—	—	—
	Less Potash	42·8	—	177	—	—	—
	„ Phosphate	41·7	—	89	—	—	—
	„ Nitrogen	36·8	—	70	—	—	—
Wellingore	Nil	40·8	52	173	265	12	277
	Complete Manure....	45·8	52	173	298	12	310
	Less Potash	43·8	53	151	290	10	300
	„ Phosphate	46·4	52	145	301	10	311
	„ Nitrogen	39·2	53	173	260	12	272

Barney Hill, E. Lothian	Nil	63·0	50	Very little	394	Very small	394
	Complete Manure....	72·0	49½	,, ,,	446	,, ,,	446
	Less Potash	68·5	49½	,, ,,	424	,, ,,	424
	,, Phosphate	73·0	49	,, ,,	447	,, ,,	447
	,, Nitrogen	71·0	49	,, ,,	435	,, ,,	435
Dereham	Nil	21·5	39½	112	106	8	114
	Complete Manure....	26·5	40	147	132	10	142
	Less Potash	20·8	40	75	104	5	109
	,, Phosphate	22·0	40	77	110	5	115
	,, Nitrogen	20·4	40	82	102	6	108
Eyton-on-Severn	Nil	33·1	48	72	199	5	204
	Complete Manure....	47·3	49	140	290	9	299
	Less Potash	47·6	49	177	292	12	304
	,, Phosphate	44·4	49	152	272	10	282
	,, Nitrogen	40·0	50	60	250	4	254
Beverley	Nil	36·8	43	130	198	9	207
	Complete Manure....	50·3	41	186	258	12	270
	Less Potash	54·8	43	210	294	14	308
	,, Phosphate	46·6	43	186	250	12	262
	,, Nitrogen	38·6	43	161	207	11	218
Warminster*	Nil	{36·7 / 32·0}	{52 / 51}	—	{239 / 204}	—	{239 / 204}
	Complete Manure....	43·1	52	—	280	—	280
	Less Potash	42·3	52	—	275	—	275
	,, Nitrogen	35·4	52	—	230	—	230
Stoke-under-Ham	Nil	27·0	47	84	159	6	165
	Complete Manure....	29·0	47	123	170	8	178
	Less Potash	26·2	47	123	154	8	162
	,, Phosphate	27·0	47	56	159	4	163
	,, Nitrogen	19·5	46	100	112	7	119

* No details as to amount of tail corn. All corn valued at head corn price.

APPENDIX IV.—**Crop Results and Valuations**—*continued.*

Centre.	Treatment.	Dressed grain.		Tail corn.	Value per acre.		Totals.
		Bush per. acre.	at per qr.	lb. per acre.	Head corn.	Tail at 30*s.*	
			s.		*s.*	*s.*	*s.*
Harper Adams	Nil	22·0	42	358	115	24	139
	Complete Manure....	30·6	42	418	161	28	189
	Less Potash	33·7	42	456	177	30	207
	„ Phosphate	30·2	42	450	159	30	189
	„ Nitrogen	33·8	42	406	177	27	204
Woburn	Nil	33·6	43	9	181	1	182
	Complete Manure....	43·1	56	9	302	1	303
	Less Potash	40·6	56	10	284	1	285
	„ Phosphate	38·1	57	10	272	1	273
	„ Nitrogen	30·5	58	6	221	—	221
Orwell Park	Nil	7·8	40	48	38	3	41
	Complete Manure....	10·8	40	48	54	3	57
	Less Potash	5·5	40	48	28	3	31
	„ Phosphate	11·2	40	48	56	3	59
	„ Nitrogen	8·1	40	48	41	3	44
Walcott	Nil	50·3	41½	413	261	28	289
	Complete Manure....	48·8	41½	406	253	27	280
	Less Potash	50·0	41½	564	259	38	297
	„ Phosphate	47·5	42	440	249	30	279
	„ Nitrogen	44·1	41	378	226	26	252

Summary.

1. The season was better for barley than in 1922, and at most centres the yield and quality were alike higher.

2. The complete artificial manure raised the yield in all except two cases. The most effective constituent was, as before, the nitrogen; the average increase in yield given by 1 cwt. of sulphate of ammonia was 4½ bushels of grain, as against 5½ last year. Phosphate was effective at nearly half the centres, the 3 cwt. super. giving an average increased yield of 3·4 bushels. Potassic fertilisers, on the other hand, produced measurable effects only on the light soils.

3. The effects of manuring on the valuation were not very consistent. Barleys receiving nitrogen were sometimes valued at less and sometimes at more than those receiving none; barleys receiving phosphate were less often affected but sometimes received more and sometimes less than those without phosphate, while barleys receiving potash were usually valued at the same as those receiving none.

4. The relationship between the valuation and the nitrogen content of the grain, when comparing barleys from the different centres, was less marked than was the case last year. For each additional 0·1 per cent. of nitrogen it was found that the valuers had deducted 1*s.* per quarter, as against 2*s.* 9*d.* last year.

5. In contradistinction to last year's results the valuers attached neither more nor less value to variations in nitrogen content from plot to plot on the same farm than they did to variations from farm to farm. The results showed some irregularity: while the sample with highest nitrogen content had the lowest valuation, and that with the lowest nitrogen had the highest valuation, the intermediate samples did not always fall into line.

The fuller analytical data being now accumulated will show whether the discrimination shown in 1922 between changes in nitrogen content brought about by soil and climate on the one hand, and fertilisers on the other, has a valid basis or whether it was accidental.

6. The nitrogen content of the grain was influenced by the manuring, being usually lowered by phosphate and raised by nitrogen; potash had but little influence. These effects are not simple, as there are some clear cases where they are reversed.

7. The moisture content of the grain was usually less on the plots receiving nitrogen and phosphate than on those not so treated; but it was approximately the same on those receiving potash as on those without it. Within narrow limits of variation round about 17 per cent. it appears that changes in moisture content have less effect on valuation than changes in nitrogen content.