IMPERIAL BUSHEL

The following American produce is sold by eight and bushel

Wheat, beans and cloverseed, [illegible] lbs per bushel.
Maize, rye and flaxseed, 56 lbs per bushel.
Buckwheat, 42 lbs per bushel.
Barley, 48 lbs per bushel.
Oats 35 lbs per bushel.
Bran, 35 lbs per bushel.
Timothyseed, 45 lbs per bushel.
A quarter of Californian wheat weighs [illegible] lbs.
A quarter of other American wheat weighs 480 lb
A quarter of Chilean wheat weighs [illegible] lbs.
A quarter of American maize weighs 480 lbs
A quarter of Danubian maize weighs [illegible] lbs
A quarter of Odessa maize weighs 492 lbs.
A quarter of peas weighs [illegible] lbs.
A quarter of lentils weighs 504 lbs.
A quarter of Danubian wheat weighs 480 lbs.
A quarter of South Russian wheat weighs [illegible]
A quarter of Galatz maize weighs 492 lbs.
A quarter of barley weighs 400 lbs.
A quarter of oats varies from [illegible] lbs to [illegible]
A quarter of oats varies from 304 lbs to [illegible]
A quarter of beans weighs 480 lbs.

A BUSHEL OF CORN.

A BUSHEL OF CORN

BY

A. STEPHEN WILSON

AUTHOR OF 'THE BOTANY OF THREE HISTORICAL RECORDS'
'THE UNITY OF MATTER,' ETC. ETC.

'Ilk' kin' o' corn has its ain hool'

WITH ILLUSTRATIONS

EDINBURGH: DAVID DOUGLAS

MDCCCLXXXIII

In memoriam
George Davidson
1825 - 1911

DEDICATION

To the Highland and Agricultural Society of Scotland.

A hundred years have elapsed since the institution of the Highland Society. And as the light of Agricultural Science—a light largely originating from itself—spreads over the land, penetrating the constituents of the soil and the tissues of the farmer's plants, it is seen that the purposes of the Society, instead of becoming exhausted, present year after year a wider scope.

That these purposes should embrace the encouragement of the solitary observer, seeking to elucidate the alimentary problems wrapped up within a cereal grain, is here assumed, without ostentation, but in the consciousness of faithful and honest work.

To detail all the good which has been done to Scottish Agriculture by the Highland Society, would be to write the history of georgical improvement for the last century. Not the least part of this good has been the stimulus given to the experimentalist. From the contemplation of an additional blade of grass at his feet, he feels it to be a natural impulse to look up to the Society, as to a fostering spirit, for a kindly recognition of his labours. And the permission of the Directors, after examination of my Manuscript, to dedicate its pages to the Society, enables me to indulge a hope that the facts of these pages may be disseminated—like the seeds of which they treat—into soils more suitable for the development of their embryos than they would otherwise have reached; and that thus, by the patronage involved in this permission, a somewhat clearer knowledge may be diffused of the mysteries hidden in a Bushel of Corn.

A. STEPHEN WILSON.

NOTE.—To mark their appreciation of his work, the Directors of the Society very kindly resolved to present the writer with a Gold Medal.

PREFACE.

When I began the present inquiry, on the 23d of May 1867, I intended only to test the popular belief in measure-weight as an indication of the quality of oats. I did not think that the work thus begun would be in hand for more than a few months. I wrote letters to those correspondents whose names will be found in succeeding pages, to furnish me with samples, promising them in return a copy of the report to be drawn up. Only one gentleman ever complained of my dilatoriness in gratifying his curiosity as to the quality of his grain. Some of my correspondents have gone to their graves, 'as a shock of corn cometh in in his season,' and I can only return my most grateful thanks to those who remain; presentation copies of the work, in the dimensions it has acquired, being impossible.

When I had once begun, it was not easy

to resist the temptation to turn into mysterious by-ways, which promised to throw some light on the history or the structure of the cereals, or on the measures by which they had been measured in early times. Had those wondrous grass seeds, which mankind bake into bread, grown heavier or lighter in the course of their history? Had any new forms or varieties originated within historical times? By such questions I was led away into the collection of materials bearing on the history of the cereals in the annals of remote times, and in the Saxon and later English records. In other directions I went in search of materials bearing on the ancient corn measures. And as these had been ignorantly supposed, as it now appears to me, to be founded on the old money esterlin, I was drawn into considerations on the weight of the old moneys of England and Scotland,—and the system of weights by which the silver penny was beaten and struck. I became convinced that the corn measures had never had anything to do in England with the weight of money, but that they had come down, along with the Roman commercial weight, our present avoirdupois, perhaps from the days of the Roman occupation, and corrected occasionally by standards from the imperial city. And I saw evidence in many of the old records that the money weight had never grown out of wheat grains, but that wheat grains had been found equal to the metal grains of the Norman mints, and that the Normans had endeavoured to supplant the old Roman commercial weight of England, and introduce the Norman commercial weight—based on the same grain as the money weight, but having its multiples one-third larger—by the fine fiction that, under the consent of all the discreet men of the Kingdom, the sterling of the merchant's pound was generated from thirty-two corns of wheat. It was also to be seen in these records that the money weight of England was the 'droit pois,' the 'troi' weight, the true weight, the right weight, the 'droit et leal,' the leal and true weight of the Anglo-Norman mint; and that the Tower Pound was not a system of independent weights, but a mere numismatic unit, the constituents of which were of the 'droit pois' of the money weight. And as we have corrupted the Norman 'feer' into fiars' prices, so have we corrupted 'droit pois' into troy weight. And in the same way as the standards of weight approved by the Government were called the 'droit pois,' or the right weight, so was the length of the King's iron yard called the right measure.

In quite other directions I was drawn into a study of the botany of the cereals, from their embryos sleeping on a delicate villus of absorbing cells resting on beds of starch and sugar, up to their anthers, the filaments of which arise for their work of pollination, and stretch themselves in a moment of time,—to generate the new race of embryos, the little grass plants which form a fortieth part of our daily bread.

Nor could I resist a glance at those mysterious parasites, the smuts and the rusts, which in all ages of the world have attached themselves to the cereal grasses; till I came to see dimly that the germinal sporidia of these parasites are carried to their birth by the gestation of these substituted mothers.

Many experiments were also made in the cultivation of different varieties, in order to compare their claims; experiments had also to be made to test the meaning and the value of degrees of ripeness. Hybridisation, likewise, was not without its temptations. In a blind way I went into this walk, imagining that the mere formal application of the pollen of one cereal to the stigma of another constituted an act of fertilisation. It is probable that all the crossing of varieties of wheat or oats which, under present cosmical conditions, is possible, has long since taken place, leaving the existing permanent forms. That is the teaching which came to me when I found that the pollen of one wheat would not throw out its tubes on the feathers of another. I was also drawn out of the straight course by the fascination of the doctrine of transmutation. Did not the unchallengeable cyclopædias tell me that *Ægilops ovata* had, with the *Ho! presto!* cultivation of a few years, been turned into wheat? and *Avena fatua* into Potato oats? Ten species of *Ægilops*, from Vilmorin of Paris, have gone on with me for five or six years, the *ovata* sometimes standing through the winter, and throwing up a couple of hundred spikes from one seed, and the *spel-tæformis* producing stalks nearly four feet in height, and corns of a troy grain in weight, but all points of their structure remain as they were at first. And why should the Wild oat change by cultivation? Has it not been always in cultivation? It has not changed under any cultivation of mine. Charles Darwin did me the honour to intrust to me experiments, to settle a question debated in some of the Russian provinces, as to whether Kubanka wheat became transmuted into Saxonka upon inferior land. No change took place upon them here, but the superior prolificacy of Saxonka in poor soil supplied a clue to explain how it supplanted its better contemporary, a clue which was thoroughly accepted by the great naturalist, who expressed his entire disbelief in sudden transformations.

And so the years came and passed by. I have only to add that the various experiments in the following pages have all been done by my own hand, so that I am warranted in saying that I believe they will be found correct. Ten years' reductions of the average weights of the Edinburgh Corn Market were made for me by Mr. Alexander Thomson, teacher of mathematics, to whom my best thanks are hereby offered. And trusting that my work may afford some information to those who till the 'valleys covered over with corn,' and to those who 'sell corn, and set forth wheat,' I submit it to their generous consideration.

NORTH KINMUNDY,
SUMMERHILL, BY ABERDEEN,
July 26, 1883.

CONTENTS.

V.

VI.

VII.

VIII.

IX.

X.

XI.

XII.

LIST OF ILLUSTRATIONS.

For Explanation, see p. 339.)

I.

Introductory and Historical.

WHAT is a Bushel of Corn? Within certain limits, the present work is intended as an answer to this question. Only three of the cereal grains are here treated of,—Wheat, Barley, and Oats.

In almost all countries, from the remotest times, the cereal grains have been quantified by measure and not by weight. Most probably this general preference given to measuring has not arisen from any considerations of an abstract character. The measuring of corn was found more convenient than the weighing, and hence its general, though not universal, adoption.

Two modes of filling the corn measures have also been in use in all countries, heaping and striking. And it appears from Luke's Gospel that the grain was sometimes 'pressed down, shaken together, running over.' In our own country, until recent times, heaped and struck measure have been constantly in use.

In the economic history of England and Scotland, one of the most important data to be determined is the size of the bushel. Without a knowledge of the size of the bushel, or the measure of the quarter, all reasoning on the prices of corn, and all conclusions as to the state of society, have a large margin of uncertainty. But it is not to be overlooked that, although we should arrive at a close approximation to the legal bushel, there were always in use alongside of it a great number of local standards. Many of these were nearly equal to the legal standard, and they were generally based on the same elements of submultiples; but no Act of Parliament was ever able to abolish them or prevent their use.

I do not propose here to trace the history of British corn measures (for which I have collected materials), but may state that these measures have been more immediately derived from Roman units. In the *Domesday Survey*, mention is made in various entries of the *sextar*, the *ambra*, the *modius*, and some other measures or multiples of these, and such measures are frequently referred to in the old Rolls.

Writers on measures and weights have usually treated more on absolute values than on the historical genesis of the various units; and hence an impression has been created that a very slight difference of capacity in two measures constituted them of two species. But it should always be kept in mind that it is extremely difficult for even the best workmen to turn out two measures of precisely the same dimensions; so that it is to the intention of commerce in the framing of measures that we must look if we would understand the true derivation of the various standards.

The ancient English pint is so close to the Roman sextarius that no one can doubt the derivation of the one from the other; or rather there was no derivation, but a continuance of the old measure with a new name. In like manner, the old Scots pint was so close to three Roman sextars, or to the semicongius, that it is impossible to doubt the genetic identity of elements in the two measures. Thus the old English and Scots corn measures were the same; and it will be found, upon proper inquiry, that the presently existing imperial measures, established in 1825-6, are simply a return to the older standards. The imperial bushel was made identical with the theoretical or intentional size of the standard Scots wheat firlot, and differed in actual size less than four cubic inches. The old Scots wheat firlot could never have been substantively constituted of 21⅓ Scots pints, except for the purpose of rendering it equal to the old English bushel of sixty-four pints. And with the facts before us that these English pints were single Roman sextars, while the Scots pints were triple Roman sextars, the harmony is complete.

The difficulty in this inquiry is not to get the names of the old measures, but to get their actual or concrete dimensions. It is very remarkable that, in all the sales of corn given by Professor Rogers in his *History of Agriculture and Prices in England*, beginning at 1259, not one instance occurs of the weight of a bushel. In the old assizes of bread, we have weights given from which doubtful inferences may be made, but the weights used are not so certain and clear as could be wished. In my essay on the *Botany of the King's Measure*, I have endeavoured to show that the commercial 'sterling' was a scale weight of thirty-two troy grains. The money 'sterling' was also a scale weight, but of twenty-four troy grains. The sterling continued to be a scale weight down to comparatively recent times, for we find it frequently used in weighing articles in an 'Inventarium Jocalium, A.D. 1549,' belonging to the cathedral of Aberdeen (*Registrum Episcopatus Aberdonensis*, v. ii. p. 179). The ounce 'troie' is there defined as containing 'viginti esterlingenses.'

But the supposed base of the corn measures was not the money sterling used in weighing gold and silver, but the commercial or tron sterling used for heavy goods. Probably the book called *Fleta* (*c.* 1340) gives the original of various readings of the ancient 'Assise of weights and measures.' In the second book and twelfth chapter of *Fleta*, there are collected together a great number of metrical standards, probably having no other authority than general and local usage. We are there told that in the English kingdom the king's measure was made from the penny called the sterling, which is made round: that this sterling should weigh thirty-two grains of average wheat; that twenty pennies make an ounce; and that twelve ounces make a pound of twenty shillings in weight and number; that the weight of eight pounds of wheat makes the measure of the gallon; that eight gallons of wheat make the bushel, eight of which constitute the common quarter. We are further told that the said sterling penny is in weight thirty-two grains of wheat, and that the weight of twenty pennies makes an ounce, that fifteen ounces make a merchant's pound (*libra mercatoria*); that twelve and a half pounds make a stone; that twenty-eight stones make a sack of wool, which is equal in weight to a quarter of wheat. In the same chapter various stones are mentioned and various pounds. The tron weight is also contrasted by implication with other systems. There has always been a tendency in most countries to use different units for different kinds of goods, and this, although well enough understood by the contemporary writers, not being explained by them, is for us a source of great perplexity.

Now, although the statement in *Fleta*, that the weight of eight pounds of wheat makes the measure of the gallon, follows on the page the statement that twenty pence make an ounce, twelve ounces a pound of twenty shillings, there is no certainty that this latter pound was the pound applied to wheat. Avoirdupois weight was the Roman weight, and was the old weight of England, and the probability is that this was the weight applicable to the wheat measures. The sextar pint just held a pound of wheat of the quality giving sixty-four pounds to the bushel; but there is no reason to believe that a bushel was ever in use in England containing sixty-four pounds of wheat, each weighing 7680 grains; or the pound arising from twelve ounces of 32-grain sterlings, each equal to 640 troy grains.

For these and other reasons, I have come to the conclusion that the old bushel of

England was equal to sixty-four sextars or pints, being the same as the wheat bushel or firlot of Scotland found existing in general use in defiance of many Acts of Parliament; in fact, no Acts of the Parliaments of either kingdom ever had the least permanent effect in regulating, or amending, or altering the corn units. The ancient bushel was essentially the same as the imperial bushel of 2218·191 cubic inches.

If such was the case, can we find out from the statement of *Fleta* what was the weight of a quarter or a bushel of wheat in the middle of the fourteenth century? That statement is, that a sack of wool and a quarter of wheat are of equal weight.

The Norman systems of weight brought into this country were subdivided into grains; these were their ultimate constituents. The esterling scale weight, for the precious metals, was twenty-four grains; the shilling (which was also a scale weight), of twelve esterlings, was 288 grains; the ounce, of twenty esterlings, was 480 grains; and the pound, of twelve ounces, was 5760 grains. (The Tower pound was a mere coinage unit, the elements of which were troy grains; it was not a system of weights.) Then the commercial system began with a unit or esterling of thirty-two of the same grains; twelve of these esterlings made a shilling of 384 grains; twenty shillings made a 'pound of London,' of 7680 grains; twenty of the same esterlings made an ounce of 640 grains; twelve of these ounces also made the pound of 7680 grains; while fifteen of these ounces made what *Fleta* calls the *libram mercatoriam*, the merchant's pound, of 9600 grains, or the pound used *secundum tronæ ponderationem*. The same pound was also formed of twenty-five of the 384-grain shillings[1] (*libra*

[1] Various ponderal pounds were subdivided either into ounces or into shillings (*solidi*). Thus the pound used for weighing the precious metals, electuaries, apothecaries' confections, etc., was subdivided into twelve ounces, and also into twenty shillings of sterlings, and amounted to 5760 grains. The 'great pound of the Normans,' used for wool, lead, iron, and heavy goods, weighed at the public trons, was subdivided into fifteen ounces and into twenty-five shillings, and amounted to 9600 grains. From the old assizes of bread it is seen that at one time shilling weights were used in the weighing of bread. (See, *Fleta*, *De Assiza panis et cervisiæ*, lib. ii. c. 9 and 12; and 'Assiza de Ponderibus,' etc., in *Stat. of the Realm*, v. 1.) In the same way as *Fleta* and the old English assizes of weights and measures mix up in their records all sorts of standards in almost inextricable confusion, so the old Scots assizes, which are evidently

ex pondere viginti quinque solidi). Both these systems came to be called *droit pois* (25 Edw. III. Stat. 5, c. 9), or right weight, by the Normans, who had introduced them and favoured their adoption, in contradistinction to the old avoirdupois standards which defied eradication in much of the traffic of the country. The phrase *droit pois* was trans-

taken from English sources, misconceive the originals, and make confusion more confounded. And hence Lord Swinton, in his *Conjectures concerning Ancient Scotch Measures and Weights*, fell into the mistake of supposing that the old money pound of Scotland was fifteen ounces and twenty-five shillings. In this blunder he has been followed by numismatic and historical writers to the present day. But that the old money pound of Scotland, like the money pound of England, was always of twenty shillings, is perfectly clear from the old Exchequer Rolls, and even from the old assizes themselves, and sums mentioned in charters of David I. In a roll of accounts of the time of Alexander III. is an account of the year 1264, the items of which are as follow: 'xx libr. et j marcam; viij marcas; xxxiij s. iiij d.; xlv lib.' which are said to amount to the 'Suma recept. lxxij li. et una marca;' and is more clear to us stated thus:—

	£20	13	4
8 m. at 13s. 4d. =		106	8
		33	4
	45	0	0
	£72	13	4

The sum agrees with the items only if the pound is taken as twenty shillings.

Again, in the account of Alex. de Cumyn, Earl of Buchan, lated and attached to these systems in such forms as *troi weight*, *trois weight*.

Justiciar of Scotland, made at Scone in 1265, are these items :—

	£95	0	0
5 marks =		66	8
	15	0	20
	12	6	8
	129	0	0
	25	0	0
	90	6	8
	23	18	4
	11	13	4
	£405	13	4

In the record the 'suma lucrorum' is given as 'ccccv lib. xiij s. iiij d.,' only a correct summation on the basis of a twenty-shilling money pound. Again, in *The Acts of the Parliaments of Scotland* a sum is to be raised by taxation by David II., on the 20th July 1366, and, modernising the items, they stand thus :—

	OLD TAXATION.			TRUE VALUE.		
Candide Case,	£368	15	6	£143	0	20
Ergad,	280	26	8	133	6	8
Aberdon,	1,492	4	4	1,358	17	8
Ross,	320	7	11½	246	12	0
Dumblan,	607	13	4	{376	13	4
				{30	19	4
Brechin,	441	3	4	321	16	8
Moran,	1,418	11	0	559	8	8
Cathan,	286	14	10½	86	6	8
Dunkelden,	1,206	5	8	600	53	4
Glasgven,	3,239	0	0	2,028	10	6½
St. Andru,	5,340	13	4	3,507	0	0
	£15,002	16	0	£9,395	6	6½

The totals given in the records are :—

'Secundum antiquam taxacoem xv^{m} li. lvj s. Suma totalis

Now, we know from analysis of the Scots pint (the Stoup of Stirling), that the tron ounce was actually 640 grains of the still current value (*Botany of the King's Measure*); and we know that the tron pound preserved very nearly its true value of 9600 grains (see Buchanan's *Tables*) till its abolition, or rather its translation into avoirdupois elements. And we further know that anciently wool was quantified by tron weight. Well, then, *Fleta* tells us that twelve and a half merchant's pounds or tron pounds made a stone (*petram*), and that twenty-eight stones made a sack of wool,—equal in

ver. valor. ix^{m}iij^{c}iiij^{xx}xvj li. vj s. vj d.' In the last total there is a mistake of one pound; but the sums clearly show that the money pound of David II. was numerically of twenty shillings and of 240 pence, and not of twenty-five shillings and 300 pence. Evidence of this kind is abundant and absolutely conclusive of the fact that all through our history the money pound has been numerically of 240 pence and twenty shillings. What the ponderal pound was at any time, by which bullion was quantified, is a very different and a much less important historical consideration. We find gold weighed by a pound of twelve ounces and by a pound of sixteen ounces; the ponderal standards remained uniform. The weight of the numismatic or money pound was never certain, and was perpetually being changed; but had not the integrity of the ponderal standards been rigidly maintained, everything would have gone to confusion,—the ponderal units remained to measure the departure of the numismatic.

weight to a quarter of wheat. The weight of the sack of wool will therefore stand thus :—

Tron oz. =	640	gr. =	($\frac{1}{41}$ of Scots pint, called
	15		ounce *trois*, Act of 1426).
Tron lb. =	9600	gr.	(*libram mercatoriam*, mer-
	12½		chant = wholesale trader).
Wool st. =	120,000	gr.	
	28		
Sack of Wool,	3,360,000	gr. =	480 lbs. avoirdupois.

Of course it is known, and has always been known, that variations exist in the weight of wheat. We must therefore select the most obvious weight, which undoubtedly would be that of sixty pounds the bushel. The comparison would therefore stand thus :—

Avoir. lb. =	60	(old Roman and English weight).
	7000 gr.	
Bushel,	420,000 gr.	
	8 bush. in qr.	
Qr. of wheat,	3,360,000	= 480 lbs. avoirdupois.

That we thus have the true solution of

this historical difficulty seems beyond all question; Professor Rogers fails to arrive at it from overlooking the system of tron weight, and hence misconceiving the value of the *libram mercatoriam* (*A History of Agriculture and Prices in England*, v. i. c. 10). Others have made the same mistake, and this mistake has partly arisen from the influence of unfounded derivations, and unauthorised restrictions of 'troy weight.' After many years' consideration, I have no doubt that the qualification 'trois weight' is simply that kind of half-translation, half-corruption of the Norman-French which has introduced *pois, troie weight*, was simply the 'right weight,' which the Government wished to be applied to the various articles. The right tron weight was called *trois*, as well as the right weight used in the mints. The Scots Parliament, in 1426, find the pint to contain two pounds and nine ounces *trois* of water from the Tay, also defined as forty-one ounces. My own measurement of the Stirling pint, with 'clear water of Tay,' gives an ounce of 640·7 grains; fifteen of these ounces made the merchant's pound of *Fleta*, and sixteen the tron pound proposed by the Scots Parliament; both being from the same foundation of grain weights as the lesser standards used in quantifying the precious metals. But the standards of right weight, used at the public trons, were *droit pois*, *troie weight*, as well as those used in the goldsmith's shop. In retail transactions, it is evident that all through our history the Roman or avoirdupois standards held their own; the second Jury of Elizabeth found them of their present value, and found them to be the old weights of England; and the Stirling jug, of three Roman sextars, equal to sixty Roman ounces of water, makes the British value of the Roman commercial ounce 437·9 grains. At first the use of the qualification *droit pois* implied no more than that any article was to be weighed by its appropriate standard. We see clearly from *Fleta* (lib. ii. c. 12) that certain heavy goods were to be weighed according to tron weight; that the *centena*, or hundredweight, for another class of goods, contained thirteen and a half stones, and each stone eight pounds, being nearly equal to our existing hundredweight of 112 pounds avoirdupois; that certain other articles were to be weighed by a pound of twenty-five shillings, and others by a pound of twenty shillings; so that the qualification *droit pois* had an obvious meaning, and could not fail to be in very frequent use. The qualification 'right' was also applied to measures. And just as the word 'esterling,' implying at first a scale weight of twenty-four grains, and a silver penny of the same weight, and also implying in commercial circles a scale-weight of thirty-two grains,—just as the word 'esterling,' corrupted into 'sterling,' from being applied to an object, came to be applied to a quality, —so the word *droit*, corrupted into *troie*, from being applied to any right weight, came to be restricted to the perfect standards used for the precious metals.

I do not propose here to trace the course of the corn measures from the time of the early definition we have been considering to the introduction of the existing imperial measures. But I cannot resist calling attention to the marvellous and happy accident by which the imperial measures exactly restored the ancient legal or current measures of England. In my *Botany of the King's Measure*, I have quoted the various forms which the definition of the bushel assumes; whatever authority these forms possessed, the probability certainly is that they did not define a new bushel, but described the bushel in current legal use. The definition of *Fleta* is, that the weight of eight pounds of wheat makes the measure of the gallon; and the definition in the *Liber Horn*, as given in the first volume of *The Statutes of the Realm*, that eight pounds make a gallon of wine, and eight gallons of wine make a bushel of London.

Now, the latter definition does not state of what substance the eight pounds were to be, whose *bulk* was to equal a gallon; while, in *Fleta's* definition, it is quite clear that it was the *bulk* of eight pounds of wheat which was equal to a gallon. Well, we know that the old Roman sextar contained twenty Roman or avoirdupois ounces of water or wine, a fact confirmed by the existing fact that the Stirling pint contains precisely three such Roman pints. If, therefore, *Fleta's* pound of wheat was an avoirdupois pound of sixty-four pound wheat, it exactly filled the sextar pint; the wheat was the *bulk* of the pint, and the *weight* of the pound; and eight pounds of wheat equally made the bulk of a gallon of wine. Thus, the cubic capacity of the old bushel holding sixty-four pounds of wheat was made up of the bulk of sixty-four sextar pints, each containing twenty ounces of water.

When the existing imperial standards were under consideration, it was finally resolved to make the gallon equal in bulk to ten pounds of water. Ten pounds are equal to 160 ounces; and, as the imperial gallon was still to be divided into eight pints, each pint was defined to hold twenty avoirdupois or old Roman ounces; so that the bushel of sixty-four pints, after many vicissitudes, returned in England precisely to its old dimensions. And the secret at the bottom of this metrical romance was the undying permanence of the old Roman standard of weight. But in Scotland the present imperial standards or their multiples had never been out of use. If the old Scots standards are placed beside the imperial, they are seen to be identical :—

	Scots. Cub. in.	Imperial. Cub. in.
Bushel or Firlot, . .	2214·32	2218·19
Gallon, ...	833·62	
One-third,	277·87	277·27
Pint, ...	104·23	
One-third,	34·74	34·66

Now, in 1618 these Scots measures were declared to be the true measures of Scotland, at a date long antecedent to the introduction of that metrological corruption, the Winchester bushel. And if the existing imperial standards have always been the legal standards of Scotland, who can doubt that they were the old legal standards of England? The two countries derived their measures from the same source, the standards of Imperial Rome. I can see the Spirit of the old Scots measures standing in an empty Linlithgow wheat firlot, with a wreath of golden ears around his brows, and looking ineffable scorn upon the statutes which affect to abolish his reign and his dynasty; and he bids me tell the husbandmen whose corn he has measured, that he has not been abolished, that it is he alone who has survived, and that, if his name has been changed, his capacity of service remains in every imperial bushel in the Kingdom.

II.

The Weight of a Bushel of Corn.

TRUSTING that, from what has been said, the reader will be somewhat familiarised with the genesis and the capacity of the bushel, I proceed next to inquire into the weight of some of the kinds of corn which are measured by the bushel. These kinds are wheat, barley, and oats.

The weight of a bushel of corn does not represent the specific gravity of the grain, but what may conveniently be called its *measure-weight*. Specific gravity treats of single grains; measure-weight treats of aggregations of grains, more or less compacted together. As usually made, the bushel is a small fraction more than eight inches deep, with the necessary diameter to give a capacity of 2218·191 inches, or of eighty avoirdupois pounds of water. The 'drum' bushel is made much deeper, and of less diameter. But a shallow bushel and a deep bushel which are commensurate for water, are not commensurate for compressible substances such as grain, and consequently the drum bushel holds a little more corn than the ordinary bushel.

But where large quantities of grain are measured in the ordinary way for the ordinary purposes of trade, it can hardly be doubted that a bushel-weight correctly represents what the bushel on an average truly contains. The fact that all grain is now weighed as well as measured, shows that weight is regarded as a more ultimate determination of quantity than measure; but measure is still in many cases continued, under the impression that measure-weight implies a certain element of what is called quality. To what extent this impression is justified will be seen when we come to treat of the percentage of kernel, more especially in oats.

In the following tables relating to the weight of grain, the two chief questions asked are: What is the average weight of a bushel of wheat, a bushel of barley, and a bushel of oats? and, What is the variation in the weight of these grains from one year to another?

In order to answer these questions, a large number of correct weights must be averaged; and to find this large number, in the present case, the sales in the Edinburgh Corn Market have been adopted for the main conclusions. These sales, as published in the newspapers,[1] are no doubt less complete than in the books of the Clerk of the market; because, where four or five parcels of grain are sold at the same price, but of different measure-weights, each sale is recorded in the market books, while only the highest and lowest weights are given in the public reports. No practical error, however, results from the omission of the intermediate weights, the data given being so numerous as to neutralise a great many such omissions.

The Edinburgh Corn Market is the only market in the Kingdom which publishes an intelligible report, containing the particulars necessary to show the price of corn. These

[1] The Edinburgh Tables are nearly all from the reports of the *Scotsman*.

particulars, however, as will be afterwards shown, are hidden and distorted by the use of such a variable unit of exchange as the quarter, so that the real and comparative prices from week to week may be found by calculation, but are not seen at a glance.

The district from which the supplies of the Edinburgh market are drawn is one of the best corn-growing districts in the country; so that the results taken from such a source will have more of a typical character than if taken from a less centrical locality. But if other districts were worked out in the same way, and the process of calculation carried on systematically for a good many years, valuable facts, both agricultural and metrological, could not fail to be accumulated.

Suppose, now, that the public reports of the Edinburgh market are accepted as containing sufficient facts for determining the weight of the bushel, there are two views of the method by which the weight of the abstract or typical bushel may be arrived at. The one is the method by which the *average* weight is found, and the other is the method by which the *mean* weight is found. The average involves quantities and weights; the mean involves weights alone. A certain number of quarters are sold of given weights; if the number of quarters in all the sales is taken into account in making the calculation, we have the *average* weight; if only the weights of all the different parcels are taken into account, we have the *mean* weight. Which of these is the true representative weight of a bushel? Is it the average weight, or the mean weight of the bushel which is wanted? The average might be wanted for one purpose, and the mean for another. If the price of the pound of wheat on any assigned market-day is required, that is a purpose for which the average weight is wanted. If the medium of the weights of a season, as represented on any assigned market-day, is required, that is a purpose for which the mean weight is wanted. And the purpose which the political economist has in view in estimating the edible value of a quarter of corn, requires rather the mean weight than the average weight; while the same may be said of the agriculturist and meteorologist, who desire to compare the productive power of different seasons.

But the question then arises, Is the mean weight different from the average weight when a large number of actual details are taken into account? And subordinate to this question come the various modes of stating the data from which the calculations are to be drawn. If 10 quarters have a weight of 62 lb. the bushel, and 100 quarters have a weight of 64 lb., then the average weight deduced from these figures is 63·82 lb. the bushel, and the mean weight is 63 lb. But if the details are given in another form, thus :—

10 qrs.	62 lb. per bushel.	
10 „	64 „	
10 „	64 „	
10 „	64 „	
10 „	64 „	
10 „	64 „	
10 „	64 „	
10 „	64 „	
10 „	64 „	
10 „	64 „	
10 „	64 „	
110	11) 702	
	63·82 lb. mean weight	

it is seen that the mean weight and the average weight are identical. Therefore, in order that the mean and the average may exactly correspond, all the parcels must be stated in equal quantities. But, as all the quantities sold in the Edinburgh market of any given weight are not equal, it is clear that the mean and average weights will not be theoretically identical. Let us see, then, from actual examples whether they approach so near to each other that the difference may be disregarded. It is also to be observed that, as the mean will sometimes be slightly above and sometimes slightly below the average, the two will tend to coalesce by neutralisation. And in the same way, if the average is employed for finding the results, it will sometimes be slightly above and sometimes slightly below the mean, so that in the end the one will not be known from the other.

Mr. James B. Thomson, Clerk of the Edinburgh market, has kindly furnished me with all the details of two market-days, the 16th and 23d of November 1870, and I shall give the reductions of the sales of wheat, barley, and oats, all for the same market-day, to show that no selection has been made of examples favouring any preconception.

SALES OF WHEAT in Edinburgh Corn Market of 16th November 1870, showing Average and Mean Weights per Bushel.

Wt.	Qrs.		Wt.	Qrs.		Wt.	Qrs.	
65½	20		63¾	32	2613·75	62½	1	
65½	1	2227·00	63¾	9		62½	8	937·50
65½	13		63½	1		62½	1	
65	10		63½	6		62½	5	
65	10	2145·00	63½	8	5016·50	62	6	
65	13		63½	40		62	38	
64¾	1		63½	15		62	1	3534·00
64¾	10	1489·25	63½	9		62	12	
64¾	12		63¼	15		60¾	1	60·75
64½	1	64·50	63¼	5	2277·00	60½	12	726·00
64¼	16		63¼	16		60¼	3	180·75
64¼	12	1863·25	63	9		60	12	720·00
64¼	1		63	8		58½	2	117·00
64	13		63	2	6804·00			
64	4		63	9				
64	1	4416·00	63	25				
64	23		63	55				
64	13		62¾	16	1819·75			
64	15		62¾	13				

Sum of quarters multiplied by respective weights, divided by number of Qrs., $\frac{37012}{584}$ = Average Weight . 63·38 lb.
Sum of weights divided by number $\frac{3226{\cdot}75}{51}$ = Mean Wt., 63·27 ,,
Mean of weights in published report, . . 63·17 ,,
Mean of weights, each different weight taken once, 62·71 ,,

Sales of Barley in Edinburgh Corn Market of 16th November 1870, showing Average and Mean Weights per Bushel.

Wt.	Qrs.		Wt.	Qrs.		Wt.	Qrs.	
59¼	70	4147·50	57	17		56	15	
59	2	118·00	57	1		56	40	6384·00
58¾	1	58·75	57	10		56	18	
58½	55	3276·00	57	1	10,830·00	56	41	
58½	1		57	60		55¾	1	
58¼	80		57	1		55¾	20	2676·00
58¼	1		57	25		55¾	19	
58¼	1	6757·00	57	75		55¾	8	
58¼	18		56¾	22		55½	11	
58¼	16		56¾	22		55½	16	2719·50
58	1		56¾	10	6242·50	55½	1	
58	59	4582·00	56¾	30		55½	21	
58	1		56¾	11		55¼	12	663·00
58	18		56¾	15		55	1	
57¾	1	115·50	56½	51		55	27	7810·00
57¾	1		56½	2		55	100	
57½	1		56½	2		55	14	
57½	6		56½	15	9096·50	54¾	65	3558·75
57½	35		56½	25		54	10	540·00
57½	1	4427·00	56½	27		53¾	2	115·50
57½	18		56½	39		52¾	1	52·75
57½	15		56¼	19		52¼	40	2090·00
57½	1		56¼	18				
57¼	7		56¼	42	9337·50			
57¼	20	3778·50	56¼	24				
57¼	39		56¼	41				
			56¼	22				

Sum of quarters multiplied by respective weights, divided by number of Qrs., $\frac{89376 \cdot 25}{1579}$ = Average Weight, . 56·60 lb.
Sum of weights divided by number $\frac{4248 \cdot 25}{75}$ = Mean Wt., 56·64 „
Mean of weights in published report, . . 56·74 „
Mean of different weights, each taken once, . 56·34 „

Sales of Oats in Edinburgh Corn Market of 16th November 1870, showing Average and Mean Weights per Bushel.

Wt.	Qrs.		Wt.	Qrs.		Wt.	Qrs.	
46	24	1104·00	43	1		41¾	16	
45½	1	45·50	43	6		41¾	6	1294·25
45	18	1080·00	43	30	3139·00	41¾	4	
45	6		43	26		41¾	5	
44¾	3	134·25	43	10		41½	60	4399·00
44½	25	1112·50	42¾	14		41½	46	
44¼	24	1637·25	42¾	7		41¼	20	1237·50
44¼	13		42¾	80	6540·75	41¼	10	
44	20		42¾	36		41	4	
44	31	2684·00	42¾	10		41	32	2911·00
44	10		42¾	6		41	23	
43¾	7		42½	14	3910·00	41	12	
43¾	15	3587·50	42½	78		40¾	6	244·50
43¾	48		42¼	6		40	1	80·00
43¾	12		42¼	50	4605·25	40	1	
43½	10		42¼	7		39¾	12	477·00
43½	4	2697·00	42¼	46		39¼	11	431·75
43½	44		42	10		38¾	14	542·50
43½	4		42	16		38¼	17	650·25
43¼	17	1643·50	42	112	8274·00	38	16	608·00
43¼	21		42	6				
			42	53				

Sum of quarters, multiplied by respective weights, divided by number of Qrs., $\frac{55070 \cdot 50}{1297}$ = Average Weight, 42·46 lb.

Sum of weights divided by number $\frac{2673 \cdot 50}{63}$ = Mean Weight, 42·44 ,,

Mean of weights in published report, . . 42·44 ,,

Mean of different weights, each taken once, . 42·20 ,,

Now, while I think it is rather the mean weight than the average weight which is really wanted for economico-historical purposes, any one who takes the contrary view will see from these three examples that, where the particulars are numerous, the average weight and the mean weight approach each other so closely that they become practically identical; for, when it is seen that they are so nearly identical, taking only the small quantities exchanged on a single market-day, it is obvious that with a whole year, or with a number of years, the coalescence of the two will be complete. But these examples were not the examples which made the conclusion sufficiently clear that the sole use of the mean weight is warranted as giving both mean and average. The weights of a whole year's sales of wheat, barley, and oats in the Edinburgh market, as will be seen below, were all found by calculating the average—that is, multiplying the weights by the quantities. The weights also of a whole year's sales of wheat, barley, and oats in the Haddington Corn Exchange, deduced from all the details in the market books (kindly supplied to me by the Clerk), were found by taking the average. The labour, however, of this method was enormous; but it was thus placed beyond doubt that, with the given materials, the easier work of finding the mean weight led to the same result; both methods gave the same result.

On the market-day from which the above examples are taken, the average bushel-weight of wheat is 63·38 lb., while the mean weight is 63·27, showing a difference of only ·11 of a pound, a quantity which is not noticed in weighing the bags in the market.[1] The mean weight which is found from the weights given in the newspaper reports is 63·17 lb., being ·21 of a pound less than the average weight, a quantity rather less than a quarter of a pound; and which, on next market-day, would probably be as much more than the average. In the market books there are fifty-one sales with weights fifty-one times stated; in the newspaper report there are thirty-four weights given. There are eighteen different weights given, the mean of which is 62·71, falling, in this case, below the average ·67 of a pound. But this mean is nowhere used in the tables.

[1] In weighing 4-bushel bags at Edinburgh, four pounds are deducted for the weight of the bag. At Haddington three pounds are deducted.

Then in regard to the barley: there are seventy-five sales, and the seventy-five weights of these give an average weight of 56·60 lb. to the bushel. The mean of the same seventy-five weights is 56·64 lb., differing from the average only ·04 of a pound. In the newspaper report thirty-nine weights are given, and the mean of these is 56·74 lb., being above the average only ·14 of a pound. There are twenty-three different weights, and the mean of these is 56·34, falling below the average ·26 of a pound.

Of oats there are sixty-three sales, giving an average weight of 42·46 lb. to the bushel. The mean of the sixty-three weights is 42·44 lb., differing from the average ·02 of a pound. In the newspapers forty-one weights are given, and the mean of these is identical with the mean of the full sixty-three weights. The range of different weights is twenty-six, and the mean of these is 42·20, being ·26 of a pound, in this example, below the average.

It will thus be seen by those who give a preference to the average over the mean, as representative unit, that while the mean sometimes rises a little above the average, and sometimes falls a little below it, the amount of the difference is practically immaterial; and as, by the nature of the case, the variation will sometimes be on one side and sometimes on the other, the mean weight and the average weight become merged into one expression; so that, for the present purpose, all questions as to their comparative propriety cease to be of importance.

The Edinburgh market year runs from the beginning of September in one year to the end of August next year, and the Edinburgh tables have been arranged for the same year. This year corresponds very nearly with the cereal year, so that the corn produced in the one year is sold in the following.

Thus the market year 1868-69 gives the corn produced during the seasons of 1868; the first year is the year of production, the second, the year of sale; so that the weight of the corn from September 1868 to August 1869, is the weight of the crop produced in 1868, and indicates the character of that year. Sometimes the weights for the markets of August, September, and October are a little affected by the mixing of old corn with new, but it will be seen that this distortion is extremely slight, and does not affect the general average for the year, as deduced from the two middle quarters, or the three last quarters.

The Edinburgh tables include the crops of the thirteen years from the crop of 1868 to the crop of 1880. The average weight of wheat, barley, and oats is given for every week, every month, every quarter, and every year, of these thirteen years. Of wheat there have passed under calculation 387,678 quarters; of barley, 699,431 quarters; and of oats, 711,520 quarters. The average weight of wheat for these thirteen years is 62·02 lb. per bushel; the average weight of barley is 54·93 lb.; and the average weight of oats is 42·22 lb. To find the weight of wheat about 15,000 separate weighings have been employed; to find the weight of barley about 20,000; and to find the weight of oats about 18,000.

The weight of wheat in these thirteen years is—

First Quarter	(September to November)	62·06 lb.
Second „	(December to February)	61·48 „
Third „	(March to May) . .	62·04 „
Fourth „	(June to August) . .	62·52 „

The first and third quarters are thus seen to have a measure-weight equal to the average for the whole year; while the second quarter's weight falls about half a pound below the year's average, and the fourth quarter's weight rises about half a pound above it. The average of second, third, and fourth quarters, which include only a single crop, is 62·01 for the thirteen years, being only one-hundredth of a pound less than the average for the four quarters.

In regard to barley the weight stands:—

First Quarter	(September to November)	55·00 lb.
Second „	(December to February)	54·91 „
Third „	(March to May) . .	55·09 „
Fourth „	(June to August) . .	54·68 „

The fourth quarter is here lightest, being a quarter of a pound below the average of the year. But as very little barley is kept up and sold in the fourth quarter, the weight for this quarter has not the same value as the weight for the other quarters. The second and third quarters embrace no old corn, and are therefore most properly representative of the crop of a given year; and the average of these two quarters for the thirteen years is 55·00 lb.; differing only from the general average by an excess of $\frac{7}{100}$ of a pound.

The weight of oats for each of the four quarters of the thirteen years is—

First Quarter	(September to November)	42·20 lb.
Second „	(December to February)	41·99 „
Third „	(March to May) . .	42·25 „
Fourth „	(June to August) . .	42·46 „

Here the first and third quarters give about average weight; the second quarter gives a weight in defect of about a quarter of a pound; the fourth quarter about as much in excess of the general average. The average of second, third, and fourth quarters (purely one crop) is 42·23, or practically identical with the whole year's average.

It thus appears that in wheat and oats the measure-weight is lowest in the second quarter, from December to February, arising partly from greater internal moisture, and partly from adherent moisture, which prevents that complete sliding in the bushel which ensures the greatest compactness of the grain. If in barley the fourth quarter be excluded as somewhat deficient in quantity, the second quarter is here also lowest in weight, but the difference is slight.

The weights given in the abstracts, representing the highest and lowest limits of measure-weight, are necessarily somewhat indefinite. They are found by taking the extreme weights of the various markets, and one or two of those nearest the extremes, and from these deducing a mean. It will be seen from these figures that the higher average limit of weight in wheat for the thirteen years is 64·8 lb., and the lower average limit 57·4 lb.; the range between the two average limits being 7·4 lb. The higher average limit for barley, found in the same way, is a weight of 57·9 lb., just touching on the lower limit of wheat, while the lower limit of barley is a weight of 49·2 lb., making a range between the two extremes of 8·7 lb. For oats the higher average limit is

45·9 lb., although there are oats which go as high as about 50 lb., and the lower limit is 36·4 lb., the distance between the two being 9·5 lb. The lighter wheats touch the heavier barleys, and the lighter barleys touch the heavier oats.

In wheat, the greatest average rise of any year from 1868 to 1880, above the average of this period, is 1·33 lb., and the greatest average fall 1·97 lb., making the greatest difference between any two years 3·30 lb. In barley, the greatest over-average rise is 1·42 lb., and the greatest under-average fall 2·55 lb., thus making the greatest difference between any two years 3·97 lb. And in oats, the best year rises above the general average 0·94 lb., while the worst year falls below it 1·31 lb., the difference between the best and worst years, in respect of measure-weight, being thus 2·25 lb. The variation between best and worst years is greatest in barley and least in oats, thus far showing a greater susceptibility to climatic influences in barley than in oats, with a medium susceptibility in Scottish wheats.

If it should ultimately be found that the years form a cycle of a certain length depending upon some evolution of solar action, then probably the true average measure-weight of any assigned variety of grain would be found by taking the average of the proper years composing this cycle. On the assumption of such a cycle of eleven years, and beginning with the best wheat year of the following tables, namely, 1869, the weight of wheat would be 61·89, of barley 54·75, and of oats 42·15 lb., all being a little under the averages of the thirteen years. It should not be concealed, however, that there are disturbing elements in the problem, and that the best developed kernels have not always the greatest measure-weight. The periods of growing and ripening may be all that could be desired; but if rain falls in considerable quantity during harvest, and while the corn is in the stook, the grain is swollen out and receives a mechanical enlargement (probably of the coats), from which it never fully contracts; so that the best year for production may not, in such a case, exceed in weight a year of somewhat inferior productive power, attended with a dry harvest. The evidence of this position will be found in Chapter XII.

In the meantime, I assume the average of the thirteen years as most truly representative of the measure-weight of corn at the present day. The weight, therefore, of a typical quarter of wheat is 496·16 lb., or very nearly five centals, equal to 225 kilograms or 2¼ quintals of the French metric system. The weight of an average quarter of barley is 439·4 lb.; the weight of a quarter of oats is 337·76 lb.

Between 1868 and 1880, wheat is heaviest in 1869, and the average quarter in that year weighs 506·8 lb.; in 1872 wheat is lightest, and the quarter weighs 480·4 lb.; the difference is 26·4 lb. Barley is heaviest, and of the same weight, in 1868 and 1870, in which years the quarter weighs 450·8 lb.; it is lightest in 1872, the year in which wheat is lightest, and the quarter weighs 419·0 lb.; the difference between the heaviest and lightest being 31·8 lb. The heaviest year for oats is 1878, when the quarter weighs 345·28 lb.; the lightest year is 1872, corresponding with barley and wheat, and the quarter weighs 327·28 lb.; the difference being 18 lb. The average variation is least in oats, greatest in barley, and medium in wheat.

But the difference in weight between a quarter at the higher limit of weight and a quarter at the lower limit is much greater than these differences. Wheat has sometimes a weight of 66 lb. the bushel, and sometimes of 55; making a difference between two quarters of 88 lb. Barley sometimes reaches 60 lb., and sometimes falls to 46; making a difference in two quarters of 112 lb. Oats sometimes weigh 48 lb. or more, and sometimes 33, so that a quarter of the one differs from a quarter of the other 120 lb. or more. Yet all these very varying quantities are called by one name and regarded as one unit, to the utter confusion of the corn trade.

But, without going to these extremes, a line drawn through the weights of the upper limits of wheat, so as to average them, gives a quarter weighing 518·4 lb., and, drawn through the lower weights, gives a quarter of 459·2 lb., showing a difference between two quarters of 59 lb. The upper average limit of barley gives a quarter of 463·2 lb., and the lower limit a quarter of 393·6 lb., the difference being 69·6 lb. A quarter at the upper average of oats weighs 367·2 lb., and at the lower 291·2 lb., showing a difference of 76 lb.

With these explanations, the tables of measure-weight will be sufficiently clear to be easily understood. I do not propose to continue this work; but I think it might very properly be continued by those having charge of the Edinburgh Corn Market, and those having charge of markets conducted on similar principles in other parts of the Kingdom. In course of time valuable facts would be accumulated, and more precision and certainty given to an important department of knowledge.

I.—TABLE of the Weekly, Monthly, Quarterly, and Yearly Average Bushel-weight of Wheat, Barley, and Oats sold in the Edinburgh Corn Market, from November 4, 1868 to August 31, 1881.

First Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1868. November 4	474	62·19	1122	55·85	1491	42·47
11	315	62·70	1247	55·84	1499	42·35
18	560	62·57	1435	56·64	1327	42·36
25	322	62·38	1243	56·52	1035	42·19
Average, .	1671	62·46	5047	56·21	5352	42·34
Average of 1st qr.,		62·46		56·21		42·34
December 2	432	62·47	1250	56·57	1476	42·25
9	549	62·07	1251	56·20	1424	42·10
16	580	62·53	1303	56·32	1285	42·12
23	505	62·44	1456	56·16	1633	41·92
30	728	62·40	1336	56·14	1226	42·03
Average, .	2794	62·38	6596	56·28	7044	42·08
1869. January 6	620	62·24	1164	56·20	1704	41·96
13	588	61·79	1070	55·97	1733	41·97
20	619	61·80	821	56·06	1598	41·63
27	858	62·00	1234	55·87	1697	42·03
Average, .	2685	61·96	4289	56·02	6732	41·90
February 3	606	62·22	646	56·28	1266	42·30
10	924	62·30	650	56·04	1243	41·85
17	890	62·41	1060	56·23	1497	41·87
24	895	62·67	987	56·52	1289	42·18
Average, .	3315	62·40	3343	56·27	5295	42·05
Average of 2d qr.,	8794	62·25	14,228	56·19	19,071	42·01

First Year.			Wheat. Qrs.	Wheat. Wt.	Barley Qrs.	Barley Wt.	Oats. Qrs.	Oats. Wt.
1869.	March	3	829	62·75	926	56·08	1127	41·95
		10	827	62·64	750	56·24	1594	41·62
		17	564	62·67	938	56·56	1312	41·99
		24	418	62·92	224	56·36	1430	42·07
		31	623	63·03	484	56·47	1080	42·47
	Average, .		3261	62·80	3322	56·34	6543	42·05
	April	7	461	62·90	451	56·32	1016	42·02
		14	292	63·10	448	56·56	1083	42·71
		21	504	63·10	247	57·20	1101	42·78
		28	614	63·51	440	56·82	1145	42·76
	Average, .		1871	63·15	1586	56·48	4345	42·57
	May	5	615	63·20	525	56·19	934	42·48
		12	670	63·17	285	56·61	1145	42·21
		19	704	63·41	226	55·96	536	41·98
		26	557	63·21	156	56·00	617	41·92
	Average, .		2546	63·25	1192	56·19	3232	42·15
Average of 3d qr.,			7678	63·07	6100	56·34	14,120	42·26
	June	2	590	63·44	163	56·11	542	42·48
		9	721	63·50	112	56·59	806	42·18
		16	656	63·42	82	57·29	1012	42·80
		23	668	63·33	39	57·53	970	42·88
		30	332	63·36	39	57·44	735	42·73
	Average, .		2967	63·41	435	56·99	4065	42·61
	July	7	249	63·45	75	56·49	748	42·45
		14	361	63·41	39	56·60	787	42·19
		21	548	63·40	27	57·80	673	42·24
		28	616	63·37	106	56·67	617	42·87
	Average, .		1774	63·41	247	56·89	2825	42·44
	August	4	454	63·55	81	56·00	517	42·73
		11	352	63·24	84	55·49	283	42·42
		18	357	63·12	97	56·76	256	43·07
		25	89	63·16	179	55·99	502	42·72
	Average, .		1252	63·27	441	56·06	1558	42·73
Average of 4th qr.,			5993	63·36	1123	56·65	8448	42·59
Average of 1868-69,			24,136	62·78	26,498	56·35	46,991	42·30

Second Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1869. September 1	237	62·86	373	56·47	487	44·04
8	361	62·96	647	56·86	780	43·72
15	452	63·11	759	56·23	595	42·33
22	312	63·15	640	55·78	904	42·37
29	232	63·03	1439	56·09	949	42·29
Average, . .	1594	63·02	3858	56·29	3715	42·95
October 6	279	62·96	1427	55·71	805	42·72
13	388	63·43	1338	55·29	766	42·54
20	423	63·24	1246	56·01	859	42·35
27	502	63·06	1385	55·86	707	42·50
Average, . .	1592	63·17	5396	55·72	3137	42·53
November 3	366	63·26	988	56·29	1469	42·64
10	193	63·37	1234	56·26	1056	42·63
17	380	63·23	1031	56·03	1161	42·40
24	279	63·44	931	56·41	993	43·05
Average, . .	1218	63·33	4184	56·25	4679	42·68
Average of 1st qr.,	4404	63·17	13,438	56·09	11,531	42·72
December 1	357	63·04	1274	56·43	1390	42·73
8	404	63·28	1293	56·01	1169	43·16
15	249	63·39	1411	55·91	966	42·69
22	113	63·22	1222	55·55	1252	42·75
29	426	62·77	1295	56·09	1126	42·83
Average, . .	1549	63·14	6495	56·00	5903	42·83
1870. January 5	342	62·87	1641	56·28	1172	43·02
12	437	62·74	1462	55·69	1139	43·38
19	484	62·44	1580	55·73	1311	42·91
26	671	63·21	1626	55·64	1378	42·75
Average, . .	1934	62·81	6309	55·84	5000	43·01
February 2	367	62·80	1691	55·87	1507	42·85
9	461	63·02	1548	55·80	1364	42·88
16	717	63·22	1424	55·80	1626	42·84
23	618	63·10	1683	55·77	1360	42·43
Average, . .	2163	63·04	6346	55·81	5857	42·75
Average of 2d qr.,[1]	5646	63·00	19,150	55·88	16,760	42·86

[1] Here *average* weights end and *mean* weights begin.

Second Year.		Wheat.		Barley.		Oats.	
		Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1870. March	2	643	63·11	1681	56·17	1266	42·74
	9	553	63·22	1312	56·11	1322	42·93
	16	719	63·39	1433	56·03	1057	42·91
	23	496	63·02	1140	56·09	689	42·81
	30	444	63·35	1144	55·96	700	43·08
Average, .	.	2855	63·22	6710	56·07	5034	42·89
April	6	446	63·26	877	56·08	742	42·78
	13	594	62·95	867	55·93	615	43·22
	20	458	63·65	531	56·26	624	42·83
	27	487	63·73	338	56·36	999	43·13
Average, .	.	1985	63·40	2613	56·16	2980	42·99
May	4	683	63·57	617	55·43	1017	43·26
	11	751	63·96	555	55·80	938	43·09
	18	771	63·69	292	55·80	722	43·42
	25	559	63·87	302	56·10	577	43·26
Average, .	.	2764	63·77	1766	55·78	3254	43·26
Average of 3d qr.,		7604	63·46	11,089	56·00	11,268	43·05
June	1	736	63·79	106	56·17	833	43·20
	8	699	63·69	145	56·04	1047	42·79
	15	752	63·60	178	55·64	1063	43·19
	22	526	63·71	177	55·84	970	43·20
	29	548	63·42	276	56·44	1066	42·78
Average, .	.	3261	63·64	882	56·03	4979	43·03
July	6	438	63·77	145	55·87	720	43·56
	13	526	64·00	147	56·17	631	42·23
	20	476	63·67	21	56·75	709	43·06
	27	353	63·78	22	56·36	502	43·12
Average, .	.	1793	63·80	335	56·29	2562	42·99
August	3	761	63·85	66	55·93	457	42·87
	10	461	63·85	16	56·25	289	42·81
	17	296	63·97	153	56·37	277	43·01
	24	250	64·12	177	56·33	251	42·92
	31	257	63·55	523	56·54	686	43·15
Average, .	.	2025	63·87	935	56·28	1960	42·95
Average of 4th qr.,		7079	63·77	2152	56·20	9501	42·99
Average of 1869-70		24,733	63·35	45,829	56·04	49,060	42·91

Third Year.		Wheat.		Barley.		Oats.	
		Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1870. September	7	275	63·03	1003	56·13	645	42·60
	14	446	63·51	2034	55·87	852	42·67
	21	424	63·70	1645	55·86	1101	42·38
	28	444	63·37	2187	56·15	1244	41·97
Average, . .		1589	63·54	6869	56·00	3842	42·40
October	5	642	63·20	1274	56·27	890	42·21
	12	521	63·54	1247	56·06	1260	42·28
	19	781	63·08	1625	56·33	979	42·44
	26	675	62·90	1501	56·23	998	41·92
Average, . .		2619	63·18	5647	56·22	4127	42·21
November	2	799	62·79	1635	56·34	968	42·28
	9	622	63·08	918	56·03	1302	42·26
	16	584	63·17	1579	56·74	1297	42·44
	23	622	62·74	1830	56·94	1319	42·54
	30	470	62·70	980	56·57	1383	42·30
Average, . .		3097	62·90	6942	56·52	6269	42·36
Average of 1st qr.,		7305	63·21	19,458	56·25	14,238	42·32
December	7	495	62·75	934	56·38	1261	41·95
	14	602	63·03	1462	56·57	1407	41·71
	21	597	62·66	1442	56·22	1012	42·29
	28	604	62·39	1320	56·19	1331	42·58
Average, . .		2298	62·71	5158	56·34	5011	42·13
1871. January	4	668	62·76	1318	56·60	1043	42·13
	11	652	62·62	1737	56·23	1186	42·16
	18	730	62·77	1456	56·52	1067	42·03
	25	1015	62·73	1360	56·42	1199	41·98
Average, . .		3065	62·72	5871	56·44	4495	42·08
February	1	944	62·49	1579	56·16	1782	41·92
	8	990	62·88	1309	55·85	1157	41·48
	15	845	62·55	1135	56·59	1328	41·86
	22	556	62·47	995	56·47	1173	41·69
Average, . .		3335	62·60	5018	56·27	5440	41·74
Average of 2d qr.,		8698	62·68	16,047	56·35	14,946	41·98

Third Year.		Wheat.		Barley.		Oats.	
		Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1871. March	1	604	62·45	1164	56·40	1071	41·78
	8	644	62·78	820	56·33	1657	41·92
	15	1090	62·41	744	56·54	863	42·05
	22	1063	63·09	507	56·27	958	42·10
	29	867	62·79	489	56·82	1070	42·32
Average, .	.	4268	62·70	3724	56·47	5619	42·03
April	5	762	63·18	317	56·84	678	41·34
	12	481	63·30	366	56·36	669	42·40
	19	479	63·54	422	56·49	524	41·83
	26	813	63·52	425	56·62	736	42·05
Average, .	.	2535	63·39	1530	56·58	2607	41·90
May	3	271	63·28	429	56·46	573	42·55
	10	802	63·10	270	56·31	591	41·49
	17	627	62·39	384	56·87	609	41·65
	24	952	63·22	165	55·88	488	42·34
	31	545	63·11	187	56·11	330	41·29
Average, .	.	3197	63·02	1435	56·33	2591	41·86
Average of 3d qr.,		10,000	63·03	6689	56·46	10,817	41·93
June	7	739	63·26	110	56·52	733	42·32
	14	783	63·43	160	56·39	485	42·44
	21	747	63·19	163	56·52	559	41·87
	28	500	63·91	167	55·83	854	42·39
Average, .	.	2769	63·45	600	56·31	2631	42·26
July	5	578	63·73	80	56·03	810	42·28
	12	547	63·36	148	56·10	398	42·54
	19	414	63·73	35	56·44	491	42·76
	26	752	63·62	74	56·36	494	42·71
Average, .	.	2291	63·61	337	56·23	2193	42·57
August	2	443	63·44	8	55·50	521	43·41
(9, no market)	16	613	63·42	68	56·28	613	42·49
	23	383	63·62	18	57·62	503	42·16
	30	678	63·25	103	56·66	492	42·65
Average, .	.	2117	63·43	197	56·52	2129	42·68
Average of 4th qr.,		7177	63·50	1134	56·35	6953	42·50
Average of 1870-71,		33,180	63·10	43,328	56·35	46,954	42·18

D

Fourth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1871. September 6	247	63·21	237	56·97	499	42·33
13	330	62·93	463	56·31	697	42·03
20	436	62·34	1107	55·71	1034	42·58
27	549	62·68	1543	55·65	1080	42·28
Average, . .	1562	62·79	3350	56·16	3310	42·31
October 4	751	62·97	1753	55·29	1191	42·28
11	384	62·66	1551	55·35	1159	40·90
18	603	62·63	1615	55·20	1200	41·91
25	401	62·60	1451	55·14	1257	41·69
Average, . .	2139	62·72	6370	55·25	4807	41·70
November 1	350	62·43	1652	55·36	699	41·78
8	546	62·04	1007	55·29	922	42·10
15	282	62·17	1675	55·58	1054	41·64
22	546	62·49	1269	55·87	1027	41·64
29	320	62·46	1815	55·72	760	41·87
Average, . .	2044	62·32	7418	55·56	4462	41·81
Average of 1st qr.,	5745	62·61	17,138	55·66	12,579	41·94
December 6	403	62·46	1397	55·77	1051	42·14
13	451	62·03	1658	55·65	1110	41·99
20	427	61·92	1896	55·67	1102	41·87
27	503	61·93	1355	55·95	1238	42·13
Average, . .	1784	62·09	6306	55·76	4501	42·03
1872. January 3	269	62·09	1506	55·69	927	42·23
10	539	62·11	1542	55·62	1552	41·73
17	468	62·30	1558	55·56	924	42·27
24	454	62·27	1149	55·44	1574	41·97
31	406	62·03	1000	55·79	1431	42·42
Average, . .	2136	62·16	6755	55·62	6408	42·12
February 7	437	61·95	1138	55·63	1475	41·86
14	533	62·27	1119	55·66	1019	41·89
21	774	62·54	940	55·57	1636	42·01
28	755	61·89	928	55·87	1209	41·97
Average, . .	2499	62·16	4125	55·68	5339	41·93
Average of 2d qr.,	6419	62·14	17,186	55·69	16,248	42·03

Fourth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1872. March 6	364	61·68	636	55·79	1254	42·07
13	411	62·08	919	55·94	999	42·06
20	366	62·21	641	55·91	945	41·98
27	785	62·40	447	56·51	764	41·85
Average, . .	1926	62·09	2643	56·04	3962	41·99
April 3	828	62·07	602	56·15	1063	42·35
10	430	61·93	233	55·68	960	41·92
17	445	61·88	554	55·69	468	42·26
24	372	62·53	285	55·99	703	42·03
Average, . .	2075	62·10	1674	55·88	3194	42·14
May 1	687	63·16	239	56·10	791	42·98
8	606	63·04	338	56·37	756	42·32
15	781	62·91	250	56·14	744	42·58
22	746	62·80	215	55·85	944	42·06
29	583	62·63	271	56·55	426	42·39
Average, . .	3403	62·91	1313	56·20	3661	42·47
Average of 3d qr.,	7404	62·37	5630	56·37	10,817	42·20
June 5	484	62·88	154	55·65	559	42·86
12	435	63·24	125	56·16	486	42·26
19	259	63·08	11	55·75	504	42·26
26	503	62·76	56	55·87	536	42·37
Average, . .	1681	62·99	346	55·86	2085	42·44
July 3	340	63·32	39	55·25	495	42·55
10	397	63·17	10	54·08	552	42·26
17	351	63·01	2	57·87	453	42·15
24	574	62·95	27	55·94	442	42·49
31	840	62·77	8	53·25	700	42·30
Average, . .	2502	63·04	86	55·28	2642	42·35
August 7	567	62·80	13	55·12	487	42·79
14	1006	62·99	3	55·08	708	43·14
21	379	62·70	11	55·41	389	42·66
28	566	62·60	44	55·00	451	42·26
Average, . .	2518	62·77	71	55·15	2035	42·71
Average of 4th qr.,	6701	62·93	503	55·43	6762	42·50
Average of 1871-72,	26,269	62·51	40,457	55·79	46,406	42·17

Fifth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1872. September 4	486	62·71	37	55·56	810	42·55
11	489	62·39	41	55·16	451	42·10
18	234	62·40	45	55·62	484	41·49
25	234	61·85	384	52·97	734	41·46
Average, . .	1443	62·34	507	54·83	2479	41·90
October 2	190	60·94	1144	52·39	586	40·90
9	139	60·50	1048	52·07	1051	40·72
16	222	59·34	1116	52·24	807	40·60
23	214	60·76	1072	51·38	830	40·63
30	138	60·78	1017	52·41	710	40·80
Average, . .	903	60·46	5397	52·10	3984	40·73
November 6	93	60·19	1067	51·53	931	40·54
13	194	60·37	778	52·04	1101	40·35
20	210	59·52	1307	51·71	1221	40·50
27	247	60·07	1207	52·15	1095	40·74
Average, . .	744	60·04	4359	51·86	4348	40·53
Average of 1st qr.,	3090	60·95	10,263	52·93	10,811	41·05
December 4	141	60·28	876	52·18	1269	40·15
11	320	59·73	832	52·01	1387	40·49
18	214	59·48	879	51·87	1239	40·52
25	171	59·23	763	51·65	1454	40·39
Tuesday 31	155	58·64	915	52·20	869	40·25
Average, . .	1001	59·47	4265	51·98	6218	40·36
1873. January 8	404	59·54	1153	51·79	1731	40·72
15	545	60·08	1188	51·69	1626	40·51
22	235	58·05	745	51·79	1738	40·39
29	498	59·43	920	51·38	1784	40·95
Average, . .	1682	59·28	4006	51·66	6879	40·64
February 5	709	58·76	826	52·15	1493	40·65
12	416	58·91	963	51·91	1876	41·11
19	493	59·57	771	52·18	1494	41·12
26	566	58·64	574	52·04	1668	41·07
Average, . .	2184	58·97	3134	52·07	6531	40·99
Average of 2d qr.,	4867	59·24	11,405	51·90	19,628	40·66

Fifth Year.		Wheat.		Barley.		Oats.	
		Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1873. March	5	185	59·60	650	52·39	1139	40·94
	12	240	60·00	636	52·48	1461	41·02
	19	309	59·82	395	52·61	1388	41·20
	26	238	59·13	656	52·73	850	41·08
Average, . .		972	59·64	2337	52·55	4838	41·06
April	2	167	60·15	213	52·60	784	40·77
	9	220	59·60	239	52·56	556	40·23
	16	124	59·65	275	52·21	636	41·37
	23	61	59·20	278	52·17	516	40·18
	30	137	60·93	289	53·02	464	41·36
Average, . .		709	59·91	1294	52·51	2956	40·78
May	7	325	60·39	236	52·58	293	41·33
	14	462	59·99	179	52·00	480	40·77
	21	696	59·27	226	52·13	329	40·95
	28	385	59·80	167	51·95	342	40·87
Average, . .		1868	59·86	808	52·17	1444	40·98
Average of 3d qr..		3549	59·80	4439	52·41	9238	40·61
June	4	501	60·01	130	52·71	347	40·52
	11	410	59·71	55	52·53	277	40·88
	18	498	59·81	80	52·25	423	40·93
	25	422	59·74	75	52·66	631	41·33
Average, . .		1831	59·82	340	52·54	1678	40·92
July	2	154	59·90	83	52·30	374	41·41
	9	176	60·17	86	50·91	168	42·27
	16	178	60·30	27	54·50	348	41·60
	23	358	59·96	32	51·94	194	41·64
	30	374	60·07	96	51·25	261	40·71
Average, . .		1240	60·08	324	52·18	1345	41·53
August	6	697	60·41	168	50·00	252	41·57
	13	570	60·63	166	52·87	121	41·70
	20	1209	60·88	136	51·88	260	41·70
	27	938	60·80	61	53·75	272	42·05
Average, . .		3414	60·68	531	52·13	905	41·76
Average of 4th qr.,		6485	60·19	1195	52·28	3928	41·30
Average of 1872-73,		17,991	60·05	27,302	52·38	43,605	40·91

Sixth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1873. September 3	647	60·39	54	53·85	454	42·16
10	354	60·50	305	55·30	570	42·74
17	220	61·94	850	54·59	616	42·53
24	329	60·04	1144	54·69	833	42·69
Average, . .	1550	60·72	2353	54·61	2473	42·53
October 1	291	59·69	1419	54·77	791	42·26
8	518	60·22	1592	54·59	903	42·01
15	165	61·06	1784	54·57	992	42·08
22	415	61·19	1248	54·20	836	42·07
29	316	61·43	1461	54·53	1065	41·77
Average, . .	1705	60·72	7504	54·53	4587	42·04
November 5	400	61·84	1916	54·63	1176	41·47
12	303	61·14	1712	54·69	1090	41·98
19	510	60·94	2081	54·42	1109	41·75
26	393	61·11	1580	54·58	1168	42·21
Average, . .	1606	61·26	7289	54·58	4543	41·85
Average of 1st qr.,	4861	60·90	17,146	54·57	11,603	42·14
December 3	583	60·89	3119	55·08	1490	42·43
10	395	61·04	2967	54·50	1909	41·55
17	871	60·42	2438	54·21	1541	41·38
24	492	61·63	2433	54·64	1823	41·99
31	464	61·73	2692	54·58	1769	41·49
Average, . .	2805	61·14	13,649	54·60	8532	41·77
1874. January 7	345	61·29	2354	55·13	2144	41·05
14	575	61·57	2843	55·01	2047	41·47
21	595	61·48	2820	54·89	1884	41·19
28	442	61·25	2668	54·55	1889	41·90
Average, . .	1957	61·40	10,685	54·89	7964	41·40
February 4	439	61·63	1614	54·91	1781	41·93
11	496	60·99	1674	55·19	1646	41·16
18	472	61·16	2000	54·86	1253	41·94
25	165	62·58	1566	55·42	1669	41·96
Average, . .	1572	61·59	6854	55·10	6349	41·75
Average of 2d qr.,	6334	61·38	31,188	54·86	22,845	41·64

Sixth Year.		Wheat.		Barley.		Oats.	
		Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1874. March	4	396	61·17	1324	55·15	1794	42·00
	11	537	61·38	1241	55·35	2239	42·25
	18	468	61·90	1114	54·96	1789	42·04
	25	425	62·45	817	55·21	1452	42·03
Average, .	.	1826	61·73	4496	55·17	7274	42·08
April	1	509	61·56	1195	55·17	1073	41·91
	8	490	62·08	699	55·44	769	42·45
	15	498	61·61	571	54·92	808	42·28
	22	538	62·02	607	55·42	820	42·36
	29	1010	62·06	777	54·96	956	42·50
Average, .	.	3045	61·87	3849	55·18	4426	42·30
May	6	1103	62·40	428	55·21	875	42·39
	13	1072	62·38	330	54·51	960	43·12
	20	1630	62·48	266	54·69	1012	42·67
	27	1361	62·60	143	54·58	819	42·66
Average, .	.	5166	62·46	1167	54·75	3666	42·71
Average of 3d qr.,		10,037	62·02	9512	55·03	15,366	42·36
June	3	801	61·95	177	55·31	603	42·12
	10	743	62·46	57	54·75	877	42·45
	17	581	62·52	323	55·68	701	42·68
	24	832	62·66	54	56·00	622	42·82
Average, .	.	2957	62·40	611	55·44	2803	42·52
July	1	731	62·77	10	55·00	515	42·41
	8	598	62·62	31	52·87	664	42·92
	15	844	62·84	40	54·25	717	43·19
	22	712	62·74	37	54·31	570	42·76
	29	968	63·07	37	52·08	601	42·76
Average, .	.	3853	62·81	155	53·70	3067	42·81
August	5	915	63·37	43	53·17	680	43·20
	12	1317	63·15	99	54·15	660	43·30
	19	688	62·86	78	55·64	834	42·40
	26	251	62·50	604	56·23	1073	42·76
Average, .	.	3171	62·97	824	54·80	3247	42·92
Average of 4th qr.,		9981	62·73	1590	54·65	9117	42·75
Average of 1873-74,		31,213	61·76	59,436	54·78	58,931	42·22

Seventh Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1874. September 2	485	62·04	528	55·97	1351	42·26
9	684	62·21	2548	55·38	1265	42·56
16	755	62·23	2466	55·58	1287	42·29
23	618	62·29	3130	55·37	963	42·22
30	576	61·93	3023	55·05	1147	41·82
Average, . .	3118	62·14	11,695	55·47	6013	42·23
October 7	692	62·41	2388	55·11	1504	41·94
14	575	62·62	2484	55·63	1396	42·50
21	680	62·91	2454	55·56	1197	41·65
28	750	62·50	2861	55·75	1480	41·98
Average, . .	2697	62·61	10,187	55·51	5577	42·02
November 4	767	62·65	2485	55·73	1429	41·68
11	636	62·81	2855	55·87	1916	41·93
18	646	62·56	2766	55·73	1999	42·21
25	584	62·38	2995	55·77	1683	41·91
Average, . .	2633	62·60	11,101	55·78	7027	41·93
Average of 1st qr.,	8448	62·45	32,983	55·59	18,617	42·06
December 2	407	62·53	2841	55·88	1808	42·52
9	379	62·24	2430	55·73	1446	41·93
16	659	61·99	2811	55·86	1709	42·50
23	704	62·34	2544	55·71	1448	41·56
30	908	61·97	2339	55·90	1409	41·44
Average, . .	3057	62·21	12,965	55·82	7820	41·99
1875. January 6	619	62·59	2020	55·79	1454	41·96
13	791	62·08	2082	55·74	1768	41·85
20	534	62·17	2331	55·49	1901	41·45
27	878	61·62	2004	55·70	1421	41·54
Average, . .	2822	62·12	8437	55·68	6544	41·70
February 3	747	62·01	2501	55·75	1723	41·77
10	596	62·14	1702	55·52	1382	41·58
17	665	62·23	1332	55·74	1660	41·78
24	942	61·86	1595	55·94	1561	42·09
Average, . .	2950	62·06	7130	55·74	6326	41·82
Average of 2d qr.,	8829	62·13	28,532	55·75	20,690	41·84

Seventh Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1875. March 3	771	61·93	1685	55·99	2179	42·09
10	907	62·34	1516	55·90	2634	42·26
17	1133	62·04	1545	55·95	2122	42·44
24	999	62·38	1720	55·95	1579	42·40
31	607	62·67	786	55·51	972	42·60
Average, . .	4417	62·27	7252	55·86	9486	42·40
April 7	844	62·69	889	56·05	1119	42·22
14	640	62·51	835	56·28	1047	41·92
21	911	62·86	683	55·56	766	41·83
28	951	62·98	617	55·82	1559	42·16
Average, . .	3346	62·76	3024	55·93	4491	42·03
May 5	1325	63·07	413	56·08	884	42·31
12	1508	63·13	454	56·61	898	41·95
19	998	63·48	388	56·22	586	42·33
26	1476	62·90	341	55·85	714	42·51
Average, . .	5307	63·15	1596	56·19	3082	42·28
Average of 3d qr.,	13,070	62·73	11,872	55·99	17,059	42·24
June 2	1102	63·04	160	55·66	866	42·17
9	1669	63·00	240	55·79	800	41·86
16	1244	63·00	97	54·63	784	42·31
23	895	62·77	185	55·90	912	42·48
30	1220	63·01	198	56·55	755	42·48
Average, . .	6130	62·96	880	55·71	4117	42·26
July 7	758	62·72	90	55·40	639	42·69
14	1159	63·17	101	54·97	943	42·64
21	1416	62·65	27	54·12	651	42·83
28	1443	62·98	...	...	715	42·61
Average, . .	4776	62·88	218	54·83	2948	42·69
August 4	1221	63·02	21	57·50	589	42·53
11	1841	62·65	64	56·46	748	42·55
18	1039	62·72	183	55·83	540	42·33
25	815	63·05	347	56·93	1087	42·00
Average, . .	4916	62·86	615	56·68	2964	42·35
Average of 4th qr.,	15,822	62·90	1713	55·74	10,029	42·43
Average of 1874-75,	46,169	62·55	75,100	55·77	56,395	42·14

Eighth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1875. September 1	977	62·84	1240	56·15	1881	42·54
8	747	62·38	948	56·16	1064	42·64
15	420	61·82	2546	55·42	1079	42·13
22	351	62·03	1874	54·89	1157	41·77
29	529	62·10	2280	54·95	972	41·84
Average, . .	3024	62·23	8888	55·51	6153	42·18
October 6	813	61·80	3416	54·79	839	40·98
13	715	61·92	3508	55·05	1181	40·87
20	1151	62·36	1899	55·11	981	41·67
27	1113	62·13	2607	55·05	1344	41·49
Average, . .	3792	62·05	11 430	55·00	4345	41·25
November 3	890	61·80	3355	54·63	1385	41·71
10	435	61·91	2970	54·34	982	41·81
17	359	62·63	3628	55·11	1321	41·90
24	496	62·60	2483	55·14	1318	41·94
Average, . .	2180	62·24	12,436	54·81	5006	41·84
Average of 1st qr.,	8996	62·17	32,754	55·11	15,504	41·76
December 1	539	62·19	2303	55·31	1260	41·88
8	748	62·01	2767	55·04	1031	41·69
15	735	61·64	2363	55·11	1154	41·74
22	329	62·12	2396	54·75	968	42·06
29	216	61·33	1717	55·06	1204	41·69
Average, . .	2567	61·86	11,546	55·05	5617	41·81
1876. January 5	304	60·91	2141	54·75	1047	41·85
12	590	61·25	3155	55·08	1306	41·72
19	528	60·99	2935	54·98	915	41·70
26	805	61·62	1820	55·31	1286	42·27
Average, . .	2227	61·19	10,051	55·03	4554	41·89
February 2	421	61·54	2036	55·04	923	41·67
9	534	61·38	1983	55·10	1284	41·52
16	437	61·33	2665	55·39	1244	41·67
23	726	61·11	1369	55·28	1358	41·83
Average, . .	2118	61·34	8053	55·20	4809	41·67
Average of 2d qr.,	6912	61·46	29,650	55·09	14,980	41·79

Eighth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1876. March 1	211	61·64	1389	55·58	1320	42·00
8	646	61·46	1876	55·51	1426	41·81
15	658	61·20	1919	55·57	1617	42·35
22	758	61·99	1814	55·27	1527	42·35
29	230	61·69	952	55·23	1113	42·09
Average, . .	2503	61·60	7950	55·43	7003	42·12
April 5	364	61·67	1096	55·66	998	41·92
12	390	62·41	873	55·62	767	42·05
19	436	62·01	797	55·14	678	41·78
26	531	62·59	620	55·46	535	41·57
Average, . .	1721	62·17	3386	55·47	2978	41·83
May 3	841	62·65	460	55·48	592	41·83
10	800	62·38	554	55·13	509	41·96
17	1045	62·12	308	54·89	447	41·00
24	1020	62·28	390	54·48	488	41·86
31	757	62·29	412	55·27	747	41·74
Average, . .	4463	62·34	2124	55·05	2783	41·68
Average of 3d qr.,	8687	62·04	13,460	55·32	12,764	41·88
June 7	672	62·53	330	55·65	457	40·85
14	1244	62·87	142	55·04	621	42·12
21	1187	62·60	183	53·94	480	41·67
28	653	62·77	129	53·12	318	41·51
Average, . .	3756	62·69	784	54·44	1876	41·54
July 5	289	63·05	227	54·46	593	42·05
12	358	63·12	190	54·53	256	41·79
19	410	62·75	85	55·40	389	41·30
26	706	63·21	151	54·86	778	42·12
Average, . .	1763	63·03	653	54·81	2016	41·82
August 2	1158	62·97	111	54·54	405	41·89
9	886	62·95	118	55·11	412	41·74
16	1090	62·41	144	56·06	525	41·93
23	510	61·55	156	55·86	947	42·50
30	715	61·85	547	55·89	704	43·01
Average, . .	4359	62·35	1076	55·49	2993	42·21
Average of 4th qr.,	9878	62·69	2513	54·91	6885	41·86
Average of 1875-76,	34,473	62·09	78,377	55·11	50,133	41·82

Ninth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1876. September 6	356	63·12	295	55·14	581	42·77
13	465	62·51	1375	55·64	1227	42·41
20	389	62·01	1912	55·53	1303	42·76
27	701	62·07	1861	54·93	1135	42·39
Average, . .	1911	62·43	5443	55·31	4246	42·58
October 4	868	61·96	2164	55·20	1040	42·10
11	831	62·08	1972	54·95	976	42·46
18	1145	61·53	2276	55·02	664	41·80
25	633	61·99	2393	54·93	803	42·11
Average, . .	3477	61·89	8805	55·03	3483	42·12
November 1	790	62·31	2675	54·81	1001	42·29
8	606	62·30	2604	55·10	1407	41·92
15	449	62·03	2689	55·22	1406	41·61
22	453	61·56	3108	55·27	1711	41·64
29	491	61·81	2761	55·37	1188	41·64
Average, . .	2789	62·00	13,837	55·15	6713	41·82
Average of 1st qr.,	8177	62·11	28,185	55·16	14.442	42·17
December 6	577	61·51	2589	55·14	1523	41·31
13	586	61·06	2343	55·09	1283	42·06
20	382	61·65	2842	55·44	1136	41·96
27	402	61·21	2470	55·16	1522	42·06
Average, . .	1947	61·36	10,244	55·21	5464	41·85
1877. January 3	273	60·73	2861	55·19	1169	41·46
10	625	61·25	2903	55·28	1562	41·89
17	566	61·39	3064	55·08	1933	41·87
24	679	60·99	2642	55·34	1611	41·94
31	792	60·88	2286	55·39	1720	42·24
Average, . .	2935	61·05	13,756	55·26	7995	41·88
February 7	696	60·45	3092	54·72	1557	42·28
14	767	60·91	2196	55·37	1272	41·78
21	707	60·81	2814	55·37	2171	42·11
28	675	61·50	1971	55·45	1462	41·73
Average, . .	2845	60·92	10,073	55·23	6462	41·98
Average of 2d qr.,	7727	61·11	34,073	55·23	19,921	41·90

Ninth Year.		Wheat.		Barley.		Oats.	
		Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1877. March	7	708	61·88	1774	55·44	2072	42·13
	14	584	62·25	1954	55·11	2100	42·55
	21	447	62·22	1441	55·11	1279	42·17
	28	557	61·70	999	55·53	1716	42·52
Average, . .		2296	62·01	6168	55·30	7167	42·34
April	4	557	61·17	1238	54·96	910	42·52
	11	832	62·06	1060	54·77	1135	42·49
	18	634	61·96	1214	54·83	1071	41·69
	25	776	62·64	1051	55·09	1166	42·30
Average, . .		2799	61·96	4563	54·91	4282	42·25
May	2	987	62·31	623	54·49	1673	42·55
	9	1344	62·45	733	54·79	1426	42·16
	16	1015	62·80	589	54·96	1033	42·04
	23	811	62·04	366	54·71	662	41·96
	30	655	61·91	245	53·63	894	42·45
Average, . .		4812	62·30	2556	54·52	5688	42·23
Average of 3d qr.,		9907	62·09	13,287	54·91	17,137	42·27
June	6	889	62·58	288	54·48	740	42·41
	13	990	62·74	194	54·31	981	42·25
	20	509	62·25	365	54·09	617	42·09
	27	696	62·46	128	53·60	611	41·65
Average, . .		3084	62·51	975	54·12	2949	42·10
July	4	575	62·47	34	54·66	606	42·57
	11	1073	62·77	221	54·37	844	42·24
	18	894	63·09	99	53·75	730	42·38
	25	1038	62·68	41	54·30	1011	42·26
Average, . .		3580	62·75	395	54·27	3191	42·36
August	1	684	62·10	114	54·68	1131	42·12
	8	983	62·65	110	53·55	849	42·49
	15	795	62·77	126	53·11	1172	42·39
	22	615	62·61	58	52·50	1037	42·31
	29	1045	62·24	137	53·65	996	42·38
Average, . .		4122	62·47	545	53·50	5185	42·42
Average of 4th qr.,		10,786	62·58	1915	53·96	11,325	42·29
Average of 1876-77,		36,597	61·97	77,460	54·82	62,825	42·16

Tenth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1877. September 5	617	62·11	74	54·37	1149	42·45
12	964	62·13	113	53·71	959	42·30
19	982	61·76	242	53·83	1617	41·83
26	484	62·14	1040	52·91	1448	41·75
Average, . .	3047	62·04	1469	53·71	5173	42·08
October 3	296	61·91	1532	53·51	1197	41·28
10	415	60·90	1946	52·60	1146	41·38
17	274	61·40	1621	52·57	677	41·90
24	497	61·19	1135	52·13	1112	41·14
31	400	61·24	1640	51·46	1165	41·50
Average, . .	1882	61·33	7874	52·45	5297	41·44
November 7	340	61·29	1526	51·63	1145	41·37
14	235	61·12	1378	51·77	1243	41·54
21	193	61·61	2106	52·05	1304	41·16
28	180	60·99	1835	52·04	973	41·52
Average, . .	948	61·25	6845	51·87	4665	41·40
Average of 1st qr.,	5877	61·54	16,188	52·68	15,135	41·64
December 5	262	60·57	1481	52·00	1404	41·18
12	161	60·31	1768	52·23	1179	41·40
19	150	60·35	1694	52·46	1359	41·25
26	152	60·66	1241	51·84	1154	41·66
Average, . .	725	60·47	6184	52·13	5096	41·37
1878. January 2	165	60·62	1407	52·15	1284	41·22
9	133	60·00	1967	52·82	1111	41·28
16	146	60·42	2177	52·50	1304	41·00
23	91	59·61	1938	52·09	1056	41·29
30	207	60·25	1827	52·30	1842	41·08
Average, . .	747	60·18	9316	52·37	6597	41·17
February 6	231	59·21	1613	52·42	1660	41·58
13	44	60·16	1404	52·25	1772	41·82
20	150	58·09	2036	52·71	1543	41·15
27	326	59·62	1942	52·32	1646	41·62
Average, . .	751	59·27	6995	52·43	6621	41·54
Average of 2d qr.,	2218	59·97	22,495	52·31	18,314	41·36

Tenth Year.			Wheat.		Barley.		Oats.	
			Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1878.	March	6	100	60·18	1105	52·15	1985	41·43
		13	153	60·06	1276	52·34	1915	42·41
		20	204	60·95	971	53·01	1641	41·24
		27	241	60·19	1000	52·23	1253	41·45
	Average, . .		698	60·35	4352	52·43	6794	41·63
	April	3	240	60·25	711	53·15	1342	41·42
		10	272	60·69	846	52·59	1055	41·37
		17	152	60·72	760	53·22	905	41·32
		24	155	61·13	442	53·17	764	41·79
	Average, . .		819	60·70	2759	53·03	4066	41·48
	May	1	612	60·91	521	52·70	930	41·68
		8	626	60·77	605	52·66	860	41·25
		15	611	60·72	503	53·30	1014	42·02
		22	601	61·16	400	53·00	832	41·87
		29	707	61·60	428	53·11	326	42·07
	Average, . .		3157	61·03	2457	52·95	3962	41·78
Average of 3d qr.,			4674	60·69	9568	52·80	14,822	41·63
	June	5	247	61·75	257	53·55	647	42·16
		12	374	61·12	161	52·77	779	41·66
		19	330	60·73	316	53·20	861	41·79
		26	228	61·82	146	53·78	877	41·51
	Average, . .		1179	61·36	880	53·33	3164	41·78
	July	3	235	60·64	93	52·45	777	42·16
		10	343	60·93	45	52·69	679	42·35
		17	733	61·43	78	51·87	495	42·25
		24	1077	61·30	231	54·16	630	41·41
		31	959	62·05	232	53·43	669	42·17
	Average, . .		3347	61·27	679	52·92	3250	42·07
	August	7	1823	61·52	292	53·72	744	42·16
		14	1256	61·62	189	52·14	915	42·40
		21	1592	61·17	139	53·53	450	42·25
		28	1027	61·46	338	53·30	641	42·24
	Average, . .		5698	61·44	958	53·17	2750	42·26
Average of 4th qr.,			10,224	61·36	2517	53·14	9164	42·04
Average of 1877-78,			22,993	60·89	50,768	52·73	57,435	41·67

Eleventh Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1878. September 4	891	61·25	504	54·18	1030	42·42
11	470	61·71	1249	55·26	814	43·10
18	534	61·55	1949	55·13	1080	43·13
25	317	61·23	2395	55·16	1877	42·86
Average, . .	2212	61·44	6097	54·93	4801	42·88
October 2	194	62·25	2657	55·32	791	42·98
9	386	61·62	2257	55·00	921	42·75
16	531	62·02	1856	54·89	524	43·20
23	381	61·74	2368	55·30	774	42·45
30	654	62·26	2530	55·38	848	43·15
Average, . .	2146	61·98	11,668	55·18	3858	42·91
November 6	968	62·07	2957	55·61	804	42·58
13	705	61·82	2833	55·49	1187	42·89
20	538	61·98	2638	55·56	1495	43·03
27	487	61·33	2171	55·44	1058	42·56
Average, . .	2698	61·80	10,599	55·53	4544	42·77
Average of 1st qr.,	7056	61·74	28,364	55·21	13,203	42·85
December 4	339	61·68	3139	55·70	1230	42·64
11	316	61·69	2566	55·69	636	43·66
18	629	61·45	2401	55·78	1217	43·39
Tuesday 24	676	61·73	1337	55·65	474	43·05
Tuesday 31	364	62·34	1743	55·48	777	42·82
Average, . .	2324	61·78	11,186	55·66	4334	43·11
1879. January 8	898	61·89	2282	55·47	1072	43·57
15	716	61·46	2051	55·30	1842	41·99
22	982	62·12	1658	55·24	1202	42·91
29	1148	61·39	1901	55·19	1640	43·11
Average, . .	3744	61·72	7892	55·30	5756	42·90
February 5	882	61·85	1578	55·34	1477	42·70
12	1181	61·29	1216	55·16	1255	42·80
19	848	61·36	1211	55·07	1213	43·48
26	1079	61·67	2109	55·30	1899	43·21
Average, . .	3990	61·54	6114	55·22	5844	43·05
Average of 2d qr.,	10,058	61·68	25,192	55·39	15,934	43·02

Eleventh Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1879. March 5	314	60·92	1202	55·07	1757	43·49
12	723	61·15	894	55·75	1365	43·33
19	481	61·61	1514	55·67	1940	43·16
26	441	62·35	1054	55·50	1578	42·86
Average, . .	1959	61·51	4664	55·50	6640	43·21
April 2	327	61·89	690	55·29	1173	43·17
9	566	62·37	507	55·21	1074	43·25
16	552	62·23	199	56·19	1075	43·76
23	536	62·28	294	55·80	1145	43·64
30	564	62·36	309	55·79	386	43·69
Average, . .	2545	62·23	1999	55·66	4853	43·50
May 7	743	62·18	277	55·45	696	43·13
14	1545	62·23	247	55·26	1189	43·58
21	1265	62·38	246	55·02	706	43·55
28	875	62·58	86	54·96	492	43·77
Average, . .	4428	62·34	856	55·17	3083	43·51
Average of 3d qr.,	8932	62·03	7519	55·44	14,576	43·41
June 4	1049	62·24	145	54·64	746	43·57
11	1516	62·08	76	55·39	889	43·55
18	917	61·84	121	55·11	713	43·12
25	1173	61·78	86	55·41	639	43·89
Average, . .	4655	61·99	428	55·14	2987	43·53
July 2	762	61·95	108	55·42	650	43·17
9	806	62·28	72	54·45	634	43·55
16	386	61·75	126	55·05	687	43·39
23	956	61·93	93	52·70	632	43·63
30	279	61·79	...	...	342	42·71
Average, . .	3189	61·94	399	54·41	2945	43·29
August 6	597	62·11	35	55·00	901	43·49
13	489	62·04	30	54·17	713	43·01
20	863	61·91	45	56·25	708	43·54
27	762	62·13	12	53·25	395	42·71
Average, . .	2711	62·05	122	54·67	2717	43·19
Average of 4th qr.,	10,555	61·99	949	54·74	8649	43·34
Average of 1878-79,	36,601	61·86	62,024	55·20	52,362	43·16

Twelfth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1879. September 3	450	61·60	13	57·75	509	42·73
10	643	61·83	30	54·25	911	43·84
17	406	61·90	n 76	53·69	340	43·73
24	o 720	62·06	n 638	53·85	1092	42·93
Average, . .	2219	61·85	757	54·88	2852	43·31
October 1	o 307	62·62	n2162	53·92	1684	43·24
8	o 654	62·22	1616	53·70	1226	43·08
15	o 615	62·25	1842	53·56	1189	42·60
22	on519	61·25	1823	53·49	946	42·33
29	on291	61·29	1062	52·91	1506	42·29
Average, . .	2386	61·93	8505	53·52	6551	42·71
November 5	624	59·94	1890	53·10	1182	42·04
12	266	60·40	1625	53·90	1261	42·42
19	271	60·52	1854	52·89	1318	42·30
26	235	60·04	1594	53·29	1424	41·48
Average, . .	1396	60·23	6963	53·29	5185	42·06
Average of 1st qr.,	6001	61·34	16,225	53·90	14,588	42·69
December 3	428	59·44	2823	53·34	1381	42·15
10	212	59·98	2430	53·37	1384	41·51
17	421	59·74	2274	53·32	1434	41·00
24	427	58·74	2041	53·85	1811	41·66
31	165	59·65	1319	53·11	1321	42·14
Average, . .	1653	59·51	10,887	53·40	7331	41·69
1880. January 7	189	60·94	1987	53·25	1043	41·38
14	437	60·64	1819	53·25	1709	41·63
21	557	59·14	1485	54·00	1765	41·61
28	288	60·30	2138	53·50	1434	41·81
Average, . .	1471	60·26	7429	53·50	5951	41·61
February 4	317	59·17	1141	53·11	1848	41·64
11	519	59·78	1887	53·83	1305	41·58
18	621	59·00	771	53·88	1381	42·16
25	503	59·20	844	53·49	1909	42·45
Average, . .	1960	59·29	4643	53·58	6443	41·96
Average of 2d qr.,	5084	59·69	22,959	53·49	19,725	41·75

Twelfth Year.	Wheat.		Barley		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1880. March 3	353	58·10	906	54·03	1043	42·07
10	260	58·86	942	53·84	1641	42·41
17	415	59·43	1114	54·13	2261	42·40
24	206	61·04	795	53·67	1394	42·42
31	203	59·33	971	54·08	1305	42·16
Average, .	1437	59·35	4728	53·95	7644	42·29
April 7	166	59·36	928	53·99	854	42·65
14	193	60·00	689	53·37	698	41·92
21	569	60·89	798	53·25	910	42·03
28	680	61·20	449	53·57	1052	42·16
Average, .	1608	60·36	2864	53·55	3514	42·19
May 5	591	61·31	413	53·19	684	41·43
12	1096	61·35	463	53·34	733	42·84
19	1006	60·71	346	53·08	547	41·95
26	616	61·14	138	53·62	773	43·35
Average, .	3309	61·13	1360	53·31	2737	42·39
Average of 3d qr.,	6354	60·28	8952	53·60	13,895	42·29
June 2	650	60·87	184	51·78	1221	42·19
9	653	61·17	286	53·50	786	42·63
16	600	61·90	181	53·36	1226	42·78
23	1021	61·15	172	53·97	875	42·69
30	463	61·53	329	53·21	585	42·78
Average, .	3387	61·32	1152	53·16	4693	42·61
July 7	513	61·44	180	50·64	457	42·32
14	848	62·09	189	52·43	541	42·42
21	482	61·55	210	50·87	746	42·95
28	529	61·54	152	51·61	922	42·89
Average, .	2372	61·66	731	51·39	2666	42·65
August 4	275	61·52	287	52·87	731	42·40
11	678	62·11	207	51·78	630	42·17
18	624	61·19	95	49·75	526	42·99
25	228	61·50	111	52·11	699	42·22
Average, .	1805	61·58	700	51·63	2586	42·45
Average of 4th qr.,	7564	61·52	2583	52·06	9945	42·57
Average of 1879-80,	25,003	60·71	50,719	53·26	58,153	42·33

Thirteenth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1880. September 1	304	61·25	632	54·98	1821	42·73
8	o 254	59·67	1121	56·51	1623	42·93
15	on 367	62·84	1543	56·24	971	43·15
22	on 442	61·43	1367	56·09	1098	42·81
29	on 743	61·82	1863	55·62	1191	42·77
Average, . .	2110	61·40	6526	55·89	6704	42·88
October 6	on 791	62·17	2494	55·46	1505	42·99
13	on 866	62·53	1966	55·58	1264	43·07
20	on 663	62·98	3031	55·72	1176	42·82
27	on 1050	62·47	3174	55·57	1481	43·12
Average, . .	3370	62·54	10,665	55·58	5426	43·00
November 3	1062	62·73	3028	55·71	1744	42·83
10	798	62·82	2874	55·22	1754	42·89
17	827	62·16	2519	55·86	1730	43·07
24	562	62·22	2804	55·63	2232	42·54
Average, . .	3249	62·48	11,225	55·61	7460	42·83
Average of 1st qr.,	8729	62·21	28,416	55·69	19,590	42·90
December 1	322	62·50	2016	55·83	1331	42·88
8	350	62·75	2441	55·56	1806	42·70
15	322	62·19	1772	55·61	1817	42·62
22	384	62·74	2296	55·63	1367	43·33
29	581	62·64	2223	55·83	1570	43·09
Average, . .	1959	62·56	10,748	55·69	7891	42·92
1881. January 5	542	62·68	1965	55·89	1245	43·05
12	480	61·63	2699	55·72	1872	42·89
19	622	63·18	2006	55·88	1652	42·94
26	1067	62·85	1967	55·56	1566	43·38
Average, . .	2711	62·59	8637	55·76	6335	43·07
February 2	670	62·98	1832	55·53	2411	43·05
9	903	62·67	1771	55·97	2571	42·67
16	915	62·27	2092	55·75	2023	42·83
23	589	62·13	1650	56·01	1808	43·29
Average, . .	3077	62·51	7345	55·82	8813	42·96
Average of 2d qr.,	7747	62·55	26,730	55·76	23,039	42·98

Thirteenth Year.	Wheat.		Barley.		Oats.	
	Qrs.	Wt.	Qrs.	Wt.	Qrs.	Wt.
1881. March 2	446	62·48	1214	56·35	1760	43·12
9	560	62·31	1244	55·68	1640	43·29
16	329	62·33	482	55·92	2154	43·20
23	334	62·27	817	55·51	1894	42·99
30	323	62·40	487	55·77	1394	42·83
Average, . .	1992	62·36	4244	55·85	8842	43·09
April 6	207	61·48	387	56·18	1246	42·90
· 13	168	62·78	558	55·26	1082	42·94
20	248	63·94	237	55·69	1307	42·43
27	529	63·46	308	55·81	1157	42·81
Average, . .	1152	62·92	1490	55·74	4792	42·77
May 4	729	63·25	194	56·13	1421	43·10
11	1173	63·25	163	55·69	729	43·09
18	1130	63·46	175	55·41	595	43·19
25	630	63·26	113	54·46	1099	43·23
Average, . .	3662	63·31	645	55·42	3844	43·15
Average of 3d qr.,	6806	62·90	6379	55·67	17,478	43·00
June 1	674	63·52	16	56·25	567	42·40
8	1025	63·54	118	56·62	630	43·31
15	729	64·34	43	55·75	439	43·14
22	1279	63·83	71	55·20	852	43·72
29	1089	63·84	00	00·00	644	42·99
Average, . .	4796	63·81	248	55·96	3132	43·11
July 6	663	63·45	84	54·20	743	42·94
13	451	63·42	77	54·94	652	42·59
20	383	63·57	83	54·38	681	42·44
27	483	62·88	8	55·00	856	42·52
Average, . .	1980	63·33	252	54·63	2932	42·62
August 3	681	63·73	3	00·00	951	42·48
10	534	63·70	38	55·37	1209	42·83
17	601	63·31	41	52·00	1168	42·71
24	468	62·11	26	53·88	1271	42·99
31	161	62·34	00	00·00	1500	43·08
Average, . .	2445	63·04	108	53·75	6099	42·82
Average of 4th qr.,	9221	63·39	608	54·78	12,163	42·85
Average of 1880-81,	32,503	62·76	62,133	55·48	72,270	42·93

nd Yearly Average Weights from 1868-69 to 1880-81.

TER.		FOURTH QUARTER.					YEAR.			
ver-e of Qr.	No. of Qrs.	June.	July.	Aug.	Aver-age of Qr.	No. of Qrs.	Aver-age of Year.	Higher Limit.	Lower Limit.	No. of Qrs. in Year.
·34	6,100	56·99	56·89	56·06	56·65	1,123	56·35	59·5	48·7	26,498
·00	11,089	56·03	56·29	56·28	56·20	2,152	56·04	59·2	50·0	45,829
·46	6,689	56·31	56·23	56·52	56·35	1,134	56·35	59·1	51·0	43,328
·37	5,630	55·86	55·28	55·15	55·43	503	55·79	59·0	49·0	40,457
·41	4,439	52·54	52·18	52·13	52·28	1,195	52·38	55·7	46·0	27,302
·03	9,512	55·44	53·70	54·80	54·65	1,590	54·78	58·1	48·1	59,436
·99	11,872	55·71	54·83	56·68	55·74	1,713	55·77	58·0	49·6	75,100
·32	13,460	54·44	54·81	55·49	54·91	2,513	55·11	58·0	49·6	78,377
·91	13,287	54·12	54·27	53·50	53·96	1,915	54·82	57·9	50·7	77,460
·80	9,568	53·33	52·92	53·17	53·14	2,517	52·73	55·5	46·9	50,768
·44	7,519	55·14	54·41	54·67	54·74	949	55·20	57·4	50·6	62,024
·60	8,952	53·16	51·39	51·63	52·06	2,583	53·26	56·3	48·7	50,719
·67	6,379	55·96	54·63	53·75	54·78	608	55·48	58·4	51·0	62,133
·09	114,496	55·00	54·44	54·60	54·68	20,495	54·93	57·9	49·2	699,431

second and third quarters (December to May) for thirteen years, . . .	55·00
age limit of weight, ...	57·9
ge limit of weight, ...	49·2
ge between the limits, ...	8·7
erage rise of any year above average of thirteen years, . . .	1·42
erage fall of any year below average of thirteen years, . . .	2·55
ference between any two years, ...	3·97
verage quarter for thirteen years, ...	439·4
verage quarter for cycle of eleven years, ...	438·0
verage quarter in best year, ...	450·8
verage quarter in worst year, ...	419·0
verage quarter at higher limit, ...	463·2
verage quarter at lower limit, ...	393·6

TABLE II.—Abstract of Table I.—Showing Monthly, Qu

3. C

Year.	First Quarter.					Second Quarter.						
	Sept.	Oct.	Nov.	Average of Qr.	No. of Qrs.	Dec.	Jan.	Feb.	Average of Qr.	No. of Qrs.	March.	A
1868-69	..	..	42·34	42·34	5,352	42·08	41·90	42·05	42·01	19,071	42·05	42
1869-70	42·95	42·53	42·68	42·72	11,531	42·83	43·01	42·75	42·86	16,760	42·89	42
1870-71	42·40	42·21	42·36	42·32	14,238	42·13	42·08	41·74	41·98	14,946	42·03	41
1871-72	42·31	41·70	41·81	41·94	12,579	42·03	42·12	41·93	42·03	16,248	41·99	42
1872-73	41·90	40·73	40·53	41·05	10,811	40·36	40·64	40·99	40·66	19,628	41·06	40
1873-74	42·53	42·04	41·85	42·14	11,603	41·77	41·40	41·75	41·64	22,845	42·08	42
1874-75	42·23	42·02	41·93	42·06	18,617	41·99	41·70	41·82	41·84	20,690	42·40	42
1875-76	42·18	41·25	41·84	41·76	15,504	41·81	41·89	41·67	41·79	14,980	42·12	41
1876-77	42·58	42·12	41·82	42·17	14,442	41·85	41·88	41·98	41·90	19,921	42·34	42
1877-78	42·08	41·44	41·40	41·64	15,135	41·37	41·17	41·54	41·36	18,314	41·63	41
1878-79	42·88	42·91	42·77	42·85	13,203	43·11	42·90	43·05	43·02	15,934	43·21	43
1879-80	43·31	42·71	42·06	42·69	14,588	41·69	41·61	41·96	41·75	19,725	42·29	42
1880-81	42·88	43·00	42·83	42·90	19,590	42·92	43·07	42·96	42·98	23,039	43·09	42
1868-81	42·52	42·06	42·02	42·20	177,193	42·00	41·95	42·01	41·99	242,101	42·24	42

Number of Quarters weighed in thirteen years, 1st Quarter, 177,193. Average weight, 42·20
" " 2d Quarter, 242,101. " 41·99
" " 3d Quarter, 179,357. " 42·25
" " 4th Quarter, 112,869. " 42·46

Total number of Quarters weighed in thirteen years, . 711,520.
Average weight of Oats for thirteen years, 1868-69 to 1880-81, ... 42·22
Average weight of cycle of eleven years, 1869-70 to 1879-80, ... 42·15
Number of weighings used in finding average of thirteen years, (about) 18,000
Years of average weight (being less than ·1 from average), 1868, 1870, 1871, 1873, 1874, 1876.
Years of over-average weight, 1869, 1878, 1879, 1880.
Years of under-average weight, 1872, 1875, 1877.

…uarterly, and Yearly Average Weights from 1868-69 to 1880-81.

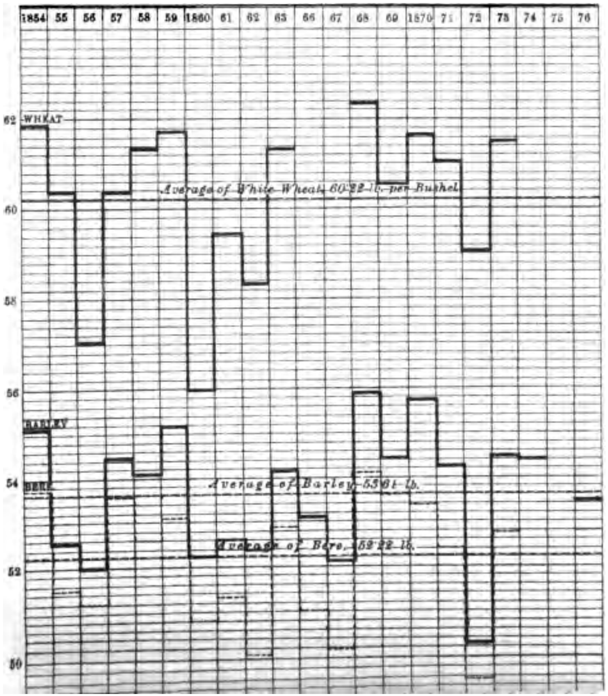
Oats.

Third Quarter.				Fourth Quarter.					Year.			
April.	May.	Average of Qr.	No. of Qrs.	June.	July.	Aug.	Average of Qr.	No. of Qrs.	Average of Year.	Higher Limit.	Lower Limit.	No. of Qrs. in Year.
…57	42·15	42·26	14,120	42·61	42·44	42·73	42·59	8,448	42·30	46·6	36·5	46,991
…99	43·26	43·05	11,268	43·03	42·99	42·95	42·99	9,501	42·91	47·2	37·2	49,060
…90	41·86	41·93	10,817	42·26	42·57	42·68	42·50	6,953	42·18	46·1	35·9	46,954
…74	42·47	42·20	10,817	42·44	42·35	42·71	42·50	6,762	42·17	46·1	35·7	46,406
…78	40·98	40·61	9,238	40·92	41·53	41·76	41·30	3,928	40·91	45·0	34·1	43,605
…30	42·71	42·36	15,366	42·52	42·81	42·92	42·75	9,117	42·22	45·5	35·6	58,931
…03	42·28	42·24	17,059	42·26	42·69	42·35	42·43	10,029	42·14	45·5	35·7	66,395
…83	41·68	41·88	12,764	41·54	41·82	42·21	41·86	6,885	41·82	45·5	37·0	50,133
…25	42·23	42·27	17,137	42·10	42·36	42·42	42·29	11,325	42·16	45·8	36·5	62,825
…48	41·78	41·63	14,822	41·78	42·07	42·26	42·04	9,164	41·67	44·9	36·0	57,435
…50	43·51	43·41	14,576	43·53	43·29	43·19	43·34	8,649	43·16	46·4	38·1	52,362
…19	42·39	42·29	13,895	42·61	42·65	42·45	42·57	9,945	42·33	45·6	35·7	58,153
…77	43·15	43·00	17,478	43·11	42·62	42·82	42·85	12,163	42·93	46·0	39·0	72,270
…21	42·34	42·25	179,357	42·36	42·48	42·57	42·46	112,869	42·22	45·9	36·4	711,520

Average of second, third, and fourth quarters (December to August) for thirteen years, 42·23
Higher average limit of weight, ... 45·9
Lower average limit of weight, ... 36·4
Average range between the limits, ... 9·5
Greatest average rise of any year above average of thirteen years, . . . 0·94
Greatest average fall of any year below average of thirteen years, . . . 1·31
Greatest difference between any two years, ... 2·25
Weight of average quarter for thirteen years, ... 337·76
Weight of average quarter for cycle of eleven years, ... 337·2
Weight of average quarter in best year, ... 345·28
Weight of average quarter in worst year, ... 327·2
Weight of average quarter at higher limit, ... 367·2
Weight of average quarter at lower limit, ... 291·2

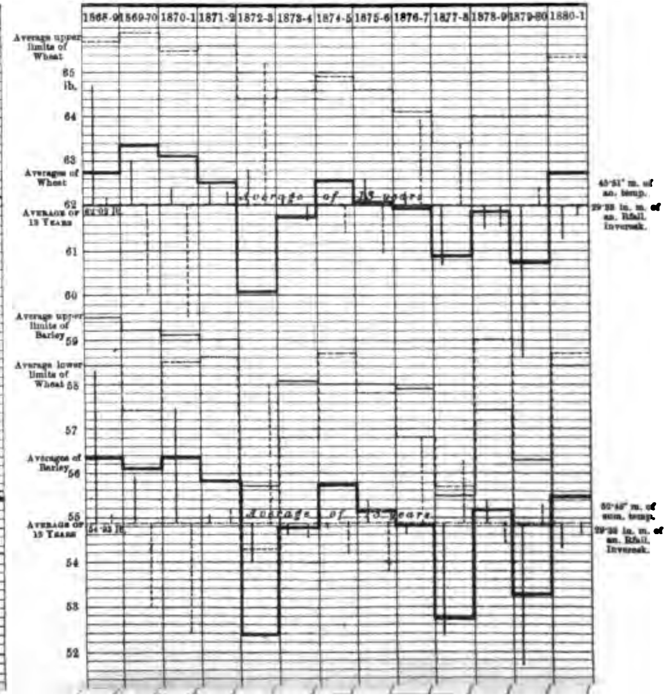
MEASUREWEIGHT OF WHEAT, BARLEY, BERE, & OATS

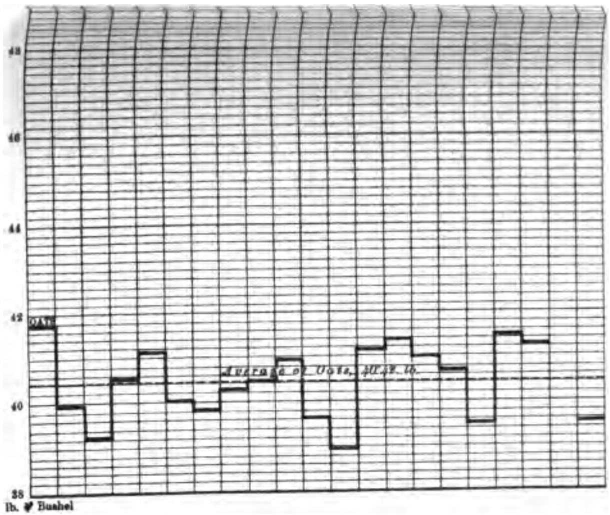
Diagram showing in relation to each other the average and yearly variation of weight in Wheat, Barley, Bere, and Oats for 20 years, deduced from the evidence given in the Aberdeen Fiars Court.

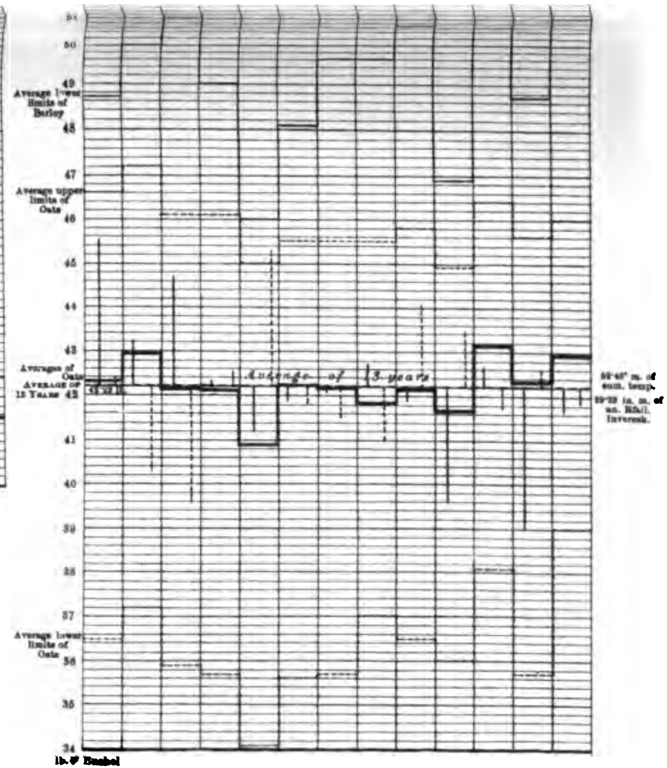


MEASUREWEIGHT OF WHEAT, BARLEY, & OATS

Diagram showing in relation to each other the yearly Measureweight of Wheat, Barley, and Oats from 1868 to 1880. Edinburgh Market.




OATS
Average of Oats, 40.42 lb.
lb. ♥ Bushel


Average lower limits of Barley
Average upper limits of Oats
Averages of Oats
AVERAGE OF 13 YEARS
Average of 13 years
Average lower limits of Oats
lb. ♥ Bushel

III.

Diagrams of Measure-weight of Wheat, Barley, and Oats.

A FEW words may be said in explanation of the diagram graphically representing the measure-weight of wheat, barley, and oats sold in the Edinburgh market from 1868 to 1881. Dotted lines run across the diagram at the proper height, to show the average weight of wheat, barley, and oats. Bold lines show the rise and fall of weight for the period represented. The faint horizontal lines represent pounds and 2-tenths of pounds of weight, from thirty-three pounds to sixty-six; and the faint vertical lines represent the thirteen years under notice. Dotted lines for wheat and oats, and thin lines for barley, show the average upper and lower limits of weight of the three grains. The rise and fall of the average weights form what may be regarded as the indications of a cereal thermometer.

In addition to these facts, I have endeavoured to place before the eye, in a comparative method, the temperature and the rainfall of the proper years. For this purpose I have selected the observations of Mr. M'Auslane, observer for the Scottish Meteorological Society at Inveresk, as being probably the most applicable to the districts trading at the Edinburgh market. The temperatures are shown by full vertical lines, and the rainfalls by vertical dotted lines. The lines of mean weight are taken as the mean temperature and mean rainfall for the thirteen years, and a full and dotted line for each year show how much above or below the mean the temperature and rainfall have been. For all the three grains the annual rainfall is taken, and for wheat the annual temperature; but for barley and oats the summer temperature is taken, from April to September. These facts may also be given in figures:—

MEAN ANNUAL TEMPERATURE from 1868 to 1880 = 45·51 deg. (Inveresk.)

	Above av.	Below av.
1868 . .	2·69 . .	...
1869 . .	0·89 . .	...
1870 . .	0·29 . .	...
1871 . .	0·29 . .	...

	Above av.	Below av.
1872 . .	0·79 . .	...
1873 . .	0·11 . .	...
1874 . .	0·08 . .	...
1875 . .	0·51 . .	...
1876 . .	0·22 . .	...
1877 . .	... . .	1·34
1878 . .	... . .	0·34
1879 . .	... . .	3·47
1880 . .	... . .	0·70

MEAN SUMMER TEMPERATURE (April—September) from 1868 to 1880 = 52·46 deg. (Inveresk.)

	Above av.	Below av.
1868 . .	3·34 . .	...
1869 . .	0·94 . .	...
1870 . .	2·54 . .	...
1871 . .	0·04 . .	...
1872 . .	... . .	0·86
1873 . .	... . .	0·26
1874 . .	... . .	0·06
1875 . .	0·47 . .	...
1876 . .	... . .	0·24
1877 . .	... . .	2·56
1878 . .	0·48 . .	...
1879 . .	... . .	3·24
1880 . .	... . .	0·55

MEAN ANNUAL RAINFALL from 1868 to 1880 = 29·33 inches. (Inveresk.)

	Above av.	Below av.
1868 . .	0·79 . .	...
1869 . .	... . .	9·65
1870 . .	... . .	12·83
1871 . .	1·09 . .	...
1872 . .	15·61 . .	...
1873 . .	... . .	1·25
1874 . .	... . .	3·06

	Above av.	Below av.
1875	...	5·54
1876	9·37	...
1877	6·33	...
1878	...	1·91
1879	1·73	...
1880	...	0·72

The diagram under notice is but a mere beginning, so that to draw any confident conclusions from it would be unwarrantable. It may be observed that although the temperature is furthest above the average in 1868, for the whole year and also for the summer, the measure-weight of wheat and oats is not highest, while the measure-weight of barley is highest, but is equalled by that of 1870. But the rainfall in 1868 is a little above the average. In 1869, when wheat is highest, the temperature is considerably above the average, and the rainfall much below the average. In 1870, when barley is as high as in 1868, there is a high temperature and a low rainfall; the same measure-weight in barley is brought about by an over-average summer temperature of 3·34 deg., and an over-average rainfall of 0·79 in., as by an over-average summer temperature of 2·54 deg., and an under-average rainfall of 12·83 in. This is a very remarkable fact in the production of plants; but how the combination of temperature and rainfall most efficient in the production of any plant or the fruit of any plant shall be formulated into the law which regulates the processes, cannot perhaps be yet seen. The year 1872 shows the lowest weight in all the three grains. The rainfall in that year is the highest above the average, while the summer heat is below the average,—although the annual heat is above the average; but probably the weight of wheat grain is not much influenced by the temperature of the winter months. If the low temperature of 1879 had been accompanied by a slightly higher rainfall, the weight would have been lowest in that year. But it is evident from the lines in 1872, that a high rainfall has a greater effect in reducing measure-weight than a low temperature.

It is evident at a glance that the measure-weight of oats is influenced in a less degree by variations of heat and rain than that of wheat or of barley. Probably a just inference from this is, that the climate where these grains have been produced is best suited to oats. Oats are more uniformly produced of average excellence than wheat and barley. The variations of measure-weight from year to year result partly from variations in development of kernel. If the season is such as to enable the utmost particle of starch to be deposited in the interior of the kernel the weight will be high. But there are many causes which influence measure-weight. For example, an oat of the Oviform class, such as the Canadian, will have a higher measure-weight than an oat of the Fusiform class, such as the Archangel, although the percentage of kernel in the Canadian is the lower. But such causes affecting measure-weight will be more intelligible after some other parts of our work have been considered.

One noticeable fact may strike the observer: the averages of wheat, barley, and oats are not midway between the upper and lower limits, but much nearer the upper limits. It might naturally be imagined that the average should be midway between the extremes, —and this would be the case if the quantities of grain of light weight were equal to the quantities of grain of heavy weight. But the quantities coming near the extreme of light weight are much smaller than the quantities near the heavier extreme; and an average always falls nearer the larger quantity.

Many of the foregoing remarks apply to the diagram for the grain of Aberdeenshire. In this are shown white wheat, barley, bere, and oats. The wheat average for sixteen years, is 60·22 lb., being 1·80 lb., lower than the Edinburgh average. The barley average for twenty years is 53·61 lb., being 1·32 lb. lower than the Edinburgh average. The bere or six-rowed barley of Aberdeenshire weighs 52·22 lb., or 1·39 lb. less than the barley or two-rowed grain. The two central rows of grain on a spike of bere are of the same form and size as the two rows on a spike of barley; but the grains of the four side rows have a slight twist upon them which increases the vacant space in the bushel and diminishes the weight. The average line of the oats for twenty years, in Aberdeenshire, runs at 40·42 lb., being 1·80 lb. below the Edinburgh line,—the same difference as in the wheat lines. With the light at present in my possession, I incline to think that the higher average weight of oats in Edinburgh is attributable rather to greater smoothness of husk than to superiority of quality; because the average percentage of kernel in ten Lothian samples of Potato oats is 76·51, and the average percentage of fifteen Aberdeen samples, 76·50; the 'quality' being thus the same in both localities. As in Edinburgh, so in Aberdeen, the yearly deviation in measure-weight, from an average of years, is less in oats than in wheat and barley; showing, as has already been said, that in the climate of Scotland an average crop of oats may be more safely calculated upon than of wheat or barley.

IV.

Measure-weight above and below Average Price in Edinburgh Corn Market.

A BUSHEL of corn is a very variable quantity. The measure-weight involves two important points in fixing the price. A high measure-weight implies a larger quantity than a low; and a high measure-weight implies, or is supposed to imply, a better quality than a low. It will be of use, therefore, to the agriculturist and corn merchant to know what is the average difference in weight between the corn sold above average price and the corn sold below average price. To obtain this information the following table has been calculated. The weights are all average weights; that is to say, the quantities of quarters sold are taken into account along with their respective weights. All the parcels of wheat, barley, and oats for each market-day sold above the average price are put to one side, and all sold below the average price to the other side, and the average weight of each side is then found by itself. The materials are from the Edinburgh market, and of the crop of 1868, including a slight part of that of 1869,—the sales being from November 1868 to October 1869. This mode of separation, at the average price, is of most importance to the corn-dealer. A separation at the average weight is of more interest to the agriculturist and to the agricultural botanist, and in another table, drawn from the Haddington Exchange, I have given the weights of four months separated both at average price and at average weight.

The chief facts brought out by this table in regard to wheat are, that the average bushel, above average price, weighs 1·11 lb. more than the average bushel below average price; so that the quarter above average price has not only the value of superior quality, but also the value of 8·88 lb. of greater quantity. In barley, the difference in weight between a bushel above average price and a bushel below average price is 1·67 lb., making the quarter above average price 13·36 lb. heavier than the quarter below. The bushel of oats above average price weighs 2·32 lb. more than the bushel below; so that the higher priced quarter has a larger quantity than the lower priced by 18·56 lb. The perpetual variation of the unit of exchange can be productive of nothing but confusion.

It will be noticed from the abstract that there are slight differences between the average weights and the mean of the weekly averages. But the greatest difference is only ·16 of a pound, or about 2½ ounces, and is therefore of no practical importance.

If measure-weight alone influenced the price, then a separation at average price and at average weight would give the same result; in both cases the over-average and under-average bushels would be the same. But colour and condition and age sometimes give a sample of low measure-weight a price above the average, so that in separating at average price a low weight sometimes finds its way in amongst the higher weights, and reduces their average a little; but, in general, the higher weights give the higher prices.

A Year's Sales of Wheat (Edinburgh Market) contrasting the Measure-weight above and below Average Price.

	Quarters above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters below Average Price.
1868. November 4	200	62·80	62·19	61·75	274
11	130	63·30	62·70	62·28	185
18	233	63·44	62·57	61·96	327
25	161	62·66	62·38	62·09	161
December 2	266	62·94	62·47	61·70	166
9	245	62·92	62·07	61·38	304
16	284	62·70	62·53	62·38	296
23	258	62·84	62·44	62·02	247
30	335	62·88	62·40	62·05	393
1869. January 6	270	62·73	62·24	61·87	350
13	324	62·15	61·79	61·34	264
20	242	62·39	61·80	61·40	377
27	420	62·70	62·00	61·19	438
February 3	315	62·79	62·22	61·60	291
10	489	62·76	62·30	61·78	435
17	466	63·05	62·41	61·73	424
24	422	63·17	62·67	62·23	473
Sums and Averages,	5060	62·83	62·29	61·79	5405
Means of wkly. Avgs.,	...	62·84	62·30	61·81	...

	Quarters above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters below Average Price.
1869. March 3	425	62·33	62·75	62·14	404
10	447	63·14	62·64	62·07	380
17	265	63·21	62·67	62·19	299
24	205	63·42	62·92	62·44	213
31	327	63·50	63·03	62·50	296
April 7	263	63·25	62·90	62·43	198
14	140	63·67	63·10	62·59	152
21	258	63·66	63·10	62·50	246
28	314	64·12	63·51	62·86	300
May 5	364	63·76	63·20	62·39	251
12	277	63·47	63·17	62·96	393
19	369	63·89	63·41	62·87	335
26	218	63·70	63·21	62·90	339
June 2	329	63·75	63·44	63·06	261
9	282	64·29	63·50	63·00	439
16	246	63·97	63·42	63·08	410
23	321	63·75	63·33	62·95	347
30	145	64·01	63·36	62·85	187
Sums and Averages,	5195	63·64	63·14	62·67	5450
Means of wkly. Avgs.	...	63·66	63·15	62·65	...
July 7	125	64·23	63·45	62·66	124
14	278	63·67	63·41	62·53	83
21	239	64·11	63·40	62·85	309
28	323	63·90	63·37	62·78	293
August 4	193	64·22	63·55	63·05	261
11	206	63·93	63·24	62·28	146
18	231	63·57	63·12	62·30	126
25	42	63·64	63·16	62·74	47
September 1	143	63·57	62·86	60·71	94
8	248	63·47	62·96	61·83	113
15	285	63·52	63·11	62·41	167
22	255	63·89	63·15	59·81	57
29	171	63·69	63·03	61·17	61
October 6	144	64·02	62·96	61·83	135
13	173	63·79	63·43	63·14	215
20	265	63·79	63·24	62·33	158
27	208	64·26	63·06	62·42	294
Sums and Averages,	3529	63·81	63·23	62·47	2683
Means of wkly. Avgs.	...	63·84	63·21	62·17	...
Year's Averages, etc.	13,784	63·39	62·84	62·28	13,538
Year's means of weekly Averages,	..	63·45	62·89	62·21	...

A YEAR'S SALES OF BARLEY (Edinburgh Market), contrasting the Measure-weight above and below Average Price.

	Quarters above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters below Average Price.
1868. November 4	560	56·58	55·85	55·13	562
11	440	56·85	55·84	55·29	807
18	832	57·58	56·64	55·34	603
25	683	57·53	56·52	55·28	560
December 2	706	57·23	56·57	55·71	544
9	714	56·82	56·20	55·36	537
16	798	56·96	56·32	55·32	505
23	890	56·97	56·16	54·88	566
30	755	56·85	56·14	55·22	581
1869. January 6	676	57·05	56·20	55·03	488
13	479	56·85	55·97	55·25	593
20	518	56·69	56·06	55·31	303
27	553	56·52	55·87	55·34	681
February 3	415	56·75	56·28	55·44	231
10	401	56·65	56·04	55·06	249
17	597	56·93	56·23	55·37	463
24	686	57·23	56·52	54·84	301
Sums and Averages,	10,703	56·98	56·21	55·25	8572
Means of wkly. Avgs.	...	56·94	56·20	55·25	...

	Quarters above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters below Average Price.
1869. March 3	469	56·96	56·08	55·18	457
10	377	57·30	56·24	55·16	373
17	547	57·00	56·56	55·94	391
24	153	57·09	56·36	54·78	71
31	228	57·14	56·47	55·88	256
April 7	240	56·86	56·32	55·43	211
14	344	56·81	56·56	55·73	104
21	161	57·85	57·20	55·99	86
28	279	57·35	56·82	55·90	161
May 5	302	56·98	56·19	55·13	223
12	167	57·29	56·61	55·65	118
19	68	57·58	55·96	55·26	158
26	91	56·86	56·00	54·79	65
June 2	97	57·47	56·11	54·09	66
9	81	57·52	56·59	54·14	31
16	39	57·77	57·29	56·85	43
23	36	57·78	57·53	54·58	3
30	16	58·00	57·44	57·00	23
Sums and Averages,	3695	57·16	56·41	55·45	2840
Means of wkly. Avgs.	...	57·31	56·57	55·42	...
July 7	26	57·61	56·49	55·90	49
14	24	56·96	56·60	56·00	15
21	6	58·75	57·80	57·52	21
28	21	57·45	56·67	56·48	85
August 4	56	56·18	56·00	55·61	25
11	53	56·57	55·49	53·65	31
18	67	56·96	56·76	56·32	30
25	120	56·32	55·99	55·31	59
September 1	274	56·76	56·47	55·68	99
8	330	57·36	56·86	56·33	317
15	397	57·21	56·23	55·15	362
22	284	56·97	55·78	54·83	356
29	817	56·77	56·09	55·18	622
October 6	723	56·30	55·71	55·11	704
13	604	56·24	55·29	54·51	734
20	589	56·68	56·01	55·41	657
27	631	56·66	55·86	55·18	754
Sums and Averages,	5022	56·69	55·95	55·20	4920
Means of wkly. Avgs.	...	56·93	56·24	55·54	...
Year's Sums and Avs.	19,420	56·94	56·18	55·27	16,332
Year's means of weekly Averages,	...	57·06	56·34	55·40	...

A YEAR'S SALES OF OATS (Edinburgh Market), contrasting the Measure-weight above and below Average Price.

	Quarters above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters below Average Price.
1868. November 4	702	43·98	42·47	41·13	789
11	778	43·54	42·35	41·05	721
18	642	43·80	42·36	41·00	685
25	549	43·55	42·19	40·65	486
December 2	645	43·81	42·25	41·03	831
9	736	43·39	42·10	40·88	688
16	555	43·76	42·12	40·87	730
23	759	43·34	41·92	40·68	874
30	546	43·32	42·03	41·00	680
1869. January 6	636	43·32	41·96	41·14	1068
13	754	43·46	41·97	40·82	979
20	678	43·19	41·63	40·47	920
27	719	43·44	42·03	40·91	978
February 3	514	43·75	42·30	41·31	752
10	599	43·46	41·85	40·34	644
17	667	43·12	41·87	40·87	830
24	533	43·64	42·18	41·14	756
Sums and Averages,	11,012	43·52	42·09	40·91	13,411
Means of wkly. Avgs.	...	43·52	42·09	40·90	...

	Quarters above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters below Average Price.
1869. March 3	505	42·96	41·95	41·13	622
10	680	43·29	41·62	40·49	914
17	597	42·99	41·99	41·15	715
24	651	43·17	42·07	41·17	779
31	619	43·31	42·47	41·34	461
April 7	535	43·21	42·02	40·69	481
14	597	43·83	42·71	41·36	486
21	531	44·04	42·78	41·61	570
28	646	43·75	42·76	41·48	499
May 5	505	43·14	42·48	41·70	429
12	486	43·46	42·21	41·28	659
19	264	43·26	41·98	40·74	272
26	295	43·03	41·92	40·90	322
June 2	293	43·65	42·48	41·10	249
9	430	43·21	42·18	41·02	376
16	559	43·86	42·80	41·48	453
23	407	44·07	42·88	42·02	563
30	373	43·38	42·73	42·07	362
Sums and Averages,	8973	43·43	42·31	41·23	9212
Means of wkly. Avgs.	...	43·42	42·33	41·26	...
July 7	350	43·46	42·45	41·56	398
14	577	42·88	42·19	40·32	210
21	312	43·43	42·24	41·20	361
28	364	43·57	42·87	41·86	253
August 4	276	43·27	42·73	42·11	241
11	95	43·89	42·42	41·67	188
18	148	43·85	43·07	42·01	108
25	309	43·42	42·72	41·61	193
September 1	253	44·96	44·04	43·05	234
8	374	44·71	43·72	42·81	406
15	241	43·47	42·33	41·55	354
22	469	43·26	42·37	41·41	435
29	454	43·06	42·29	41·58	495
October 6	313	43·41	42·72	42·48	492
13	368	43·51	42·54	41·64	398
20	440	43·79	42·35	40·85	419
27	335	43·44	42·50	41·65	372
Sums and Averages,	5678	43·54	42·63	41·69	5557
Means of wkly. Avgs.	...	43·61	42·68	41·73	...
Year's sums and Avs.	25,663	43·49	42·28	41·17	28,180
Year's means of weekly Averages,	...	43·52	42·37	41·30	...

ABSTRACT of YEAR'S SALES of WHEAT, BARLEY, and OATS (Edinburgh Market), contrasting the Average Measure-weight above and below Weekly Average Prices.

November 1868 to October 1869.	Quarters above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters below Average Price.
WHEAT. Sums and Averages,	13,784	63·39	62·84	62·28	13,538
Means of Weekly Averages, . . .	...	63·45	62·89	62·21	...
BARLEY. Sums and Averages,	19,420	56·94	56·18	55·27	16,332
Means of Weekly Averages, . . .	...	57·06	56·34	55·40	...
OATS. Sums and Averages,	25,663	43·49	42·28	41·17	28,180
Means of Weekly Averages, . . .	...	43·52	42·37	41·30	...

DIFFERENCE between the Average Weight above the Average Price, and the Average Weight below the Average Price, in Wheat, Barley, and Oats.

WHEAT, .	63·39 − 62·28 = 1·11	lb. difference.
BARLEY, .	56·94 − 55·27 = 1·67	,,
OATS, . .	43·49 − 41·17 = 2·32	,,

V.

Measure-weight of Grain in Haddington Corn Exchange.

THE following table embraces a year's sales of wheat, barley, and oats in the Haddington Corn Exchange, extending from 3d July 1868 to 25th June 1869, and thus representing the crops of 1867 and 1868. The materials are derived from the market books, and embrace the whole of the sales. The weights given are average weights; the quantity exchanged in each transaction in wheat, barley, and oats is multiplied by its weight, and the product divided by the number of quarters. The amount of labour involved in this method will be seen by any one who will verify any portion of my results. The number of sales for the twelve months here tabulated is 5251.

From the gross weight of the four-bushel bags in the Haddington reductions, 3 lb. are subtracted for weight of bags. In the

Crop of 1868.		Quarters sold above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters sold below Average Price.
1869. March	5	301	64·11	63·20	62·64	492
	12	304	64·08	63·59	63·12	314
	19	294	63·75	63·06	62·54	384
	26	181	63·93	63·64	63·27	146
April	2	209	63·86	63·54	63·33	325
	9	201	63·84	63·43	62·94	163
	16	222	64·14	63·66	63·32	313
	23	294	63·85	63·43	62·99	277
	30	229	64·54	63·81	63·06	224
May	7	355	64·32	63·70	62·87	265
	14	280	64·36	63·51	63·03	493
	21	395	64·12	63·64	62·69	209
	28	217	64·20	63·61	63·19	303
June	4	324	64·47	64·01	63·52	304
	11	355	64·25	63·68	62·81	234
	18	379	64·65	63·86	63·11	398
	25	245	64·18	63·55	62·67	176
Sums and Averages,		4785	64·18	63·57	62·98	5020
Means of Weekly Averages, . . .		...	64·16	63·58	63·00	...
Sums and Means of Weekly Averages from September 4, 1868, to June 25, 1869. (Crop of 1868.)		13,453	63·63	63·10	62·53	13,105

SALES OF BARLEY in Haddington Corn Exchange, showing Average Weight, and Average Weight above and below Average Price.

Crop of 1867.		Quarters sold above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters sold below Average Price.
1868. July	3	40	55·25	54·75	53·29	14
	10	60	58·25	56·92	54·63	35
	17	44	56·61	55·57	54·77	58
	24	21	56·64	55·38	54·90	55
	31	14	55·57	54·79	54·24	20
August	7	11	56·00	54·87	54·42	28
	14	1	54·00	54·40	54·44	9
	21	30	56·66	55·80	53·40	11
	28	117½	57·69	57·11	56·86	266½
Sums and Means of Weekly Averages, ...		338½	56·30	55·51	54·55	496½

	Quarters above Average Price.	Average Weight above Average Price.	Average Weight.	Average Weight below Average Price.	Quarters below Average Price.
OATS. Crop of 1867, . .	1181	44·24	43·43	42·29	916
To make bag 4 lb. instead of 3 lb. deduct, ...	...	·25	·25	·25	...
With bag taken at 4 lb.	...	43·99	43·18	42·04	...
Crop of 1868, . .	7544	44·18	43·45	42·65	6582
To make bag 4 lb. instead of 3 lb. deduct, ...	...	·25	·25	·25	...
With bag taken at 4 lb.	...	43·93	43·20	42·40	...

DIFFERENCE between the Average Weight above the Average Price and the Average Weight below the Average Price, in Wheat, Barley, and Oats.

WHEAT, .	63·53 − 62·28 = 1·25 lb.	difference.
BARLEY, .	56·64 − 55·04 = 1·60	,,
OATS, . .	43·96 − 42·22 = 1·74	,,

DIFFERENCE between the Average Weight above and below the Average Weight from November to February. (See details above.)

WHEAT, .	63·39 − 61·77 = 1·62 lb.	difference.
BARLEY, .	57·27 − 55·65 = 1·62	,,
OATS, . .	44·28 − 42·12 = 2·16	,,

VI.

Measure-weight of Grain in Aberdeenshire, with Remarks on Fiars.

THE materials from which the following table of the weight of grain in Aberdeenshire has been calculated are the sworn evidence of the witnesses attending the annual Fiars' Court. Each witness submits the number of quarters he has bought along with the average weight. If the average weights of these witnesses are a correct mean of all their transactions, the table would be trustworthy. But if their averages are derived from a narrower basis, the same implicit reliance cannot be placed upon the result; nevertheless, I am disposed to accept the weights given by the witnesses as fairly representative of the crops to which they refer. The table begins at the crop of 1854, and embraces twenty years,—giving the average weight of white and red wheat;

barley (two-rowed); bere (six-rowed barley); and oats.

For a few of the latter years the mean weight, from about twenty-five witnesses, is given; all the other years show average weights, the quantities in evidence being involved in the way before explained.

The weight of wheat is given from 1854 to 1873, the years 1864-67 being awanting. The highest weight in these sixteen years is in 1868; and the lowest in 1860. The mean weight for white wheat is 60·22 lb., and for red 59·44 lb.; the mean for both united being 59·83 lb.

The weights for two-rowed barley are given from 1854 to 1876, the years 1864, 1865, and 1875 being awanting. The average weight over these twenty years, and deduced from 289,000 quarters is 53·61 lb. to the bushel. The greatest weight occurs in the year 1868, when it reaches 55·82 lb. The weight in 1870 is almost as high. The weight in 1872 falls to the lowest point, namely 50·23 lb.

Bere is one of the varieties of *Hordeum*, having six rows of florets and grains, arranged in the thin-set manner. Another *hexastichum*, known in Aberdeenshire as Packmanrich, differs from bere only in having the ear thick-set; both varieties have about the same number of grains. It is the thin-set variety which is chiefly cultivated, and the weight of whose grain is given in the table. Two qualities of bere are struck in Aberdeen; and so in the table, along with the average weight of the whole, are given the average weight of first quality, and the average weight of second quality. The striking of two or three qualities of one grain involves various absurdities. In some counties the qualities are separated by difference of price, and in others by difference of measure-weight. Both methods are faulty; because the best oats, for example, may sell in November below the average price; and if the market is rising, the worst may sell in February above the average price. So that if qualities are separated by price, the best quality may be ranked below the worst; and if the qualities are separated by weight, the purpose of having all the highest priced grain in the first fiar will be frustrated,—the highest weights must be put in the first quality, whether they sold for the highest price or not. It has sometimes happened in Aberdeen and in other counties that the fiar, per pound or per cental, has actually been higher for second quality than for first; but the absurdity is concealed by the fact that the first quality quarter is so much larger a quantity than the quarter of second quality, that the second fiar is less than the first by the quarter. This is not the place to discuss the subject of the fiars, but it is in a state of great confusion. Were there corn markets in all the counties regulated on the same principles as those of Edinburgh and Haddington, the records of these markets would afford a better basis for fiars than the evidence of witnesses slumping together the sales or purchases of many different dates. Confusion exists as to what is meant by quality. We have seen that high measure-weight does not necessarily imply high commercial quality. Measure-weight is a physical or a chemical quality, and a high degree of it may have money value, or it may not. A high money value alone is the test of high commercial quality; and the quality which is measured by money is the sole quality to be taken into consideration in fixing fiars.

But having given the subject of fiars a vast deal more attention than it deserves, I may show here from the records of the Haddington market several ways in which, from such records, were they kept in other counties, fiars might be struck :—

HADDINGTONSHIRE FIARS FOR 1868. Evidence from 6th November to 26th February.

I.—WHEAT.

FIRST METHOD.—Mean Prices of Haddington Corn Markets, each Market separated into 1st, 2d, and 3d, at its own date.

	Quarters.	Weight.	Fiar. *s.*	*d.*
1st Quality, ...	6,124	63·36	49	$2\frac{2}{12}$
2d „	12,246	62·84	47	$8\frac{1}{12}$
3d „	6,122	62·32	46	$3\frac{3}{12}$

SECOND METHOD.—Average Prices of Haddington Corn Markets, each Market separated into 1st, 2d, and 3d, at its own date.

	Quarters.	Weight.	Fiar. *s.*	*d.*
1st Quality, ...	6,124	63·35	48	$7\frac{10}{12}$
2d „	12,246	62·83	47	$2\frac{11}{12}$
3d „	6,122	62·30	45	10

THIRD METHOD.—Average Prices of Haddington Markets from November 6 to February 26, all taken as of one date.

	Quarters.	Weight.	Fiar. *s.*	Fiar. *d.*
1st Quality, . . .	5,358	...	49	$8\frac{8}{12}$
2d " . . .	12,246	62·83	47	$2\frac{11}{12}$
3d " . . .	6,888	...	45	$3\frac{10}{12}$

FOURTH METHOD.—The Sheriff's Determination.

	Quarters.	Weight.	Fiar. *s.*	Fiar. *d.*
1st Quality, . . .	...	...	53	6
2d " . . .	...	...	49	$11\frac{3}{4}$
3d " . . .	...	...	47	$5\frac{1}{2}$

II.—BARLEY.

FIRST METHOD.—Mean Prices of Haddington Corn Markets, each Market separated into 1st, 2d, and 3d, at its own date.

	Quarters.	Weight.	Fiar. *s.*	Fiar. *d.*
1st Quality, . . .	11,529	57·42	46	$1\frac{4}{12}$
2d " . . .	18,849	56·91	44	$11\frac{7}{12}$
3d " . . .	7,320	56·14	43	$2\frac{5}{12}$

SECOND METHOD.—Average Prices of Haddington Markets, each Market separated into 1st, 2d, and 3d, at its own date.

	Quarters.	Weight.	Fiar. *s.*	Fiar. *d.*
1st Quality, . . .	11,529	57·30	46	$1\frac{3}{12}$
2d " . . .	18,849	56·82	45	$0\frac{6}{12}$
3d " . . .	7,320	56·06	43	$4\frac{3}{12}$

THIRD METHOD.—Average Prices of Haddington Markets from November 6 to February 26, all taken as of one date.

	Quarters.	Weight.	Fiar. s.	Fiar. d.
1st Quality, ...	9,689	...	46	$6\frac{3}{12}$
2d "	18,849	56·82	45	$0\frac{6}{12}$
3d "	9,160	...	43	$5\frac{8}{12}$

FOURTH METHOD.—The Sheriff's Determination.

	Quarters.	Weight.	Fiar. s.	Fiar. d.
1st Quality, ...	..	...	47	$2\frac{3}{4}$
2d "	...	...	45	9
3d "	...	...	43	$9\frac{1}{2}$

III.—OATS.

FIRST METHOD.—Mean Prices of Haddington Corn Markets, each Market separated into 1st, 2d, and 3d, at its own date.

	Quarters.	Weight.	Fiar. s.	Fiar. d.
1st Quality, ...	3253	44·21	32	$0\frac{2}{12}$
2d "	6467	43·40	30	$11\frac{6}{12}$
3d "	3214	42·56	29	$10\frac{9}{12}$

SECOND METHOD.—Average Prices of Haddington Markets, each Market separated into 1st, 2d, and 3d, at its own date.

	Quarters.	Weight.	Fiar. s.	Fiar. d.
1st Quality, ...	3253	44·21	32	$1\frac{1}{12}$
2d "	6467	43·42	31	$0\frac{6}{12}$
3d "	3214	42·62	29	$11\frac{9}{12}$

THIRD METHOD.—Average Prices of Haddington Markets, all taken as of one date.

	Quarters.	Weight.	Fiar. *s.*	Fiar. *d.*
1st Quality, . . .	2774	...	32	$6\frac{7}{12}$
2d „ . . .	6467	43·42	31	$0\frac{6}{12}$
3d „ . . .	3693	...	29	$10\frac{1}{12}$

FOURTH METHOD.—The Sheriff's Determination.

	Quarters.	Weight.	Fiar. *s.*	Fiar. *d.*
1st Quality, . . .	...	...	32	$9\frac{3}{4}$
2d „ . . .	...	...	31	$3\frac{1}{2}$
3d „ . . .	...	...	29	$10\frac{3}{4}$

I may explain that the Sheriff's determination in Haddingtonshire is based on the sales of witnesses from all parts of the county; no jury is employed. The method adopted is this: All the wheat, for instance, is averaged, and the average price of the whole gives the medium or second fiar. Then all parcels of higher than average price are averaged for the first fiar; and all parcels of lower than average for the third fiar. The first and third fiars are not necessarily representative of the best and worst wheats, but of the highest and lowest market rates. The third of the above methods is done upon this false principle, and sometimes all the sales on a market-day are above or below the average of the four months embraced; while the probability is that first quality and third quality wheats were in the market on both occasions. But the whole of the sales in the market of 13th November, being above average price, go into the first fiar; and the whole of the sales of February 5th go into the third average. Either the date of the various transactions must be taken into account, or there should only be one average, one fiar, of each kind of grain.

The second of the above methods is probably that which would recommend itself as the best. The evidence, where proper markets exist, could be collected as in England over the whole year, if thought necessary, and it would be liable to few objections. In the above comparisons, the barley and oats in the market do not depart far from the Sheriff's findings; and in the case of wheat, where the difference on the medium is about two shillings and ninepence, the market is probably nearest the truth.

As every now and then a controversy

arises in the public prints as to whether the mean or the average price should be accepted as the fiar of some county, I may here state some further facts, which may be of use when a reformation of the fiars shall be resolved upon. It is very easy to show, by assumed figures, a great difference between mean price and average price, but we should reason the matter from the actual cases.

I employed reporters in various counties to give me the whole details in the Fiars Courts, and shall give the results in two cases.

In Peeblesshire the average price is calculated for the fiar. The evidence before me is for the crop of 1868. The total quantity of barley in evidence is 689 quarters; of oats 1337 quarters; and of oatmeal 1198 bolls,—quantities which must be regarded as too small. Three fiars are given by the same method as at Haddington. The averages here given are the second fiars, or averages of the whole :—

BARLEY.

Average of 689 Quarters, ...	£2	2	2¼
Mean of prices given, ...	2	1	9½
Difference between average and mean,	£0	0	4¾

OATS.

Average of 1337 Quarters,	£1	8	0¾
Mean of prices given,	1	8	3½
Difference,	£0	0	2¾

OATMEAL.

Average of 1198 bolls,	£1	1	10½
Mean of prices given,	1	1	9¼
Difference,	£0	0	1¼

These differences are so small that, for all practical purposes, the two methods may be said to give the same result. And the larger the amount of evidence, the more nearly do the mean and the average approach each other.

In the Fiars Court of Mid-Lothian the mean prices are adopted in striking the fiars, not the average. At the Court for striking the fiars here given for the crop of 1869, Mr. Charles Cowan suggested to the Sheriff that the jury should take the quantities into account as well as the prices. The Sheriff replied that the existing system could not be altered except by Act of Parliament. It did not seem to occur to any one to try both methods, and test the amount of divergence. At Edinburgh two fiars are given of wheat and oats and three of barley. But here the mean price of the whole is the first fiar in all cases; so that the first fiars of Mid-Lothian correspond with the second fiars of East Lothian. The comparison of mean and average prices in Mid-Lothian, for crop 1869, stands as below:—

WHEAT.

	£	s.	d.
Mean price of 335¾ Qrs. (1st Fiar),	£2	0	3
Average price of 335¾ Qrs.,	2	0	3¼
Difference,	£0	0	0¼

BARLEY.

	£	s.	d.
Mean price of 1485⅞ Qrs. (1st Fiar),	£1	13	9
Average price of 1485⅞ Qrs.,	1	13	7¼
Difference,	£0	0	1¾

OATS.

	£	s.	d.
Mean price of 789½ Qrs.,	£1	6	2
Average price of 789½ Qrs.,	1	6	0¼
Difference,	£0	0	1¾

The mean of the average prices in the Edinburgh market, from November 1869 to February 1870, which would represent the fiars of crop 1869, may be shown alongside of the Sheriff's fiars:—

	Wheat.	Barley.	Oats.
First Fiars,	40s. 3d.	33s. 9d.	26s. 2d.
Edinb. market prices,	43s. 2¼d.	32s. 11¾d.	25s. 4¾d.
Differences,	2s. 11¼d.	0s. 9¼d.	0s. 9¼d.

Whether the actual fiars or the market prices are most truly representative of the rates at which the crop of 1869 was exchanged would require investigation. It is evident that the quantities submitted in evidence to the Sheriff are far too small. And to show the absurdity of making second and third fiars without reference to the date of sale, intending thereby to give prices representing different qualities of grain, it may be noticed, that as the average price of the four months for wheat is 43s. 2¼d., and as all the wheat in the market of 2d February 1870 sells at rates below 43s. 2¼d. except one parcel, and all the wheat of the 9th February without exception, so all the wheat of these two markets becomes inferior quality, not from any inhering inferiority in the grain, but simply because the market has fallen. In November the price of wheat was 49s. 3d., but by February it has fallen to 39s. 2d., the qualities of the wheat remaining the same all the time. The top price on November 3, is 60s., and the weight 63½ lb.; the top price on February 9, is 43s., and the weight 64½ lb.; so that probably the best sample of

February is better than the best sample of November, and yet the worst becomes first quality and the best second. All the double and triple fiars involve this fallacy. Only one true average can be struck. But I must return from this digression.

The average weight of bere in Aberdeenshire for nineteen years, drawn from nearly 174,000 quarters, is 52·22 lb. per bushel, being 1·39 lb. less than the weight of (two-rowed) barley. The reason of the difference is to be found in the shape of the side rows of grain in bere. The two central rows are straight, and the same as the two rows on barley; but the grains on the side rows of bere have a slight twist upon them, so that a greater amount of vacant space is left in a bushel of bere than in a bushel of barley. The highest weight of bere falls in the year 1868, when it is 54·03 lb.; and the lowest weight is in 1872, when it is 49·51 lb.

The average weight of oats in Aberdeenshire, for twenty years, from 1854 to 1876, but wanting 1864, 1865, and 1875, is 40·22 lb. This weight is the average derived from nearly 2¼ millions of quarters. The weight of first quality rises to an average of 41·02 lb.; and the average of second quality falls to 39·25 lb., being a difference on the bushel of 1·77 lb.

I may here contrast the Aberdeenshire average weights with those of Edinburgh.

	Wheat.	Barley.	Oats.
Aberdeen, . . .	59·83	53·61	40·42
Edinburgh, . . .	62·02	54·93	42·22
Difference in favour of Edinb.,	2·19	1·32	1·80
Difference per Qr., . .	17·52	10·56	14·40

We thus see that a quarter of wheat in the Edinburgh market is a greater quantity than a quarter in the Aberdeen markets by 17½ lb.; the quarter of barley a greater quantity by 10½ lb.; and the quarter of oats a greater quantity by 14½ lb. What these differences arise from we are not yet in the best position to determine. In regard to wheat, the probability is that the Aberdeenshire kernel is not so fully completed as the Edinburgh, and therefore falls further short of the globular form which gives the greatest weight. In barley and oats it might be supposed that the greater measure-weight in Edinburgh arises from that superiority of quality which is conferred by higher percentage of kernel; but as there are other conditions which go to make high measure-weight besides high percentage of kernel, any present decision of this point must be deferred.

MEASURE-WEIGHT of WHEAT, BARLEY, BERE, and OATS, grown in Aberdeenshire, from evidence laid before the Fiars [1] Court.

Crop of Year	White Wheat.		Red Wheat.	
	No. of Quarters.	Average Weight.	No. of Quarters.	Average Weight.
1854	3,635	61·86	The two sorts not separated in these three years.	61·86
1855	5,043	60·35		60·35
1856	7,374	57·02		57·02
1857	1,433	60·30	3,289	59·64
1858	1,717	61·32	2,746	60·30
1859	2,007	61·68	1,370	60·97
1860	233	55·95	679	55·17
1861	215	59·49	1,168	58·18
1862	42	58·33	467	58·66
1863	595	61·29	379	58·17
* *	* *	* *	* *	* *
1868	53	62·29	118	60·90
Mean Weight.				
1869	210	60·45	255	60·28
1870	586	61·62	615	61·30
1871	616	61·00	752	60·20
1872	487	59·00	200	56·75
1873	696	61·50	643	61·25
Means, . . .	...	60·22	...	59·44
Sum and Mean of 16 years, .	37,623	59·83	...	...

[1] See Note on Fiars, p. 125.

Barley (Two-rowed.)

	No. of Quarters.	Average Weight.
Crop of 1854, ...	11,569	55·15
,, 1855, ...	8,934	52·52
,, 1856, ...	9,010	51·95
,, 1857, ...	9,895	54·41
,, 1858, ...	13,584	54·06
,, 1859, ...	13,038	55·16
,, 1860, ...	15,925	52·18
,, 1861, ...	14,233	52·55
,, 1862, ...	10,063	52·34
,, 1863, ...	15,967	54·08
,, 1866, ...	11,537	53·05
,, 1867, ...	13,605	52·10
,, 1868, ...	13,199	55·82
,, 1869, ...	20,737	54·42
,, 1870, Mean Weight,	17,297	55·72
,, 1871, ,,	19,528	54·20
,, 1872, ,,	14,898	50·23
,, 1873, ,,	19,436	54·41
,, 1874, ,,	20,193	54·38
,, 1876, ,,	16,348	53·40
Sum and Mean Weight of 20 years,	288,996	53·61

Crops of 1864, 1865, and 1875 awanting.

BERE (Six-rowed Barley: Thin-set Ear).

Crop of Year	First Quality. No. of Quarters.	First Quality. Average Weight of First Quality.	Average Weight of First and Second Quality.	Second Quality. Average Weight of Second Quality.	Second Quality. No. of Quarters.
1854	8,460	53·76	53·69	50·84	198
1855	5,077	51·73	51·43	49·57	872
1856	3,133	51·63	51·14	50·26	1,744
1857	5,419	53·60	53·51	52·60	458
1858	6,569	52·75	52·56	51·19	903
1859	5,098	53·10	53·04	52·65	863
1860	3,703	51·33	50·72	49·96	2,955
1861	5,522	51·77	51·28	50·19	2,451
1862	2,147	50·43	50·00	49·57	2,214
1863	4,916	53·23	52·87	51·21	1,053
* *	* *	* *	* *	* *	* *
1867	6,017	51·02	50·10	48·71	4,041
1868	9,379	54·38	54·03	50·96	1,086
1869 Mean Weight.	10,748	54·07	53·57	51·11	2,220
1870	15,071	54·40	53·31	51·14	2,090
1871	13,309	53·40	52·36	50·20	2,894
1872 Average Weight.	4,196	50·72	49·51	48·65	5,252
1873 Mean Weight, 1st. and 3d.	9,005	53·58	52·72	51·33	3,851
1874	9,729	54·05	53·54[1]	51·59	2,580
* *	* *	* *	* *	* *	* *
1876	6,478	53·40	52·73	50·50	1,952
Sums and Means of 19 years, .	133,976	52·76	52·22	50·64	39,677
Sum and Average Weight of 19 years, . .	173,653	52·22	...	...	...

[1] 53·54, average; 52·86, mean of the whole.

OATS.

Crop of Year	First Quality. No. of Quarters.	First Quality. Average Weight of First Quality.	Average Weight of First and Second Quality.	Second Quality. Average Weight of Second Quality.	Second Quality. No. of Quarters.
1854	78,765	41·91	41·76	40·96	14,787
1855	52,536	40·17	39·93	38·93	22,588
1856	31,467	40·19	39·27	38·91	52,400
1857	62,641	40·70	40·49	39·85	20,472
1858	80,937	41·33	41·09	40·03	18,796
1859	93,097	40·13	40·01	39·09	12,918
1860	50,755	40·40	39·81	39·05	39,640
1861	95,186	40·43	40·26	39·35	18,615
1862	74,508	40·77	40·49	39·38	19,371
1863	88,008	41·27	40·92	39·34	26,306
* *	* *	* *	* *	* *	* *
1866	65,122	40·60	39·58	38·45	59,212
1867	55,442	39·76	38·92	37·60	35,488
1868	101,235	41·48	41·10	39·12	19,323
1869	83,610	41·70	41·34	40·00	22,211
Mean Weight.					
1870	100,137	41·96	40·99	39·61	15,446
1871	104,546	41·70	40·66	39·10	23,140
1872	51,932	40·87	39·55	38·12	36,228
1873	135,644	42·27	41·45	39·84	33,889
1874	109,717	42·05	41·23	39·81	63,528
* *	* *	* *	* *	* *	* *
1876	62,465	40·70	39·53	38·53	72,566
Sums and Means	1,577,750	41·02	40·42	39·25	626,924
Sum and Mean of Averages of 20 years, . .	2,204,674	40·42	...	...	...

ABSTRACT of the WEIGHTS of WHEAT, BARLEY, BERE, and OATS, as deduced from the evidence laid before the Aberdeenshire Fiars Court.

WHEAT.

Sixteen years between 1854 and 1873, give upon 37,623 quarters a bushel-weight of 59·83 lb.

BARLEY.

Twenty years between 1854 and 1876, give upon 288,996 quarters a bushel-weight of 53·61 lb.

BERE.

Nineteen years between 1854 and 1876, give upon 173,653 quarters a bushel-weight of 52·22 lb.

The average above this mean is 52·76 lb.
„ below „ 50·64 „
Difference between over and under averages = 2·12 lb.

OATS.

Twenty years between 1854 and 1876, give upon 2,204,674 quarters an average bushel-weight of 40·42 lb.

The average above this mean is 41·02 lb.
„ below „ 39·25 „
Difference between over and under averages = 1·77.

FIARS.

To those who have studied the subject of Fiars, the etymology of the name has been a source of some interest. Mr. Paterson (whose *Historical Account of the Fiars in Scotland* is the best, though defective from want of practical acquaintance with grain) throws aside the derivation of *Jamieson's Dictionary*, and thinks he has found the original word in old French 'feur,' signifying 'average,' etc. Whatever may be the ultimate source of the word, I find that it was in use in England in its present shape and signification early in the fourteenth century. In a Norman-French Act (4 Edw. III. c. 12, *Statutes of the Realm*) occur these words: 'Item. Because there be more taverners in the realm than were wont to be, selling as well corrupt wines as wholesome, and have sold the gallon at such price as they themselves would, because there was no punishment ordained for them, as hath been for them that have sold bread and ale, to the great hurt of the people: It is accorded, that a cry shall be made that none be so hardy to sell wines but at a reasonable price (nul soit si hardy de vendre vyns forq. a resonable feer), regarding the price that is at the ports from whence the wines came, and the expenses, as in carriage of the same from the said ports to the places where they be sold; and that assay shall be made of such wines two times every year.'

It is thus evident that in the year 1330 the word 'feer' was simply equivalent to 'price.' But in succeeding times the word 'feer' was substituted for 'price' where the exchange value was fixed by assize or by burghal authority; like some other French words, it acquired a technical use. As the phrase 'droit pois' (25 Edw. III. Stat. 5, c. 9), altered into 'troi weight,' became technically attached to certain approved standards, so the word 'feer,' variously altered in spelling, became technically denominative of money values fixed by legal authority. The conception of *average* did not necessarily form an element of the meaning, neither was the word restricted to corn. Most of the articles bought and sold in the burghs had 'competent prices' affixed to them; and probably the word 'feer' was more or less in use to imply the price fixed from time to time by the proper burgh officers. On the 26th January 1578 (*Burgh Records*), the bailies of Aberdeen adjudged 'the feir off feggis and raisingis' at two shillings and at thirty pence a pound.

VII.

Measure-weight and Degrees of Ripeness.

DURING the years 1869, 1870, and 1871, I made a great number of experiments to determine various facts regarding ripening. Only some of the results naturally fall into the present work. But I may state something of the nature of these experiments. They were conducted upon wheats of several winter and spring varieties, rye, barley, bere, and several varieties of oats.

In wheat, rye, and the barleys, two methods were adopted. At the various stages of yellowing which have been recommended by agricultural writers as the best conditions for reaping, ears were selected, and marked by threads and numbered tickets; and descriptions made of the extent and degree of yellowness on the ear and stalk. Alternate kernels were then extracted with a pincers from the outer rows of florets, and laid aside for several months, until completely air-dry. The ears were cut off when dead ripe, and after becoming dry the alternate kernels remaining were extracted; the two sets of grains were then weighed to the nearest hundredth of a troy grain, and the results tabulated. By the other method, a certain number of ears, sometimes up to 100, were cut off in various stages of ripeness, with the dates registered and attached to the bunch. Similar numbers of ears of the same size, as nearly as could be selected, were cut off when dead ripe at the same spot of the field. And when both sets of ears and grains were completely air-dry, the grains were numbered and weighed, and the weight of the average grain in the unripe parcel compared with the weight in the ripe parcel. This last method only was found applicable in the case of oats.

Altogether about 360 experiments were carried out; and the result was to show that a kernel does not attain its highest possible weight before being dead ripe. Ripeness simply means the greatest attainable weight of grain. If a kernel has not arrived at its greatest weight, it is not ripe. These assertions seem to be mere truisms. But it has been contended that unripe wheat has a thinner coat than ripe wheat, and will produce more fine flour. Supposing that this is true, it involves a different question from the question of ripening; namely, the question,—Is it best to reap wheat *before* it is ripe? Such questions should be kept quite clear of each other. The heaviest crop of grain is from ripe corn; although various contingencies may often make it proper to reap before ripeness is attained.

Organically a wheat kernel has two coats, although some have subdivided these into several more. These coats reach maturity sooner than the interior of the albumen. And the last stages of ripening make no difference to the absolute amount of the coats, but every addition to the interior of the albumen diminishes the percentage of the coats. How much the percentage of bran shall be depends more on the condition of the grain at the time of grinding, and on the character and the state of the mill, than upon differences in percentage of coats. The bran consists of those coats, the inner one being excessively delicate, and in far greater part of the outer layer of the kernel. This layer consists of the terminal cells enclosing the starchy interior; they are of honeycomb arrangement, and contain gluten or aleurone grains of a very small size. If the corn is in a good condition for milling, this layer comes off with little of the starch adhering to it; and if the corn is not in so good a condition, more starch adheres to the bran films, so that the percentage of bran is large; but the actual quality of the wheat and the actual proportion of its parts have nothing to do with that percentage.

The husk of barley and oats does not correspond to the bran of wheat. The bran of wheat consists of the ovary and part of the kernel; the husk of barley and oats consists of the adherent pales of the floret; and the more completely the enclosed kernel is ripened, the smaller is the percentage of husk. But the husks of barley and oats are fully formed at an earlier part of the season than the kernel, and their absolute amount is not affected by degrees of ripening one way or the other.

The following figures are intended to show experimentally whether ripe or unripe corn has the greatest measure-weight. The materials are taken from some of the winter and spring wheats used in the ripening experiments. The first column gives the absolute weight in parts of a troy grain of the average seed at the various stages of ripeness. Thus in No. 2, the weight ·522 is the average weight of one grain of wheat at the earliest stage of ripeness tested; ·583 is the average weight of a grain of the same wheat at a more advanced stage; ·637 is the weight at a still more advanced stage; and ·671 is the weight of an average grain of the same wheat when dead ripe. The dead ripe weight is made 100; so that when ·522 is divided by ·671, it gives 78, showing the first stage of ripeness in this experiment to be 78 parts; full ripeness being 100 parts. The other stages of ripeness are treated in the same way. Then a quantity of the ripe wheat is poured into a test-tube used as a 'bushel,' and the measure-weight is called

100, and also called 60 lb. per bushel. The number of ripe seeds in the tube is found, and is also called 100. Then the tube is filled in the same way with the grain at the various stages of ripeness, and the number and weight of these being found, and divided by the weight and number of dead ripe grains, the relationships are found as before. The results stand as follows :—

TABLE comparing the Measure-Weight and Measure-Number of several varieties of Wheat at various stages of ripeness.

	Average Weight of one Grain.	Parts Ripe.	Measure-Number.	Measure-Weight.	Weight per Bushel.
No. 1.	·273 ·395	69 100	130 100	90 100	54 60
No. 2.	·522 ·583 ·637 ·671	78 87 95 100	127 117 112 100	96 98 103 100	57·6 58·8 61·8 60
No. 3.	·566 ·688	82 100	109 100	90 100	54 60
No. 4.	·534 ·638 ·649	82 98 100	120 103 100	99 101 100	59·4 60·6 60
No. 5.	·559 ·617 ·677	83 91 100	114 108 100	92 98 100	55·2 58·8 60
No. 6.	·599 ·710	84 100	111 100	90 100	54 60
No. 7.	·694 ·817	85 100	120 100	102 100	61·2 60
No. 8.	·890 1·030	86 100	110 100	95 100	57 60
No. 9.	·763 ·869	88 100	116 100	102 100	61·2 60
No. 10.	·565 ·643	88 100	108 100	96 100	57·6 60

	Average Weight of one Grain.	Parts Ripe.	Measure-Number.	Measure-Weight.	Weight per Bushel.
No. 11.	·856 ·972	88 100	106 100	94 100	56·4 60
No. 12.	·774 ·868	89 100	107 100	96 100	57·6 60
No. 13.	·552 ·605	91 100	104 100	94 100	56·4 60
No. 14.	·724 ·794	92 100	111 100	101 100	60·6 60
No. 15.	·579 ·628	92 100	104 100	96 100	57·6 60
No. 16.	·675 ·724	93 100	104 100	98 100	58·8 60
No. 17.	·757 ·807	94 100	110 100	104 100	62·4 60
No. 18.	·664 ·706	94 100	102 100	96 100	57·6 60
No. 19.	·634 ·673	94 100	102 100	96 100	57·6 60
No. 20.	·603 ·621 ·638	94·5 97 100	102 103 100	97 100 100	58·2 60 60
No. 21.	·579 ·602	96 100	103 100	99 100	59·4 60
No. 22.	·622 ·639	97 100	102 100	99 100	59·4 60
No. 23.	·718 ·736	97·5 100	108 100	105 100	63 60
No. 24.	·682 ·692	98·5 100	105 100	104 100	62·4 60

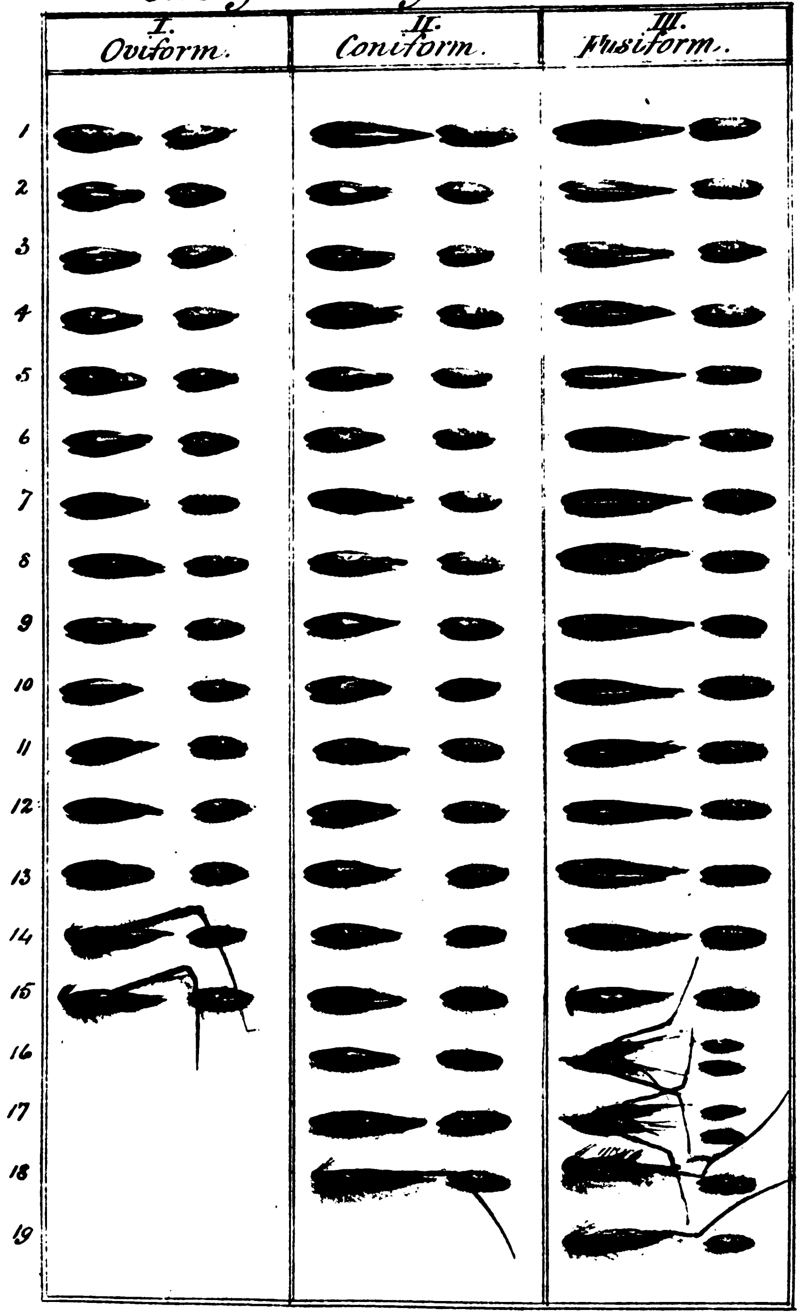
It will be noticed in this table that the experiments are arranged progressively; those having the fewest parts ripe being placed first. In every case the unripe grain presents a greater number of seeds in the measure than the ripe, and is therefore of smaller size. On the other hand there are eight cases out of twenty-nine in which unripe grain presents a greater measure-weight than ripe. But in such experiments there is always a margin of possible error, and most probably the average of the whole is the one proper conclusion—namely, that ripe grain is of higher measure-weight than grain in any stage of unripeness. All the grain here treated is such as may frequently be seen in the market. The outer part of the kernel is ripe first, and ceases to enlarge, while the interior is still soft along the axis which deposits the material; so that a kernel in which the final particles of starch have not been laid down may be as plump outwardly as if these particles had been deposited, but the absolute weight of food is less. I may add that we have here the real explanation of the fact that analysis sometimes shows an unripe wheat to be of better quality, as estimated by percentage of albuminoids, than a ripe. The albuminoids existing mostly in the outer coat of honeycomb cells (which is the analogue of the outer cells of the leaf) are laid down before the deposit of starch is completed; and if the addition of starch is arrested by premature reaping, the percentage of starch must be low. But the absolute weight of food in the unripe crop is less; and the conclusion from such analysis, while true, is a pure delusion.

Various methods have been tried for finding the specific gravity of the cereal grains; but they have all a large margin of uncertainty. In the cases of oats and barley, it very soon becomes obvious that unequal vacancies exist in different grains, between the husk and the kernel, and these, whether full of air or not, are sources of error. In wheat grains, lacunæ exist of very various sizes along the axis of the grain, and these cannot be cleared of air; so that two grains from the same spikelet may float in solutions of very different density, while for all purposes of food or propagation they may be equal. It has been contended by Professor Church (*Practice with Science: Report of Wheat Experiments*, 1863-1864, p. 99), that seeds of a certain specific gravity produce the best plants. But before such a conclusion can be accepted, we must know a great deal more than we know yet about the characters of different embryos. Some embryos are larger than others. Some are more vital than others and germinate sooner, and therefore have probably a greater assimilative power. Some have a broader scutellum or cotyledon than others. Some have produced larger radicles than others before the dessication of ripeness arrests them for their autumnal sleep; so that the requirements of a good seed are perhaps not yet specified.

Classification of Oat Grain.

	I. Oviform.	II. Coniform.	III. Fusiform.
1.	Potato.	Dun winter.	Black Tartarian.
2.	Canadian.	Kildrummy.	White Tartarian.
3.	Longfellow.	Sandy.	Finlay.
4.	Earlyfellow.	Lothian.	Swiss.
5.	Finefellow.	Sandwich.	Archangel.
6.	Scots barley.	Red early.	Rough panicle (?)
7.	Hopetoun.	Barbacklaw.	Smooth panicle (?)
8.	Old black.	Blainslie.	Yellow.
9.	Early barley.	Early Angus.	Waterloo.
10.	English barley.	Grey Angus.	White Swedish.
11.	Providence.	Late Angus.	Danish.
12.	Common dun.	Shirreff.	German.
13.	Tawny.	Fyvie.	Swedish.
14.	Short wild.	African.	Russian.
15.	Tawny wild.	White Poland.	Markel.
16.		Black Poland.	White small.
17.		Brown Swedish.	Black small.
18.		Long wild.	Brown wild.
19.			Dun wild.

Classification of Oat Grain.



[illegible] Drawn.

[illegible]	II [illegible]	III [illegible] Form
[illegible]	[illegible]	[illegible]

VIII.

Classification of Grain.

THE close similarity of many of the corn plants, especially in wheats and oats, seems to forbid all hope of any such classification and description as would enable each variety to be distinguished from all the other varieties. And the grains or fruits of these plants, in many cases, so much resemble each other that they can hardly be separated; much less can any description or drawing convey a clue to identification. A few of the wheats and their grains are easily distinguished from the others; the Polish wheat (*Tr. Polonicum*) and its long grains are easily identified. The varieties which have a thin-set ear are easily distinguishable from the varieties which have a thick-set ear; but the grains of the varieties in these two divisions are often very much alike.

Again the plants of the Tartarian oats are sufficiently distinct in outward appearance to enable them to be contradefined from other varieties; but their grains, whether black or white, find others very much resembling them. The grains of the Potato oat cannot in many cases be distinguished from the grains of the Canadian.

A cause of great confusion is that of the same plant having different names in different localities, and at different times. Some seedsman or agriculturist selects a good plant, gives it a new name, cultivates it for a few years, with careful prevention of admixture, and when it comes abroad it is complacently taken to be a new variety. There is no adequate evidence that any new cereal grass has appeared within historical times. But the selection of a good plant, and the raising of a pure stock from it, with a new name, although confusing to the agricultural botanist, is not without important uses. It gives facilities for comparing the productive capacities of different varieties, for it has at all times been difficult or impossible long to preserve pure stocks.

But it is only with grain that I am here dealing. And I do not propose to treat of the classification of any other grain than that of oats.

A very general impression exists among agriculturists, millers, and corn merchants that the measure-weight of oats, irrespective of variety, is a test of that aspect of quality related to percentage of kernel and husk; and as my experiments have fully shown that this impression is true only under various qualifications, I have proposed such a classification of oat grain as will help to explain what the differences of measure-weight mean.

Except in respect of form, there is no such obvious difference in the grains of different oats as would subserve the purpose of a classification. Form has therefore been adopted as the idea on which to base a classification.

All the short round oats approaching the form of an egg are classed as Oviform. In the Oviform class are placed such oats as the Potato oat and the Scots barley oat. In the illustrative plate have been included most of the so-called varieties which I have tested, and which are in cultivation under different names, although there can be no doubt that some of them are the same as others. For example, the late Mr. Shirreff, in forwarding samples of Longfellow, Earlyfellow, and Finefellow oats, which he had selected, informed me that they were of the Potato variety. Scots and English barley oats (sometimes called birlie—an old form of the word barley) and Providence oats are also probably all one. But when a pure sample of some variety, with such a name as Longfellow, throws up a taller crop than the neighbouring crops of somewhat mixed Potato oats, it is stoutly declared to be a distinct variety; and, if agriculture profits by the propagation of a pure stock, botany may take a quiet laugh and will suffer no great harm. In this class I have included two forms of the wild oat (*Avena fatua*). Both are white, except that the one called Tawny has a dun-coloured inner pale. These two forms of the wild oat have ruffs round the neck and a tuft on the breast, but no hairs on the outer pale. Whatever their genetic relationship may be to the ordinary Brown wild oat on the one side, and to the ordinary cultivated oat on the other, they are structurally intermediate between the two. The most important point of difference between all forms of the wild oat, and all forms of the cultivated oat, is the connection of the floret with the hanger. In the wild oat the hanger terminates in a little oval spatula, and this spatula lies into an oblique scar terminating the pales, forming a kind of ball-and-socket connection. As the seed ripens the ball dries up and shrinks, so that the seed drops off. In the cultivated oats the continuity of the vascular tissue in the hanger is not broken off by any joint of this kind, but runs into the pales, so that in ripening no break takes place.

The second class consists of forms having a greater length in proportion to their diameter than the first; they are somewhat conical in shape, and are named the Coniform class. The Sandy oat and Red oats, under whatever name, are types of this class. In this class is the Dun winter oat, having the highest percentage of kernel of any oat in existence. Of the seventeen cultivated forms here given in this class, no doubt a few might be struck out as mere local creations, but, before reducing the number, it is better to ascertain all the qualities and all the claims presented under different names. I have put another long white wild oat into this class (18); if it is the progenitor of the class it has escaped the influences of variation.

The third or Fusiform class includes all the long oats. The Tartarian oat and the Archangel oat are typical forms of this class. Many of the Continental oats belong to this class, and some of the forms grown in America. Probably where the summer is hot, and the season rapid, the oat seed has a tendency to assume this form; my own experiments, however, in growing Archangel oats, have not induced any change of form; but more time is required. In this class I have included the white and black forms of the Small oat (16, 17, *Avena strigosa*). These were cultivated oats in England and Scotland from remote times. They are frequently mentioned in Rogers' *History of Agriculture and Prices*. Fiars were struck of these oats in some Scots counties a few years into the present century. They are still grown as a crop in Orkney and Shetland. The common Brown wild oat (*Avena fatua*) is placed in this class, and another form, slightly different, of a dun colour (18, 19). It has been confidently asserted that all the cultivated oats have originated in the Brown wild oat; and this doctrine has got into books of reference as a thing proved by experiment. My own cultivation of the wild oat for many years has made no difference upon it; nor, indeed, should I have expected any difference; for the wild oat has been cultivated intermixed with other forms as long as oats have been under cultivation, and it still resists the evolutionary factors. I have seen it throw up seventy stalks from one seed. Its panicles, when at their best, outvie in grace and size and prolificacy the panicles of any other oat; and it sometimes towers up to a height of eight feet and a half. I do not contend that it is not the progenitor of the cultivated oats, but merely that as yet we have no real proof of the relationship. If the existence of man upon the earth be taken for an argument that nature is tending in the direction of supporting him, it may be held that the wild oat is tending towards the cultivated forms; otherwise it is just as probable that the cultivated forms are tending towards *Avena fatua*. But although a principle which may be called *proanthropy* has guided many experiments, conducted with a view to make certain plants more serviceable to man, yet this principle is purely hypothetical, and the present biological direction of nature is only to be determined by pure experiment.

I have but recently been furnished with a sample of the Naked oat, by Mr. W. H. Mold of Ashford, in Kent, who is cultivating it as a seed oat of great promise,—and I cannot yet say in which class it should be placed. But as it comes into the market, like a wheat, without the husks or pales, the principle of classification here adopted does not apply to it. According to Lindley, the Naked oat is the pilcorn of the old agriculture, and we see from Rogers (*Rarer Kinds of Grain*, vol. ii. p. 173) that it was in cultivation in England in the thirteenth century. Parkinson tells us that in his time the Naked oat was sown in sundry places, but 'nothing so frequent' as the common sort. Gerarde also mentions the Naked oat, as differing from common oats only in being more easily threshed out. And this ungallant old botanist tells us that the good housewives of Northfolke and Southfolke, 'that delight not to have anything but from hand to mouth, whiles their pot doth seeth, go to the barne, and rub forth with their hands sufficient for that present time.' It is to be hoped that the cultural efforts of Mr. Mold will settle the claims of this oat.

The use of the classification here proposed will become more obvious after we have seen in what relation measure-weight stands to percentage of kernel. It will be seen that the measure-weight of a round, short, Oviform oat cannot be compared with the measure-weight of a long Fusiform oat for any purpose of estimating money value or capacity of yielding meal. Only samples of the same class of oats can be compared with each other in respect of the information afforded by the weight of the bushel.

IX.

Percentage of Kernel in Oats in respect of Measure-weight.

THE original purpose of the inquiry considered in this chapter was to discover, if possible, what percentage of kernel is indicated by a given weight per bushel. Various experimenters have gone more or less into this subject, both with oats and wheat; but, so far as oats are concerned, the present investigation is more extended than anything of the kind ever before attempted. Within a very few of all the cultivated oats in existence have been subjected to analysis, my inquiry having gone far beyond its first intention.

About fifty varieties of oats have been examined. Upwards of 800 analyses have been made; and about 200,000 seeds have been decorticated. The whole work has been done with my own hand; and as it has extended over a good many years, all immature conclusions have, I believe, disappeared.

As will be seen in the tables, the names are given of the correspondents who supplied me with samples, the localities where the oats grew, and the years in which they were produced. Samples were procured from many parts of Scotland, and various parts of England and Ireland. A good many Continental oats, and a few samples from America are also included. Prize samples were sought till the secrets of their excellence became manifest; and the work was carried on till no hope could be any longer entertained of finding still better qualities. My correspondents were requested to state the weight per bushel of their oats. But it became at once obvious that the weights thus given were no proper data to rely upon. The samples requested were, in general, a pound in quantity. And when they were turned out for a first examination, it was almost invariably found that mixed up with the oats were many empty husks, wheat, barley, rye, various grass and other seeds, and bare oat kernels; one sample, I remember, contained one-eighth of its weight of bare kernels, and many others contained large percentages. The foreign oats especially held a large mixture of impurities, such as sand, barley, peas, husks, thistle-tops, grass seeds, etc., sometimes amounting to five or seven per cent. All samples were therefore most scrupulously dressed; every seed, kernel, or other impurity being selected out of the mass, and lifted aside with a pincers.

A method of uniform measuring had therefore to be devised for the purified samples, and after some experimenting with measures a model was fixed upon, of the same depth as the imperial bushel, and one-fortieth of its dimensions. A measure one-fortieth the size of the bushel, but of less than 8 inches depth, was found to admit less corn than another of the same capacity but of greater depth—the deeper the measure, the greater the compression. But the method of filling such a measure is of not less importance than the proper arrangement of the dimensions. If the corn is poured in from one height a certain weight will be made, and if it is poured in from a different height another weight will be made. A tin dish was therefore constructed with a flat bottom perforated with holes to the same width as the mouth of the measure. This dish was supported by a hoop immediately over the brim of the measure. It was placed in position with a disc of paper in the bottom to prevent the corn from falling through. The corn was then poured into the dish and the paper withdrawn by a thread attached; the corn being then stirred through the bottom till the measure was as full as to be struck by a ruler. In general, all samples were thus measured and weighed three times, and the average taken as the measure-weight.

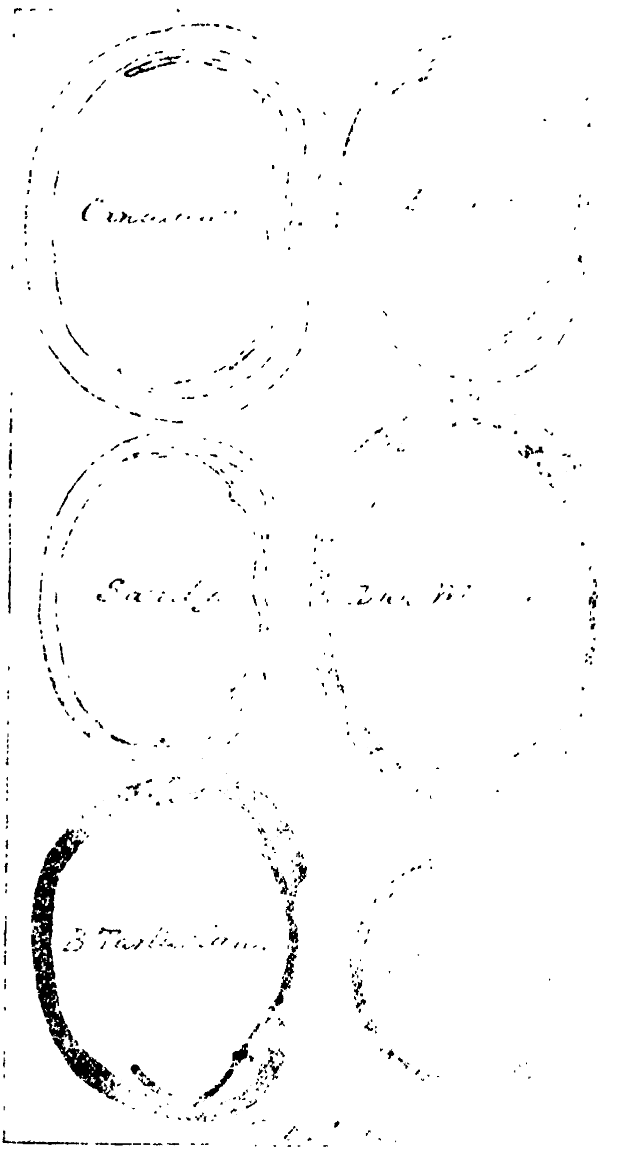
Unfortunately, it was then found that this mode of filling the measure gave, in general, a weight of from 1 to 4 or 5 lb. more to the bushel than the ordinary way of filling the bushel in actual practice. Where the grain is in its ordinary state, the difference between the two modes of filling is greatest; where the grain is hummelled and smoothed for show purposes the difference nearly disappears.

The sample becomes in a manner liquid, and flows into a compact mass by both methods.

But although the column of uniform weights shows heavier bushels than are found in the barn, or in the corn-market, yet, as all these weights are comparative, they answer the intended purpose exactly as well as ordinary measuring would have done with the same completely dressed samples.

In the tables the samples are arranged according to the succession of different weights. The highest weight found by the uniform method just described is placed first, in the different varieties,—and a glance down the column of 'percentage of kernel,' shows whether there is any regular fall in percentage of kernel with diminishing measure-weight. The weights found in the ordinary way, and supplied by correspondents, are given in the column of 'ordinary weight.' The number of seeds in a pound is given to show the difference of weight to which the seeds attain in different circumstances.

In a great many cases microscopic measurements are given of the thickness of the outer and inner pales or husks, in



[illegible] combined [illegible]

[illegible] the [illegible]

[illegible] of [illegible]

[illegible]

[illegible] in the continuation [illegible]

[illegible] would [illegible]

[illegible] the object [illegible] to

[illegible] may [illegible] would have done

[illegible] comparing [illegible] samples.

[illegible] the samples [illegible]

[illegible] success[illegible] of different

[illegible] highest weight found by the

[illegible] is placed first,

[illegible] and a place [illegible]

[illegible] of kernel [illegible]

[illegible] for fall in percent-

[illegible] measure-

[illegible] in the ordinary

[illegible] respondents, are

[illegible] of 'ordinary weight.'

The [illegible] a pound is given to

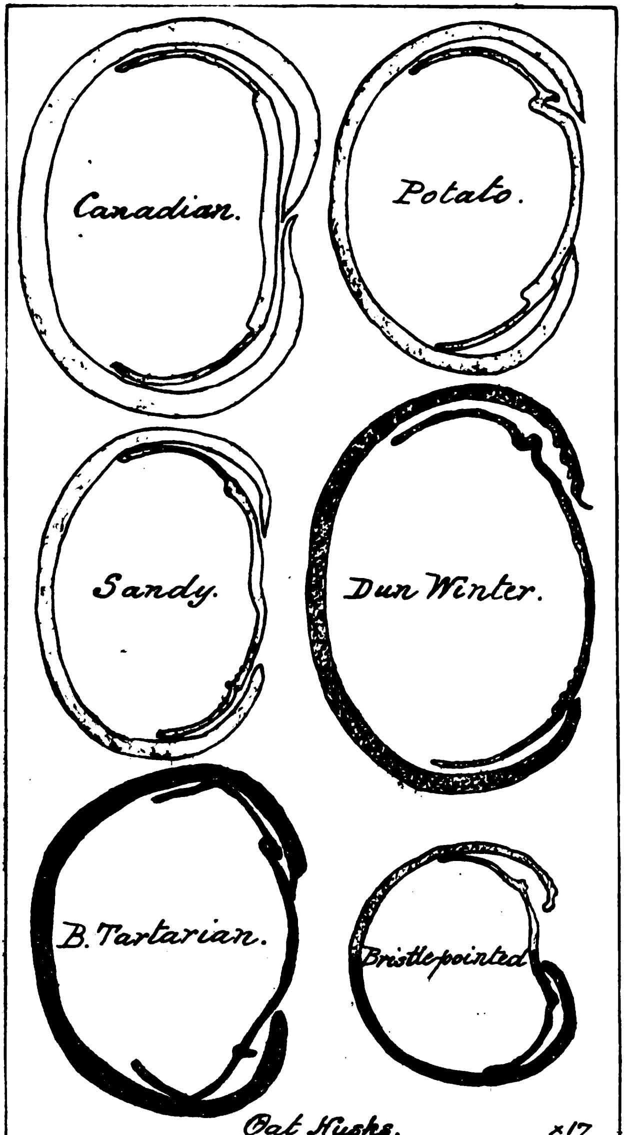
[illegible] weight to which the

seeds attain in different circumstances.

In [illegible] great [illegible] microscopic

[illegible] are given of the thickness of

[illegible] and inner pales or husks in


Canadian.
Potato.
Sandy.
Dun Winter.
B. Tartarian.
Bristlepointed
Oat Husks.
×17

decimals of an inch. These may be compared together in different varieties of oats; and they will help to explain how it comes about that some oats with a low percentage of kernel have yet a high measure-weight. (*See Illustration.*)

I shall now proceed to direct attention to such points in the different varieties as may be made clearer by explanation. The analysis here given of an oat may be called a *faranalysis*, being an estimation of the percentage of far, kernel, or meal in an oat seed or grain. This percentage is most correctly found by the manual process of extracting the kernel from the husk. I began this work with my thumb nails, but they were soon worn down to the quick, and would answer no longer. Two brass pincers were worn out in succession by the abrasion of the silica in the husks. I then got a steel pincers, roughened on the inner faces, and this is the instrument I would recommend to others.

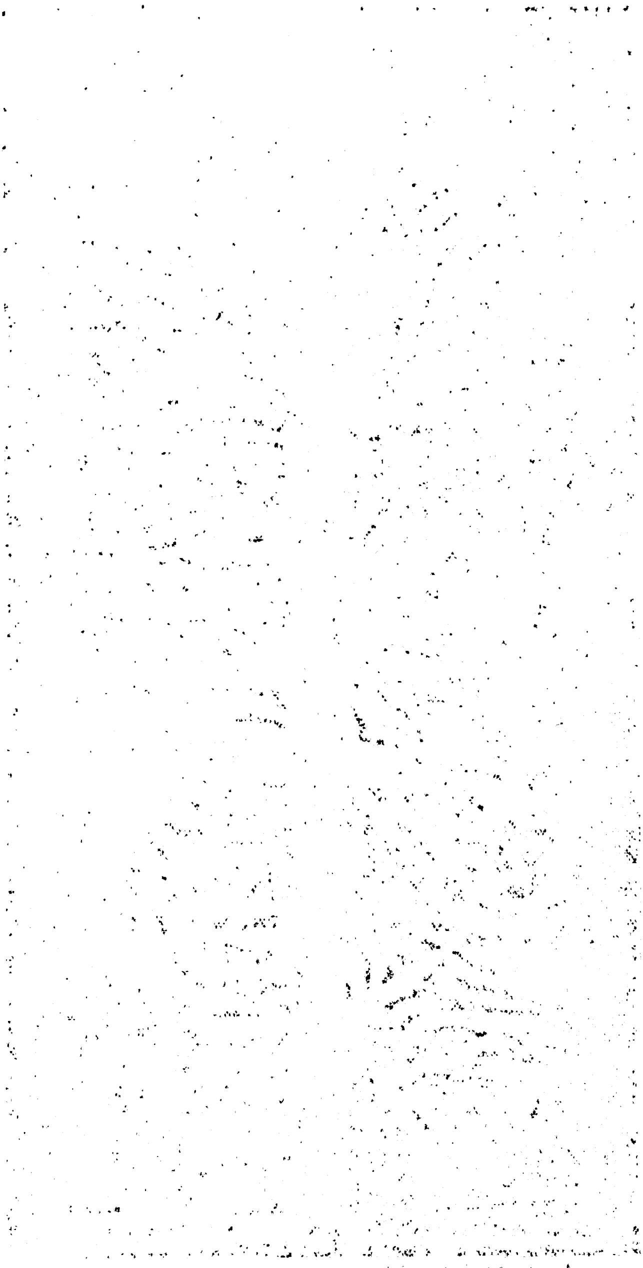
CANADIAN.

In the Oviform class of oats the Canadian variety attains to the greatest weight, rising as high, by ordinary measuring, as 50 lb. to the bushel; and, by the method of stirring the grain through a perforated filler, to nearly 54 lb. This is the 'Georgian Oat' of *Lawson's Manual* (p. 45). It forms a beautiful sample, consisting as it does of round, smooth grains. The outer husk goes round the whole grain, almost entirely enclosing the inner. (*See Illustrations.*) It is this roundness and smoothness to which the great measure-weight is due; for it is known that the more closely such grains, or grains of wheat, approach the spherical form the greater is their measure-weight. But while the measure-weight of Canadian is the highest attained by any oat, the percentage of kernel is the lowest. The Surprise oats included in this class, and falling to a kernel percentage of 65·90, are simply Canadian oats, grown in Washington and Oregon, under a new name. Nothing can more completely stagger a corn-dealer who believes that measure-weight is a test of quality, than a comparison of Canadian oats with Archangel. The Canadian may weigh

Oats in the Bushel.

Weight ℘B. 50lb.
% of kernel 69.12.

Weight ℘B. 38lb.
% of kernel 69.77.



50 lb., and show 69 per cent. of kernel; while the Archangel, weighing only 37 lb., contains 73¼ per cent. of kernel. No proper comparison can be made of oats differing so much in form. The long form and sharp point of the Archangel oat leave a great amount of vacant space in the bushel (*see Illustration*); so that the comparative measure-weight becomes meaningless. If differences of weight indicate difference of quality, the comparison should be most obvious in different samples of a given variety. And so we here find that the four higher weights of Canadian give, on an average, 3 per cent. of more kernel than the four lower weights. But the gradation is not regular; No. 7, with a weight of 47·88, has a higher percentage of kernel than No. 5, with a weight of 51·00. The average per cent. of kernel in this oat is 67·83.

The Canadian oat is an oat which Major Hallett has cultivated as a 'Pedigree' oat. It forms a beautiful sample, and it attains to the highest measure-weight of all the oats; but we see that for the miller it is the very worst, 100 lb. of an average Scots barley oat being equal to 110 lb. of Canadian oat.

But although the Canadian oat is a very inferior miller's oat, this does not prove that it may not be a good farmer's oat. If 110 lb. of Canadian can be produced at the same cost as 100 lb. of Scots barley, then, for the producer, the two oats are about equal. It is most important to keep these two aspects in view. The miller and general consumer of oats cares for nothing but a high percentage of kernel; the producer wishes to combine with a high percentage of kernel a large weight upon the acre. But which variety of oat a farmer can cultivate with the greatest profit is only to be ascertained by experiment.

POTATO.

The potato oat is probably the most generally cultivated oat in Great Britain. It is said to have been first discovered in a field of potatoes in Cumberland, in the year 1788. But we can hardly suppose that it was then evolved for the first time. In the old agriculture of this country, the various forms of the oat were cultivated separately only to a limited extent. The classification was into great oats and small oats, the small oats being mostly composed of the white and black varieties of *Avena strigosa*, mixed up with *Avena fatua*, and the great oats consisting of a mixture of many of the forms presently in cultivation. Selections of good forms were sometimes made, but the poor appliances of husbandry were hostile to the perpetuation of unmixed varieties. The Potato oat was therefore most probably a form which had grown in company with other forms from more distant sources of evolution or eduction than human observation could trace. The contention that *Ægilops ovata*, or *Æ. speltæformis*, has been turned into wheat; and that *Avena fatua* has been turned into Potato oats or Tartarian oats, by the cultivation of a few years, has not been verified, and it would imply a rate of evolution or transformation before which all living forms would become historical in a few generations.

Analyses are given in the table of 38 samples of Potato oats. The highest measure-weight, by ordinary measuring, is 49¼ lb. per bushel; and by the uniform method 49·86 lb., and the sample of this weight gives a percentage of kernel of 75·54. The sample giving the lowest 'uniform' weight of 41·65 lb. shows a percentage of kernel of 75·10. So that in this comparison a difference of weight of 8·21 lb. is accompanied by a difference in percentage of kernel of only 0·44. This can hardly be regarded as a practical difference. The three different analyses of No. 1 stand thus:—

(*a*)	75·48	
(*b*)	75·60	
(*c*)	75·54	Average, 75·54

The three analyses of No. 38 stand thus:—

(*a*)	75·12	
(*b*)	75·43	
(*c*)	74·76	Average, 75·10

showing in the latter a departure in two cases of ·33 per cent. from the average of the three; or, what might be an error were only one analysis made, of nearly as great amount as the difference between a measure-weight of 49·86 lb. and one of 41·65 lb.

Taking the 38 samples in three equal

groups, it will be seen that the averages stand as under :—

	Weight per Bushel.	Percentage of Kernel.
Higher weights,	48·65	76·34
Medium weights,	46·33	76·61
Lower weights,	44·73	75·97

So that here the highest measure-weight is not accompanied by the highest percentage of kernel. The reason of this in the present case is that many of the higher weights are prize samples, which have been hard dressed for show purposes. Hard dressing, as will be afterwards seen, not only rubs off the points of the husks, but also smooths down the minute teeth which grow on the ribs of the outer husk, and thus enables a greater quantity to flow into the bushel. But the practice is useless and misleading, inducing purchasers to buy samples which are not naturally heavy, but made so by hard dressing, while samples which may have a higher percentage of kernel and a greater natural measure-weight are neglected.

The best sample of Potato oats is No. 23, the percentage of kernel in which rises to 78. This is the kind of sample from which a fresh and pure stock should be raised. And any farmer who proposes to raise a pure stock should only enter upon the work after selecting his seed by analysis. To select by measure-weight can only be done after a small quantity has been produced. But the produce of single seeds can be analysed, and the decorticated kernels will be as good for seed as if they had on their husks.

The worst sample falls to a percentage of kernel of about 74. But in general very few samples depart one per cent. from the average 76·30.

The medium weights averaging 46·33, and the lower weights averaging 44·73, differ from each other 1·60 lb. per bushel, and 0·64 per cent. of kernel. These are not liable to the objection of over-dressing, and the difference in quality (percentage of kernel) is so small that no man could estimate its value by mere optical inspection.

A few samples in most of the varieties were dried at the heat of boiling water, and then tested; and it will be seen by going over the table that the percentage of kernel in dried oats is practically the same as in oats containing the ordinary commercial percentage of moisture, which is about 14. Thus sample No. 32 is given in its ordinary market state, and also as dried, and the results stand thus :—

Ordinary state, . .	75·47
Dried at 212°, . .	75·63

Again, No. 35 comes out thus :—

Ordinary state, . .	76·53
Dried at 212°, . .	76·32

The meaning of which results is that, in drying, the husk loses as many per cent. of moisture as the kernel. This fact has a considerable value for those farmers who would wish to test the quality of their oats by the simple process of extracting the kernels from a small sample; they may use a sample direct from the barn, and they will get as good a result as the chemist who goes through the more difficult process of drying.

The seeds in different samples of the same variety differ considerably in weight. Of the Scots Potato oats here examined, sample 33 has the smallest seeds, the pound containing 16,875, while No. 5 has the largest seeds, the pound containing 13,312. It might be thought that the larger seeds would give a higher percentage of kernel than the smaller, but all the advantage they show is only 0·10; thus showing in some degree that larger seeds have thicker husks than smaller seeds.

But this is better shown with seeds of one sample. Most varieties of oats produce, in good soil, two fertile florets, and some three, in each spikelet, and the percentage of kernel in the secondary floret or seed or breast pickle is much the same as in the chief seed. This point is examined in sample No. 20. A quantity of the larger seeds were selected and a quantity of the smaller, and the test resulted thus:—

	No. in lb.	Percentage of Kernel.
Seeds all large, . .	12,094	77·19.
Seeds all small, . .	18,269	77·47.

So that the smaller seeds have an advantage of only 0·28 per cent. With seeds taken at random and dried at 212°, this sample gives a farinal percentage of 76·92.

In measuring the thickness of the husks, a transverse section was made through the middle of the grain; one-half was then put under a microscope furnished with a micrometric eye-piece. It will be noticed that in general the outer pale is nearly double the thickness of the inner, and ranges in the Potato oat between ·0034 and ·0044 of an inch. The outer husk of the Canadian oat, which nearly meets in front, is about ·0060 of an inch thick.

SCOTS BARLEY.

The Barley oat, or Scots barley oat, sometimes written birlie or berlie, has been a selected form for more than 200 years. In an account of Buchan, supposed to have been written by Lady Anne Drummond, Countess of Errol, about the year 1680 (*View of Diocese of Aberdeen.* COLLECTIONS. Spalding Club), we are told that, 'the grain which grows most plentifully is oats, some of which they have good and fair; but they have another sort again, long, small, and very black, which strangers would hardly give to their horses; and yet the inhabitants make very good meal thereof. Sometimes they sow bear and reap oats, but it is not every kind of bear that doth this, but a peculiar sort which is called barley oats.'

The small black oat here alluded to is

botanically known as *Avena strigosa*, or by some placed in the genus *Danthonia*. It is not very clear from the above account how the barley oat came by its name, but the meaning seems to be that sometimes bere or barley seed produced a crop of oats. And this is probably to be explained by the fact that the seed of all the grains was very much mixed; so that in cases in which a mixture of damaged bere and good oats was sown, and little came up but oats, it was inferred that the bere or barley seed had been transformed,—and the produce was called barley oats. A belief in sudden transmutations of this kind has not yet disappeared even from scientific books of reference.

Of the Scots barley oat we have here before us 21 samples. The weight per bushel extends from 48·43 lb. to 42·52, and the percentage of kernel in the lowest weight is greater than in the highest. The greatest percentage of kernel attained is 77·15, and the least to which any sample descends is 74·82, showing a difference of 2·33 per cent. But the weight of both samples given by those who sent them is the same, namely, 42½ lb., while the difference between them found by my method of measuring is only 0·19 lb. on the bushel.

All the samples of Scots barley are in the ordinary market condition, none of them being hard dressed for exhibition; so that if high measure-weight is accompanied by high percentage of kernel, the fact should here be well seen. Arranging the 21 samples into three groups of 7 samples each, highest weights, medium, and lowest, the facts stand as below:—

	Average Weight.	Average per cent. of Kernel.
7 higher weights, .	46·59	75·87
7 medium weights, .	45·31	76·25
7 lower weights, .	44·25	75·56

The medium weights thus show a slight superiority in percentage of kernel, but it is not so marked as to be of any practical value in the corn market; a cental of Scots barley oats weighing 46½ lb. having an advantage over a cental weighing 44¼ lb. (per bushel) of only about 5 ounces of meal.

In sample No. 16 the larger seeds, numbering 13,541 to the pound, give a percentage in kernel of 76·76; the smaller seeds, numbering 20,250 to the pound, give a percentage of 76·96. In sample No. 8 an analysis of grains, one-half large and one-half small, gives a kernel percentage differing from that derived from a parcel taken at random by only 0·06, and showing that all the seeds of a stock have the same proportion of husk and kernel. Dried parcels of samples 8 and 21 give percentages hardly differing from those of the same samples in their market state of moisture.

HOPETOUN.

The two heaviest samples of Hopetoun oat, Nos. 1 and 2, having ordinary weights of 43½ and 44 lb., give a percentage of 74·72. The two lightest samples, Nos. 5 and 6, weighing 41½ and 42 lb., give percentages of 76·11 and 76·45; the lightest weights having the highest percentages of kernel, and showing measure-weight to be a very uncertain test of that element of quality which consists of percentage of kernel. The average percentage of kernel in the lower weights here is slightly greater than in the higher weights.

TAWNY.

The Tawny oat is a good deal grown in Ireland, and most of my samples were either produced there or produced in Scotland from Irish seed. The Tawny oat somewhat resembles the Dun Winter, but is much inferior to the latter as a milling oat. Sample No. 2 is the best here tested, rising to a percentage of 76·70. The heavier samples, with an average bushel of 45·26, give a kernel percentage of 74·67; the lighter samples, with a bushel weight of 44·08, give a percentage of 74·21.

SURPRISE.

The Surprise oat is simply Canadian or Georgian, grown in America, and probably introduced there from attaching an exaggerated importance to measure-weight.

CONIFORM CLASS.—DUN WINTER VARIETY.

The Dun Winter oat, in respect of percentage of kernel, is the best of all oats. In the finest samples it rises to 82 per cent. of kernel. And my experiments in growing it, from Irish seed and from English seed, show that it ripens as early when sown in spring as when sown in autumn, and that the percentage of kernel in spring-sown grain is as great as in autumn-sown. But my trials were not sufficiently extended to show the character of this oat as a farmer's oat. The spikelet has generally three grains, but the panicle does not show anything like the number of spikelets shown by the Potato oat. So that, although the Dun Winter is the best miller's oat, the farmer may find it deficient in number of grains. I think, however, there is no coloured oat more deserving of a fair trial, both as a farmer's and as a miller's oat.

The three groups of weights into which my samples are divided give results as below:—

	Average Weight per Bushel.	Percentage of Kernel.
Average of higher weights,	46·17	78·67
" medium weights,	44·39	79·95
" lower weights,	43·00	79·96

The lower weights were grown by myself, and, not having been much tossed about in thrashing or otherwise, the points of the husks were little broken or smoothed, so that the bushel contained more vacant space, and therefore less weight, than with such a sample as No. 1, which was much hummelled. But if measure-weight is to be applied as a test, it should be applicable under all ordinary commercial circumstances. Let us look at a sample of Canadian along with a sample of Dun Winter. To the eye of the unwary purchaser, the Canadian is by far the most tempting. Every grain is compact and as round as an egg, reflects the light, and flows through his fingers like water. The Dun Winter is a long and somewhat dull-looking grain, with the points of its husks standing out rather sharply, and the sample containing a great many smaller seeds. A quantity of it is poured into the bushel, and the weight is found to be 40 lb. The Canadian is next poured in, and the weight is found to be 50 lb. Can any buyer hesitate a moment longer as to which is the best quality? But now let us look a little further through the husks, and set the two against each other thus:—

Canadian,	50 lb.	69 per cent. of kernel.
Dun Winter,	40 lb.	79 per cent. of kernel.

We see that the Dun Winter, paying no attention to its low measure-weight, has 10 per cent. more of kernel than the Canadian. But the purchaser is confused by the much greater quantity which the Canadian gives to the quarter than the Dun Winter; the one giving 400 lb. and the other only 320 lb. Then, if he grinds a quarter of Canadian he will have (setting aside here the deductions to be made for drying, loss, and imperfect workmanship) 276 lb. of meal, while if he grinds a quarter of Dun Winter, he will have only 253 lb. But if he will be good enough to apply his common sense to this matter, and deal in corn by the cental, his eyes will be opened. There are four centals in the quarter of Canadian, giving as above 276 lb. of kernels; and if four centals of Dun Winter are placed against them, they will show 316 lb. of kernels.

KILDRUMMY.

The Kildrummy oat is a form of the Red oat. Sample No. 1 is a first prize sample, weighing, by ordinary measuring, 45½ lb., and giving a kernel percentage of 75·84, and may be compared with sample No. 3, weighing 40½ lb., with a percentage of 75·72. In quality both samples are really the same;

and the extra weight of the first has been secured in deference to the ignorance by which our agricultural shows are still regulated.

SANDY.

A pure sample of the Sandy oat gives a correct idea of a class of oats characterised by a faintly reddish hue in the outer husk or pale. It is a rather small oat, and very smooth, giving sometimes a high measure-weight. The best sample here tested (No. 15) gives a kernelage of 77·35 per cent., the worst 73·08, but this last contains unripe grains. Sample No. 1, which has the highest weight by the uniform method of filling the measure, has the next lowest percentage of kernel. It is a very beautiful sample, grown in Peeblesshire, of a bright red colour, with the pales tightly closed, and the grain consequently very smooth, and calculated to give a high measure-weight; and it shows clearly that, even with the same variety of oat, measure-weight will not determine between two samples which is the best.

A sufficient number of samples of Sandy

oats are here tested to enable us to compare averages thus :—

	Weight per Bushel.	Percentage of Kernel.
Average of higher weights, .	47·37	75·66
" medium weights,	46·09	76·05
" lower weights, .	44·37	75·48

For practical purposes there is thus no difference between the produce of the higher weights and the lower. As in several other varieties, the medium weights give slightly the better out-turn of meal.

The highest weight given to me by any correspondent is 45 lb., and this weight is found to give 76·14 per cent. of kernel. The lowest weight of ripe grain supplied weighs 40 lb. by ordinary measuring, and has the same percentage of kernel, namely, 76·20; the first was grown in Banffshire, the second in Dumfries.

A quantity of sample No. 11 was dried at 212° till the weight became permanent, and the percentage of the kernel and husk, as in previous cases, remained the same as in the ordinary hygrometric condition.

Of the same sample a quantity of the larger grains, giving 13,508 to the pound, showed a percentage of kernel of 77·08; while a quantity of the smaller grains, giving 20,069 to the pound, showed 75·89 per cent., being a difference of 1·19 per cent. But in this case the smaller seeds were not secondary florets, but small sizes of the main floret not proportionately filled.

SANDWICH.

All my samples of this variety are grown in Aberdeenshire, to which I think, under this name, it is chiefly confined. The three higher weights, averaging 45·50 lb., give an average per cent. of kernel of 75·60; while the three lower, averaging 43·88 lb., give an average per cent. of kernel of 76·17,—the lower weights being thus slightly better in quality than the higher.

EARLY ANGUS.

Ten samples of Early Angus are here tested. The highest weight by uniform measuring gives the lowest percentage of kernel, namely, 73·98. Two samples rise to a percentage of 76·85. The five higher weights average 45·95 lb., and are associated with a kernelage of 75·96 per cent.; the five lower weights average 43·75 lb., and give 75·82 of kernel,—both products being practically equal to the average 75·89.

FYVIE AND AFRICAN.

Fyvie and African are probably the same oat. Under both names a high percentage of kernel is shown; and if any farmer would raise a pure stock, he would do a service to the country.

BROWN SWEDISH.

I raised a small stock from brown seeds selected from a sample of Swedish oats. This stock forms the prettiest sample of all the coloured oats, while the percentage of kernel is fully above the average of the Coniform class.

FUSIFORM CLASS.—BLACK TARTARIAN VARIETY.

The black and white Tartarian oats are usually described as having the panicle all on one side. But this is not properly descriptive of the structure of these oats. In the ears of all oats, and all grasses having a panicled ear, the lateral branches arise all round the central axis, and before coming out of the sheath the branches necessarily lie parallel, and close to the axis. The peculiarity of the Tartarian varieties is, that the branches retain this parallel position after coming out of the sheath, while in other varieties the branches, when freed of the sheath, spread out from the axis. That the grains of the Tartarian hang to one side is a mere mechanical effect of the stalk being temporarily or permanently blown off the perpendicular by the wind.

Seventeen samples of black Tartarian are here tested from various parts of England, Ireland, and Scotland, and one from Sweden, —and the qualities of the seeds are nearly uniform throughout. Sample No. 10, with the high percentage of 76, was very thin upon the ground; and although it can hardly be regarded as a fair agricultural crop, the result shows that there are higher possibilities in this oat than ordinary tillage usually brings out. The percentage of kernel of 74·15 (No. 11) is the upper limit of these samples produced in ordinary cultivation; the lower limit is 68·06 per cent. (No. 18). In this sample from Ireland many of the main grains of the spikelet have only a very meagre kernel, while the secondary grain or breast pickle is embedded in the outer husk of the main seed,—the cause of this defect probably being the badness of the season of 1867, in which the sample grew. In this season the measure-weight of oats in Aberdeenshire fell a pound and a half below the average of twenty years, being the greatest departure from the average during that time.

Arranging these eighteen samples into three groups by uniform measure-weight, the comparison stands thus :—

	Weight per Bushel.	Percentage of Kernel.
Average of higher weights, .	45·85	73·26
" medium weights,	43·14	73·05
" lower weights, .	41·02	70·61

Here the results, in a feeble and unemphatic way, go to support the belief that high measure-weight is accompanied by high percentage of kernel. But a quarter of a per cent. between the higher and the medium weights for a difference of $2\frac{3}{4}$ lb. per bushel is not solid enough to stand upon. If No. 10 is taken out of the medium average the percentage of kernel will be 72·45, making a difference for the 2¾ lb. of bushel-weight of 0·81 per cent. of kernel, and this probably indicates nearly the truth. Deleting sample No. 18 also, as being exceptional, the comparison would stand thus :—

	Weight per Bushel.	Percentage of Kernel.
Average of higher weights, .	45·85	73·26
„ medium weights, .	43·15	72·45
„ lower weights, .	41·09	71·12
Then from higher to medium,	2·70	0·81
„ medium to lower,	2·06	1·33

The greater difference in measure-weight thus gives the lesser difference in percentage of kernel. And these differences in percentage of kernel are so small for very considerable differences of measure-weight, as really to have little practical value for the corn market. But small as they are, were they invariable and certain they could be based upon in fixing prices; but when we know that hard machine thrashing, or the frequent turning of oats in the granary, will raise the measure-weight, especially of the Fusiform class of oats, a few pounds on the bushel, while the percentage of kernel remains practically the same, the importance of measure-weight as a test of quality becomes very doubtful.

Although the black Tartar is an oat with a low percentage of kernel, and therefore inferior as a miller's oat, it has a comparatively rich panicle, and may thus be a good farmer's oat. It is one of the oats which Major Hallett cultivates as a 'Pedigree' oat.

WHITE TARTARIAN.

Under good cultivation, we see from sample No. 4 that white Tartar rises to as high a percentage of kernel as black. The higher weights of this oat, averaging 43·40 lb., give a kernel percentage of 71·04, and the lower, averaging 39·48, a percentage of 68·74, being a difference of 2·30 per cent. for a difference in weight of 3·92 lb. per bushel.

FINLAY AND SWISS.

The Finlay and Swiss oats are very much alike, and are probably the same oat under different names. They are both of the same measure-weight, and have the same percentage of kernel, namely, about 74·80.

The Swiss is an early oat, arising from the fact of its light straw. The walls of the stalk are very thin, and require little material to bring them to their mature condition; hence, a short season is sufficient to complete the process of ripening. The weight of grain and the weight of straw in a crop of this variety are about equal. The same is true in a crop of the Potato oat.

ARCHANGEL.

Foreign oats usually contain a large admixture of impurities, which conceals from the miller the actual value of the oats. Pease, tares, wheat, barley, and rye do no harm, and help to keep up the character of the stock of oats in which they are mixed. In sample No. 1 of the Archangel oats here tested 7 per cent. by weight was found of pease, tares, barley, rye, stones, grass seeds, etc., etc. Of course only oat seeds were taken for analysis. Of three foreign samples tested, the heaviest gives the highest percentage of kernel, namely 74·32.

I sowed a small plot of Archangel oats to observe the effects of change of circumstances. The character of the produce was the same as that of the seed, but all the parts were more fully developed, the percentage of kernel being (No. 4) 76·58, or equal to a good Potato oat. Some farmer who is not prejudiced in favour of oats having a high measure-weight, might give the Archangel a fair trial in this country.

GREY TARTARIAN. ROUGH PANICLE. SMOOTH PANICLE.

Forms of oats which I have called by the names of Grey Tartarian, Rough panicle, and Smooth panicle, were found by me in nursery ground on heaps of rubbish formed of miscellaneous materials, the seeds being from packing materials of shops in Aberdeen. Fine ears of various wheats were to be seen mixed with beautiful plants of rye; six-rowed barleys showed 98 seeds to the spike; a great many forms of cultivated oats stood in tufts here and there, and the wild oat, in two or three colours, insinuated itself into society where it was hardly deemed respectable.

The three forms of oat here tested give

kernel percentages of 77·90, 80·95, and 79·27. But were these forms grown in a close crop, such percentages could not be expected. Had I been inclined to start new and pure stocks of various cereals, a good opportunity was presented on that heap of shot rubbish. Probably it would pay a few farmers here and there, with a good knowledge of the cereals, to devote their whole capital to the production of pure stocks of the best varieties. No new forms are likely to be now found; and, if hybridising is not impossible, it is still not likely to produce better forms than those already existing.

DANISH VARIETIES.

Of the four samples of oats from Denmark, the heaviest, with a weight of 44·07 lb., gives the lowest percentage of kernel, namely, 72·67, while the lowest weight has the highest weight of kernels, 74·24.

GERMAN VARIETIES.

In the case of the four German samples also, the highest weight per bushel is accompanied by the lowest percentage of kernel. In these, and in most of the Continental samples, there are generally three or four varieties.

SWEDISH VARIETIES.

The Swedish oats here tested have a pretty high measure-weight with a low percentage of kernel, and somewhat resemble the Canadian oat. No law governing the relationship of measure-weight and proportion of kernel can be here detected.

RUSSIAN VARIETIES.

(Other than Archangel.)

The heaviest sample of Russian oats, weighing by uniform method 48·63 lb., has the highest percentage of kernel, namely, 75·08; but the lowest weight of 40·89 lb. comes up to a percentage of 74·04, and no regular order is maintained.

THE SMALL OAT.

The Small oat (*Danthonia strigosa*), as it grows either white or black, intermixed with other varieties, has a percentage of kernel of about 74½; but when cultivated on good soil, as was done for the present work, to test its capabilities, its kernel develops to a percentage of fully 78. Its measure-weight is a thing entirely uncertain, depending very much on the amount of hummelling which its bristly points receive. There are about 30,000 grains in the pound—being about three times as many as in a pound of Canadian. The Countess of Errol tells us that it made good meal for the old farmers of Buchan; it is also frequently mentioned by Rogers as for sale in the ancient corn markets of England; and it had its fiars struck in Scotland, as well as the best of them, down into this nineteenth century. Their Longfellows and their Finefellows may try to laugh it out of countenance and out of cultivation, but it still haunts the fields of which it was once the rightful owner, defies elimination by the riddle, and claims a spot of earth here and there 'in spite o' them a'.'

THE WILD OATS (*Avena fatua*).

It is not because the wild oats are very defective in kernel that they are not intentionally cultivated. The worst of them has about as high a percentage of kernel as the Canadian oat. The shorter white form rises to a percentage in kernel of 74; and the longer to a percentage of 72½. And even the common brown form, with its percentage of 67½, can throw up, when liberally treated, a panicle putting all other oats into the shade, and carrying a load of meal that would not discredit a Scots barley. But the wild oats do not like the slavery of regular husbandry, to which it seems they were at one time bound. These are the oats of which Bellenden, in translating Boetius, speaks: 'In Buchquhane growis aitis but ony tilth or seid. Quhen the peple passis with set purpos to scheir thir aitis, they find nocht but tume hulis; yet quhen thay pas but ony premiditation, thay find thir aitis ful and weil ripit. Thir thingis cumis nocht be nature, but erar be illusiaun of devillis.' From which the only clear conclusion is, that 'thir' wild oats, in order to save themselves from the penalties of thrashing and grinding, had entered into a compact with the devil to shake them out of the chaff scales before they could be reaped. If such a result could come 'be nature,' it might be attributed to the peculiar ball-and-socket connection of the wild oat floret to the hanger; we leave the reader to form his own opinion.

DEDUCTIONS AND CONCLUSIONS.

It has been already stated that the bushel weights here used for comparing different samples are found by a uniform method of stirring the grain through a perforated tin dish, and that in general this method gives the bushel a weight of several pounds more than is given by the ordinary method of filling the bushel. In a few cases of hard dressing the ordinary method of filling has given very nearly the same weight as the uniform method. All my samples, after being cleared of everything except oat seeds with the husk upon them, were measured and weighed three times, and the mean taken thus: The weight of a sample as sent to me is 43 lb. My own trials give—

1.	7989	troy grains.
2.	8000	"
3.	8013	"
Average,	8001	$\times 40 = \frac{320040}{7000} = 45{\cdot}72$ lb.

If, therefore, the reader would rather look at the percentages of kernel in relation to the ordinary weights than in relation to the weights made by my method, he will not be far wrong if he make a deduction from my weights of 3 lb.

Has any clear relationship, then, been discovered between measure-weight and meal? From the final abstract it is seen that the Oviform class of oats, with an average weight in the samples tested of 46·23 lb. per bushel (or 43), give an average percentage of kernel of 76·34; while the Fusiform class, with a weight of 43·30 lb. (or 40), give a percentage of 73·23. These facts seem to leave no doubt that, taking these whole classes, the class which has the highest weight has also the highest percentage of meal, a difference of 1 lb. on the bushel being accompanied by a difference of 1 per cent. in the kernel. Between the Fusiform class and the Coniform there is a difference in weight of 2·19 lb., and in per cent. of kernel of 2·84; and between the Coniform and Oviform a difference in weight of 0·74 lb., and in per cent. of kernel of 0·27. These differences, although not harmonising with each other, all go in the direction of supporting the doctrine that the higher the measure-weight the higher will be the percentage of meal.

But as whole classes of oats are not dealt with by farmers or corn factors, what is the importance to be attached to measure-weight in the corn market? Excluding from consideration all exceptional oats here tested, let us look at a few of the facts. Were measure-weight an unexceptionable test of percentage of kernel, the Canadian oat, having the highest measure-weight, ought to have the highest percentage of kernel; but it has the lowest. How is this to be explained? The Canadian has the thickest husk of all the oats; but were the husk of oats of very low specific gravity, the weight of Canadian could not be so high. It is very difficult, however, to determine the specific gravity of husks. If any solution is taken, and a piece of husk freed from air is put into it, the husk becomes saturated with the solution; but it is the specific gravity of the dry husk which is wanted—not the specific gravity when it is 'water-logged.' The objection here implied to the use of solutions is equally an objection in finding the specific gravity of grains. I endeavoured to find the specific gravity of dry husks micrometrically. Small triangular pieces of husk were cut out and their dimensions measured under the microscope; they were then accurately weighed, and the cubic bulk which their dimensions gave compared with the weight of the same bulk of water. The results in a few cases stand thus:—

	Specific Gravity of Dry Oat Husk.
Canadian, . .	·934
Potato, . .	·974
Sandy, . . .	·906
English barley oat, .	1·009

By the application of water the husks increase in weight faster than they increase in bulk, so that saturated Canadian husk has a specific gravity of 1·241. It is thus seen that the husk of oats has a specific gravity not very much below that of the kernel; so that the high measure-weight of Canadian is to be explained by the ovoid form and great smoothness of the grain. The measure-weight of bare oat kernels is about 55 lb., while that of good Canadian oats measured in the same way is nearly 54 lb.; indeed, as the Canadian kernel has a slight hollow in it, the measure-weight of its kernels and its undecorticated grain will be about equal.

The case of the Canadian oat puts it beyond all doubt that a theory which essentially associates high measure-weight with farinacity cannot be accepted.

We have already noted many cases in which high weight was associated with low percentage of meal in the same variety of oats; let us compare different varieties. The Dun Winter and the Tawny, which somewhat resemble each other in colour, and weigh about the same, 44½ lb. (41½), differ in percentage of kernel 5·03. Sandwich also weighs about the same as Tawny, and has 1·31 per cent. of more kernel. Swedish samples, with about the same weight, have nearly 10 per cent. less kernel than Winter, and nearly 5 per cent. less than Tawny. A more extended comparison will show further differences.

On the other hand there are many comparisons which show a higher percentage of kernel going along with the higher bushel-weight. Potato weighs about 1 lb. more than Scots barley, and has 0·41 per cent. of more kernel. English barley (which is just Scots barley grown in England) weighs 1·31 lb. more than Sandy, and has 1·07 per cent. of more kernel. Kildrummy and Scots barley have weights and percentages about equal to each other.

The general conclusion must be that the measure-weight, and the variations which occur in measure-weight, afford no certain clue to percentage and variations in percentage of kernel.

Measure-weight is influenced by a good many causes which do not influence the statical relationship of husk and kernel in oats, and of bran and flour in wheat. The measure-weight of grain, if still retaining the same percentage of moisture, is increased by the frequent turning it gets in a granary. Mere external damp, by rendering the grain less smooth, diminishes the measure-weight. Probably the half of a field of grain, cut down and secured dry, will weigh more than the other half which has been soaked with rain after being reaped. The swelling which takes place from the rain is never fully reduced, while the percentage of kernel remains unaltered. There are other ways by which measure-weight may be increased sometimes to be seen illustrated at agricultural shows; but there is only one way of increasing percentage of kernel,—the proper cultivation of the best varieties.

Now, if there is no certainty that of two samples the heavier shall yield the higher percentage of kernel, what meaning are we to attach to a higher or lower annual measure-weight? In the year 1872 the average weight of oats for Edinburgh market falls 1·31 lb. below the average of thirteen years; and the weight of 1878 rises 0·94 lb. above the same average. Had these two years, therefore, the highest and lowest percentages of kernel during these thirteen years? I do not think we have yet sufficient data for fully explaining the meaning of the annual measure-weight. When we find Canadian, so nearly resembling Potato, and, while with a higher weight, presenting a lower percentage of kernel, the meaning of the annual weight is seen to be less simple than might have been expected. With all other circumstances the same, probably 1 per cent. higher of kernel would raise the annual weight 1 lb. But if the ripening part of the season should produce 1 per cent. of kernel above the average, and be followed by a harvest of cold, rainy weather, the measure-weight would probably be less than without the 1 per cent., but with bright, dry harvest weather. This will be better seen when we come to 'Measure-weight and Moisture,' where the experiments show that grain after being soaked in water never returns to its original measure-weight. A dry, warm season may be too rapid for giving the fullest development of the oat kernel, but may produce a smooth and tightly closed husk which shall give a high weight of bushel. A larger kernel requires greater length of time to lay in all the central starch, and then it prevents the husk from so fully closing as it does on a smaller kernel. Hence the grain is rougher, and runs less compactly into the bushel and yields less weight, while the quality is actually better.

TABLES,

Showing the Percentage of Kernel in relation to the Bushel-weight in about Fifty Varieties of cultivated Oats; also the Number of Grains in a Pound, and the Thickness of the Husks of the different varieties; the whole being arranged in three classes, Oviform, Coniform, and Fusiform.

I.—Oviform Class.

Canadian Variety.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. Hurst & Son, London. Grown in Hampshire. Crop of 1866. Thickness of o. h. ·0057 inch. Thickness of i. h. ·0035 inch. Mean of 4 analyses,	10,875	...	53·86	69·04
2. Raynbird & Co., Basingstoke. Grown in Surrey. Crop 1866. Thickness of o. h. ·0065 inch. Thickness of i. h. ·0036 inch. Mean of 3 analyses,	11,062	50·00	53·82	69·12
3. Lawson & Son, Edinburgh. Grown in Surrey. Crop 1866. o. h. ·0061; i. h. ·0037 inch. Mean of 3 analyses,	10,957	50·00	53·65	69·17
4. Lawson & Son, Edinburgh. Grown England. Crop 1866. o. h. ·0061; i. h. ·0036 inch. Mean of 3 analyses,	12,500	48·00	51·34	69·92
5. George Sheppard, N. Pacific Railroad, Montana, U.S. Crop of 1872,	14,000	48·00	51·00	65·60
6. Mr. Yeo, *p.* Samuel Ball, Barnstaple, Arlington, Devonshire. o. h. ·0062; i. h. ·0027 inch. Mean of 3 analyses,	13,437	...	48·63	64·90
7. Captain Hallett, Brighton ('Pedigree') 'Chalkdowns,' Sussex. Crop 1867. o. h. ·0063; i. h. ·0030 inch. Mean of 3 analyses,	12,500	45 to 48	47·88	65·93
8. Thomas Kennedy & Co., Dumfries, Dumfriessh. Crop 1866. o. h. ·0060; i. h. ·0032 inch. Mean of 3 analyses, (This sample is not pure.)	13,125	43·00	47·82	68·92
Average percentage of Kernal in greater weights (1-4),	...	...	53·17	69·31
Average percentage of Kernel in lesser weights (5-8),	...	...	48·83	66·34
Average percentage of Kernel in Canadian Oats,	...	...	51·00	67·83

POTATO VARIETY.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. Mr. J. Bruce, Collithie, Aberdeenshire. Crop of 1868. o. h. ·0039; i. h. ·0019. Mean of 3 analyses, . .	16,812	49¼	49·86	75·54
2. Drummond Bros., Edinburgh. East Lothian. Crop 1866. o. h. ·0044; i. h. ·0021. Mean of 3 analyses, . .	15,125	44	49·82	75·93
3. M'Lean & Hope, Leith. Mid-Lothian (?) Crop of 1866. o. h. ·0045; i. h. ·0023. Mean of 3 analyses, . .	15,062	46	49·53	75·90
4. Mr. Peter Beattie, Dunnydeer, Aberdeenshire. Crop 1867. First Prize. o. h. ·0039; i. h. ·0026. Mean of 3 analyses, . .	13,375	47½	48·88	76·69
5. Messrs. James and Thos. Clark, Oldhamstocks Mains, Haddingtonshire. Crop 1867. o. h. ·0038; i. h. ·0020. Mean of 3 analyses, . .	13 312	46	48·69	77·06
6. Mr. J. Bruce, Collithie, Aberdeenshire. Crop 1867. Seed from Haddington. First Prize. o. h. ·0043; i. h. ·0023. Mean of 3 analyses, . .	14,187	45¾	48·59	77·60
7. Mr. T. Duff, Edinburgh. 'Ferguson's Pedigree.' Crop 1870. Exhibited at Edinburgh Show. Mean of 2 analyses, . . .	13,755	45½	48·50	75·53
8. Mr. Ferguson, Kinnochtry, Forfarshire. 'Pedigree.' Crop 1870. Tested March 4, 1871. Mean of 2 analyses, 75·48, 75·46, ...	13,685	45⅛	48·50	75·47

POTATO VARIETY—*continued.*	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
9. Drummond Bros., Edinburgh. East Lothian. Crop 1868. o. h. ·0042; i. h. ·0030 inch. Mean of 3 analyses, . .	15,937	46	48·47	75·43
10. Wm. M'Combie, M.P., Tillyfour, Aberdeenshire. Crop 1872. First Prize, . .	14,490	45⅛	48·00	76·87
11. Robert Spring, Monymusk, Aberdeenshire. Crop 1872. Second Prize, . . .	13,720	45¼	48·00	77·20
12. Mr. Adam, King Edward, Aberdeenshire. Crop 1867. 'Commended.' o. h. ·0041; i. h. ·0025 inch. Mean of 3 analyses, . .	14,250	...	47·84	77·14
13. Drummond Bros., Edinburgh. Forfarshire. Crop 1866. o. h. ·0044; i. h. ·0024 inches. Mean of 3 analyses, . .	15,000	43	47·81	76·00
14. William Murray, Tipperty, Aberdeenshire. Crop 1866. o. h. ·0036; i. h. ·0017 inch. Mean of 3 analyses, . .	15,837	...	47·15	77·45
15. T. Mackenzie & Sons, Cork. Grown Wicklow. Crop 1867. o. h. ·0041; i. h. ·0022 inch. Mean of 3 analyses, . .	17,062	42	46·87	74·16
16. Dickson & Turnbull, Perth, Perthshire. Crop 1866. o. h. ·0037; i. h. ·0018 inch. Mean of 3 analyses, . .	14,812	...	46·72	76·53
17. John Exley, Mark Lane, London. Ireland. Crop 1867. o. h. ·0039; i. h. ·0018 inch. Mean of 3 analyses, . .	16,000	40	46·60	76·35

POTATO VARIETY—*continued.*	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
18. Thomas Imrie & Sons, Ayr, Ayrshire. Crop 1866. o. h. ·0037; i. h. ·0024 inch. Mean of 3 analyses, . .	15,000	43	46·56	77·11
19. W. Drummond & Sons, Stirling, Stirlingshire. Crop 1866. o. h. ·0036; i. h. ·0017 inch. Mean of 3 analyses, . .	14,937	42	46·52	76·08
20. W. M'Combie, M.P. (B. Reid & Co.), Tillyfour. Crop 1866. o. h. ·0044; i. h. ·0020 inch. Mean of 3 analyses, . .	16,125	45½	46·43	76·68
(*a*) One half of seeds taken large, and half small, . . .	13,666	...	...	77·05
(*b*) Seeds all largest, . .	12,094	...	...	77·19
(*c*) Seeds all smallest, . .	18,269	...	...	77·47
(*d*) Seeds at random, dried at 212°, ...	17,937	...	45·21	76·92
The corn thus fully dried is of less measure-weight than in its ordinary market condition.				
21. Drummond Bros., Edinburgh. Leuchars, Fifesh. Crop 1866. o. h. ·0039; i. h. ·0021 inch. Mean of 3 analyses, . .	15,000	41¾	46·21	77·05
22. Drummond Bros., Edinb. Gogar, Mid-Lothian. Crop 1866. o. h. ·0034; i. h. ·0018 inch. Mean of 3 analyses, 77·23, 77·20, 77·26, ...	15,687	43½	46·07	77·23
23. Lawson & Son, Edinburgh. Berwick (?) Crop 1866. o. h. ·0035; i. h. ·0018 inch. 3 analyses, 78·11; 78·01; 78·12, ...	15,312	42½	46·05	78·08
24. Dickson & Turnbull, Perth, Perthshire. Crop 1866. o. h. ·0039; i. h. ·0024 inch. Mean of 3 analyses, 75·65, 76·25, 75·82, ...	15,812	...	46·01	75·91

POTATO VARIETY—*continued.*	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
25. Mr. Thom, per Ben. Reid & Co., Quithillhead, Aberdeenshire. Crop 1866. o. h. ·0038 ; i. h. ·0027 inch. Mean of 3 analyses,	15,500	43	45·72	76·70
26. Stewart & Sons, Dundee. Crop 1866. Forfarshire. 'Highly cultivated land.' o. h. ·0036 ; i. h. ·0018 inch. Mean of 3 analyses,	16,312	41	45·58	76·23
27. Thomas Kennedy & Co., Dumfries, Dumfriessh. Crop 1866. o. h. ·0039 ; i. h. ·0017 inch. Mean of 3 analyses,	16,375	41	45·49	74·68
28. James H. Harvey, Pitgersy, Aberdeenshire. Crop 1866. o. h. ·0037 ; i. h. ·0019 inch. Mean of 3 analyses,	16,000	42	45·38	75·92
29. Stewart & Sons, Dundee. Carse of Gowrie, Perth. Crop 1866. o. h. ·0036 ; i. h. ·0018 inch. Mean of 3 analyses,	15,875	42	45·21	76·18
30. James M'Adam, Newmachar, Aberdeenshire. Crop 1868. o. h. ·0037 ; i. h. ·0024 inch. Mean of 3 analyses,	15,062	...	45·21	76·26
31. Dickson & Turnbull, Perth, Perthshire. Crop 1866. o. h. ·0035 ; i. h. ·0022 inch. Mean of 3 analyses,	15,187	...	45·14	76·28
32. Mrs. Dodds, Artnacrea, Clough, County Antrim. Crop 1867. o. h. ·0042 ; i. h. ·0023 inch. Mean of 3 analyses,	15,000	...	44·95	75·47
(*a*) Dried at 212°,	17,937	...	...	75·63

POTATO VARIETY.—*continued.*	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
33. Drummond Bros., Edinburgh. Loanhead, Mid-Lothian. Crop 1866. o. h. ·0034; i. h. ·0014 inch. Mean of 3 analyses,	16,875	43½	44·91	76·96
34. Northern Agrcl. Co., Aberdeen, Aberdeenshire. Crop 1866. o. h. ·0040; i. h. ·0018 inch. Mean of 3 analyses,	14,937	41	44·74	75·75
35. George Stephen, Bonnyton, Aberdeenshire. Crop 1867. o. h. ·0038; i. h. ·0025 inch. Mean of 3 analyses,	14,250	...	44·60	76·53
(*a*) Dried at 212°,	16,250	...	...	76·32
36. Stewart & Sons, Dundee. Forfarshire, 'muirland recent.' Crop 1866. o. h. ·0033; i. h. ·0020 inch. Mean of 3 analyses,	15,625	42¼	44·32	76·22
37. Geo. Low, Newmachar, Aberdeenshire. Crop 1866. o. h. ·0040; i. h. ·0025 inch. Mean of 4 analyses,	15,687	41	44·23	76·04
38. George Stephen, Bonnyton, Aberdeenshire. Garioch. Crop 1866. o. h. ·0035; i. h. ·0018 inch. Mean of 3 analyses,	16,000	37	41·65	75·10
Average percentage of Kernel in greater weights (1-13),	...	...	48·65	76·34
Average percentage of Kernel in medium weights (14-25),	...	...	46·33	76·61
Average percentage of Kernel in lesser weights (26-38),	...	...	44·73	75·97
Average percentage of Kernel in Potato Oats,	...	...	46·57	76·30

SCOTS BARLEY VARIETY (also spelled Birlie, Berlie, etc.)	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. Drummond Brothers, Edinburgh. Mid-Lothian. Crop 1866. o. h. ·0034; i. h. ·0020 inch. 3 analyses (74·98; 74·98; 75·06)	16,187	43½	48·43	75·01
2. J. Tremble & Sons, Penrith. Edenside, Cumberland. Crop 1866. o. h. ·0040; i. h. ·0023 inch. Mean of 3 analyses, . .	15,375	...	46·91	75·50
3. J. Tremble & Sons, Penrith. Newton District, Cumberland. Crop 1866. o. h. ·0034; i. h. ·0018 inch. Mean of 4 analyses (October 8; Nov. 7; Dec. 10, 23), . .	14,937	...	46·67	76·19
4. William Murray, Tipperty, Aberdeenshire. Crop 1866. o. h. ·0038; i. h. ·0017 inch. Mean of 3 analyses, . .	16,312	...	46·15	76·64
5. Lawson & Son, Edinburgh. Lothians or Berwick. Crop 1866. o. h. ·0036; i. h. ·0019 inch. Mean of 3 analyses, . .	16,125	42½	46·08	76·05
6. Mr. Tait, Newburgh, Aberdeenshire. Mill of Mennie, seaside. Crop 1866. o. h. ·0037; i. h. ·0025 inch. Mean of 3 analyses, . .	17,123	42	45·99	75·81
7. Mr. Tait, Newburgh, Aberdeenshire. Nether Leask, Slains. Crop 1866. o. h. ·0038; i. h. ·0022 inch. Mean of 3 analyses (June, July, October), ...	17,000	42	45·87	75·86
8. ———, Newhills, Aberdeenshire. Crop 1866. o. h. ·0040; i. h. ·0017 inch. Mean of 3 analyses, . .	15,437	42½	45·77	77·15
(*a*) Seeds selected, half large, half small, . . .	15,406	...	...	77·21
(*b*) Dried at 212°, . . .	17,437	...	...	77·61

SCOTS BARLEY—*continued.*	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
9. Benjamin Reid & Co., Aberdeen. Thurso, Caithness-sh. Crop 1866. o. h. ·0040; i. h. ·0025 inch. Mean of 3 analyses, . .	17,249	42½	45·58	74·82
10. Mrs. Dodds, Artnacrea House, Coleraine, County Antrim. Crop of 1867. o. h. ·0044; i. h. ·0024 inch. Mean of 3 analyses, . .	15,625	...	45·40	75·98
11. Mr. Merchant, Newton, Deeside, Aberdeenshire. Crop 1866. o. h. ·0036; i. h. ·0021 inch. Mean of 3 analyses, . .	16,125	41¾	45·28	75·75
12. W. Drummond & Son, Stirling, Stirlingshire. Crop 1866. o. h. ·0042; i. h. ·0018 inch. Mean of 3 analyses, . .	15,687	41½	45·07	76·26
13. James Stephen, Kinmundy. Newmachar, Aberdeenshire. Crop 1866. o. h. ·0041; i. h. ·0020 inch. Mean of 3 analyses, . .	16,687	40	45·04	76·81
(*a*) Seeds half large and half small. Mean of 3 analyses, . .	15,719	...	...	77·01
14. James Stephen, Kinmundy. Seed from Ben. Reid & Co. Crop 1876, ...	15,960	42	45·00	76·95
15. Mr. Tait, Newburgh, Aberdeenshire. Knapperna, Slains. Crop 1866. o. h. ·0036; i. h. ·0022 inch. Mean of 3 analyses, . .	17,748	40	44·85	74·93
16. James Stephen, Kinmundy, Aberdeenshire. Crop 1866. o. h. ·0043; i. h. ·0025 inch. Mean of 3 analyses, . .	16,561	...	44·64	76·74
(*a*) Seeds half large, half small,	16,125	...	..	76·98
(*b*) Seeds taken all largest, .	13,541	...	...	76·76
(*c*) Seeds taken all smallest, .	20,250	...	...	76·95

SCOTS BARLEY—*continued.*	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
17. Northern Agricultural Company, Aberdeen, Aberdeenshire. Crop 1866. o. h. ·0037; i. h. ·0021 inch. Mean of 3 analyses,	17,061	40¾	44·67	75·50
18. Northern Agricultural Company, Aberdeen, Aberdeenshire. Crop 1866. o. h. ·0036; i. h. ·0021 inch. Mean of 3 analyses,	16,937	40	44·55	75·70
19. Northern Agricultural Company, Aberdeen, Aberdeenshire. Crop 1866. o. h. ·0038; i. h. ·0015 inch. Mean of 3 analyses,	16,687	40	44·49	75·32
20. William Smith, Aberdeen, Aberdeenshire. Crop 1866. o. h. ·0038; i. h. ·0018 inch. Mean of 4 analyses,	17,249	40	44·03	75·34
21. William Henderson, Kinmundy, Aberdeenshire. Crop 1867. o. h. ·0033; i. h. ·0018 inch. Mean of 3 analyses,	17,062	...	42·52	75·48
(*a*) Dried at 212°,	19,700	...	...	75·10
Average percentage of Kernel in greater weights (1-7),	...	...	46·59	75·87
Average percentage of Kernel in medium weights (8-14),	...	...	45·31	76·25
Average percentage of Kernel in lesser weights (15-21),	...	...	44·25	75·56
Average percentage of Kernel in Scots Barley Oats,	...	...	45·38	75·89

Hopetoun Variety.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. Drummond Bros., Edinburgh. East Lothian. Crop 1866. o. h. ·0035; i. h. ·0028 inch. Mean of 3 analyses, . .	17,375	43¼	47·50	74·71
2. M'Lean & Hope, Leith. Lothian. Crop 1866. o. h. ·0038; i. h. ·0019 inch. Mean of 3 analyses, . .	17,812	44	47·35	74·72
3. A. S. Wilson, N. Kinmundy, Aberdeenshire. Crop 1866. Part Canadian and Potato. Can. o. h. ·0059; i. h. ·0043 in. Pot. o. h. ·0039; i. h. ·0030 in. Hop. o. h. ·0044; i. h. ·0030 in. Mean of 3 analyses, . .	14,750	...	47·34	77·44
4. Samuel Ball, Miltown Malbay, County Clare. Crop 1867. o. h. ·0037; i. h. ·0020 inch. Mean of 3 analyses, . .	16,312	...	46·87	75·74
5. William D. Wilson, Limerick, County Limerick. Crop 1867. Mean of 3 analyses,[1] . .	16,250	41½	45·98	76·11
6. Lawson & Son, Edinburgh. Lothians or Berwick. Crop 1866. o. h. ·0033; i. h. ·0017 inch. Mean of 3 analyses, . .	15,875	42	45·39	76·45
(a) Dried at 212° Fahr., . .	17,375	...	...	76·44
7. Drummond Bros., Edinburgh. Loanhead, Mid-Lothian. Crop 1866. o. h. ·0037; i. h. ·0015 inch. Mean of 3 analyses, . .	18,937	43½	43·94	75·31
Average percentage of Kernel in greater weights (1-4), . .	...	...	47·26	75·65
Average percentage of Kernel in lesser weights (5-7), . . .	...	...	45·10	75·96
Average percentage of Kernel in Hopetoun Oats, . . .	...	...	46·18	75·78

[1] There are grains of Potato and Hopetoun.

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
Earlyfellow Variety.				
1. Mr. Shirreff (selector of this oat), Haddingtonshire. Crop 1867. o. h. ·0043 ; i. h. ·0024 inch. Mean of 3 analyses, . .	13,250	...	47·75	76·83
2. Peter Murray, Bogtown, Portsoy, Banffshire. Crop 1867. o. h. ·0039 ; i. h. ·0028 inch. Mean of 3 analyses, . .	15,062	47½	47·25	76·68
Average percentage of Kernel in Earlyfellow Oats, . . .	...	...	47·50	76·75
Finefellow Variety.				
1. Patrick Shirreff (selector of this oat), Haddingtonshire. Crop 1867. o. h. ·0042 ; i. h. ·0020 inch. Mean of 3 analyses, . .	15,000	...	46·37	76·77
Average percentage of Kernel in Finefellow Oats, . . .	...	...	46·37	76·77
Longfellow Variety.				
1. Peter Murray, Bogtown, Banffshire. Crop 1867. o. h. ·0042 ; i. h. ·0023 inch. Mean of 3 analyses, . .	13,812	47	47·89	76·94
2. Mr. Shirreff (originator of this oat), Haddingtonshire. Crop 1867. o. h. ·0040 ; i. h. ·0018 inch. Mean of 3 analyses, . .	14,437	...	47·59	77·18
3. William Leslie of Nethermuir. Grown by Mr. Scott, Yokieshill, Buchan. Crop 1875. (Prize sample.) 2 analyses, ...	14,840	...	47·00	77·85
Average percentage of Kernel in Longfellow Oats, . . .	...	...	47·49	77·32

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
OLD BLACK VARIETY.				
1. Mrs. Davidson, Aberdeen. Garden, on shot rubbish. Crop 1869. Seed from shop packings, accidental, ...	17,562	?	46·00	79·52
Average percentage of Kernel in Old Black Oats, . . .	...	..	46·00	79·52
EARLY BARLEY VARIETY.				
1. William Murray of Mastrick, Tipperty, Aberdeensh. Crop 1866. o. h. ·0036 ; i. h. ·0017 inch. Mean of 3 analyses, . .	16,062	...	46·64	77·08
(*a*) Dried at 212° Fahr., . .	17,437	...	...	77·23
2. Mr. Warrack, Kinharrachie, Buchan, Aberdeenshire. Crop 1867. o. h. ·0039 ; i. h. ·0020 inch. Mean of 3 analyses, . .	16,062	44¾	46·40	77·33
3. Mr. Cowie, Cromely Bank, Ellon, Buchan, Aberdeenshire. Crop 1867. (2d Prize.) o. h. ·0035 ; i. h. ·0021 inch. Mean of 3 analyses, . .	17,125	44⅜	46·36	76·63
Average percentage of Kernel in Early Barley Oats, . .	...	...	46·47	77·01
ENGLISH BARLEY VARIETY.				
1. Peter Beattie, Dunnydeer, Aberdeensh. Crop 1867. (1st Prize.) o. h. ·0036 ; i. h. ·0019 inch. Mean of 3 analyses, . .	14,562	47½	48·88	76·62
2. Alexander Cantlay, Mains of Carnousie, Banffshire. Crop 1867. (3d Prize.) o. h. ·0040 ; i. h. ·0023 inch. Mean of 3 analyses, . .	15,187	45	47·35	76·88

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
English Barley—*continued.*				
3. Alexander Cantlay, Mains of Carnousie, Banffshire. Crop 1867. (1st Prize.) o. h. ·0037; i. h. ·0020 inch. Mean of 3 analyses, . .	15,125	45¾	47·22	77·49
4. James M'Adam, Kinmundy, Aberdeenshire. Crop 1868. o. h. ·0040; i. h. ·0027 inch. Mean of 3 analyses, . .	16,250	...	45·58	76·11
Average percentage of Kernel in greater weights (1-2), . .	...	...	48·11	76·75
Average percentage of Kernel in lesser weights (3-4), . .	...	...	46·40	76·80
Average percentage of Kernel in English Barley Oats, . .	...	...	47·25	76·78
Providence Variety.				
1. Drummond Bros., Edinburgh. Mid-Lothian. Crop 1866. o. h. ·0040; i. h. ·0023 inch. Mean of 3 analyses, . .	15,687	43½	47·55	76·03
(*a*) Dried at 212° Fahr., .	16,375	...	...	76·76
2. Lawson & Son, Edin. Lothians or Berwick. Crop 1866. o. h. ·0038; i. h. ·0025 inch. Mean of 3 analyses, . .	15,500	42	46·21	76·42
3. M'Lean & Hope, Leith. (?) Locality. o. h. ·0036; i. h. ·0019 inch. Mean of 3 analyses, . .	15,625	44½	46·16	75·96
Average percentage of Kernel in Providence Oats, . . .	...	...	46·64	76·14
Common Dun Variety.				
1. Various. Scotland. Crop 1866. o. h. ·0032; i. h. ·0018 inch. Mean of 3 analyses, . .	17,125	?	44·01	76·49
Average percentage of Kernel in Common Dun Oats, . .	...	...	44·01	76·49

TAWNY VARIETY.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. Mrs. Dodds, Coleraine, County Antrim. Crop 1867. o. h. ·0043; i. h. ·0018 inch. 3 analyses, 73·98, 74·57, 74·61,	15,187	...	45·71	74·39
2. Alexander Wilson, Irvine Mills, South of Ireland. Crop 1867. o. h. ·0032; i. h. ·0019 inch. Mean of 3 analyses, . .	14,812	40	45·41	76·70
(*a*) Dried 5·75 p. c. of moisture, ...	15,250	...	...	77·25
3. Mr. Sim, Fawels, Aberdeenshire. Crop 1868. (Prize.) o. h. ·0037; i. h. ·0025 inch. 1 analysis, ...	17,000	42½	45·06	74·80
4. Mrs. Dodds, Coleraine, County Antrim. Crop 1867. o. h. ·0041; i. h. ·0016 inch. Mean of 3 analyses, . .	15,937	...	44·85	72·78
5. Mr. Gordon, Newmachar. Seed from Ireland. Aberdeenshire. Crop 1867. o. h. ·0040; i. h. ·0022 inch. Mean of 3 analyses, . .	15,187	...	44·77	75·75
6. Arthur H. Singer, Newmachar, Aberdeenshire. Crop 1868. o. h. ·0043; i. h. ·0024 inch. Mean of 3 analyses, . .	15,625	...	44·01	71·85
Many embedded breast pickles or secondary florets or seeds.				
7. Mr. Anderson, Newmachar. Seed originally from Ireland. Crop 1867. o. h. ·0040; i. h. ·0025 inch. Mean of 3 analyses, . .	14,937	...	43·46	75·03
(*a*) Dried at 212° Fahr., .	16,625	...	...	74·64
Average percentage of greater weights (1-4), . . .	...	...	45·26	74·67
Average percentage of lesser weights (5-7), . . .	...	...	44·08	74·21
Average percentage of Kernel in Tawny Oats, ...	...	...	44·67	74·47

SURPRISE VARIETY.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. George Sheppard, N. Pacific Railroad, Washington Territory, Walla Walla, 1000 feet above sea. Crop 1872, .	14,700	48	51·00	66·35
2. George Sheppard, Pacific Railroad, Oregon, U.S. Crop 1872, ...	16,520	46	49·00	65·45
Average percentage of Kernel in Surprise Oats, . . .	...	...	50·00	65·90

II.—Coniform Class.

Dun Winter Variety.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. Raynbird & Co., Basingstoke. Hampshire. Crop 1868. o. h. ·0034; i. h. ·0018 inch. Mean of 3 analyses, . .	13,812	42	47·92	77·29
(Husks smoothed, and points broken off.)				
2. Thomas Mackenzie & Sons, Cork. Co. Cork. Crop 1867. o. h. ·0034; i. h. ·0019 inch. Mean of 3 analyses, . .	14,250	43	46·13	77·70
3. William D. Wilson, Limerick. County Limerick. Crop 1867. o. h. ·0035; i. h. ·0018 inch. Mean of 3 analyses, . .	14,250	...	45·80	78·83
(Called 'Don,' but same as Dun Winter.)				
4. Raynbird & Co., Basingstoke. Hampshire. Crop 1866. o. h. ·0033; i. h. ·0017 inch. Mean of 3 analyses, . .	13,937	38	45·51	78·24
5. A. Stephen Wilson, N. Kinmundy. Formartine. Crop 1867-68. o. h. ·0033; i. h. ·0020 inch. Mean of 3 analyses, . .	13,875	?	45·48	81·28
(From Irish seed sown in autumn.)				
6. Lawson & Son, Edinburgh and London. Hampshire. Crop 1866. o. h. ·0030; i. h. ·0013 inch. Mean of 3 analyses, . . .	14,750	38	45·32	78·36
(*a*) Dried at 212° Fahr., . .	15,750	...	...	78·64
7. A. Stephen Wilson, North Kinmundy. Formartine. Crop 1868. o. h. ·0033; i. h. ·0022 inch. Mean of 3 analyses, . .	14,250	?	44·98	82·26
(From Irish seed, and sown in spring.)				

DUN WINTER VARIETY—*continued.*	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
8. A. Stephen Wilson, North Kinmundy. Crop 1867-68. o. h. ·0033; i. h. ·0018 inch. Mean of 3 analyses, . . (From English seed sown in autumn.)	12,562	?	44·55	81·99
9. James Stephen, Kinmundy, Newmachar. Crop 1870. Spring sown, seed damaged, .	13,650	41¼	43·89	78·33
10. William D. Wilson, Limerick. County Limerick. Crop 1867. o. h. ·0032; i. h. ·0020 inch. Mean of 3 analyses, . .	13,125	39	43·21	78·81
11. A. Stephen Wilson, North Kinmundy, Newmachar. Crop 1869. Spring sown, with home-grown seed, ...	11,313	41	43·00	80·12
12. A. Stephen Wilson. Crop October 1868 to September 1869. From home-grown seed of crop 1868, ...	12,040	41	43·00	81·12
13. A. S. Wilson. Crop 1869. Spring sown. From home-grown seed of crop 1868, ...	12,810	41	43·00	79·57
14. A. S. Wilson. Crop 1869. Spring sown. Seed from Hampshire. Grown close beside No. 13. . .	12,810	41	43·00	79·04
Average percentage of Kernel in greater weights (1-5), . .	...	...	46·17	78·67
Average percentage of Kernel in medium weights (6-10), . .	...	...	44·39	79·95
Average percentage of Kernel in lesser weights (11-14), . .	...	...	43·00	79·96
Average percentage of Kernel in Dun Winter Oats, . . .	...	...	44·52	79·50

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
Kildrummy Variety.				
1. Peter Beattie, Dunnydeer, Garioch. Crop 1867. (1st Prize.)				
o. h. ·0040; i. h. ·0020 inch. Mean of 3 analyses, . .	16,812	45½	47·03	75·84
2. Mr. Barron, Ellon, Formartine. Crop 1867.				
o. h. ·0033; i. h. ·0018 inch. Mean of 3 analyses, . .	17,562	42¼	45·38	75·83
(*a*) Dried at 212° Fahr., . .	20,562	?	42·29	75·87
3. William Johnstone, Fyvie, Aberdeenshire. Crop 1866.				
o. h. ·0035; i. h. ·0020 inch. Mean of 3 analyses, . .	17,312	40½	44·03	75·72
(*a*) Dried 6 per cent. of moisture,	17,937	...	...	76·24
(*b*) Unripe seeds, . . .	19,125	?	?	70·96
Average percentage of Kernel in Kildrummy Oats, . . .	...	...	45·48	75·80
Sandy Variety.				
1. Drummond Brothers, Edinburgh. Peeblesshire. Crop 1866.				
o. h. ·0037; i. h. ·0022 inch. Mean of 3 analyses, . .	17,312	43	48·34	74·74
2. Lawson & Son, Edinburgh and London. Berkshire. Crop 1866.				
o. h. ·0035; i. h. ·0022 inch. Mean of 3 analyses, . .	18,062	40	47·29	74·91
3. R. Murray, Bogtown, Portsoy, Banffshire. Crop 1867.				
o. h. ·0038; i. h. ·0022 inch. Mean of 3 analyses, . .	16,687	45	47·25	76·14
4. Drummond Brothers, Edinburgh. Montrose, Forfar. Crop 1866.				
o. h. ·0037; i. h. ·0022 inch. Mean of 3 analyses, . .	15,812	43	47·20	75·77

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
Sandy Variety—*continued.*				
5. Drummond Bros., Edinburgh. East Lothian. Crop 1866.				
o. h. ·0038; i. h. ·0020 inch.				
Mean of 3 analyses, . .	16,500	44	47·18	75·87
6. Drummond Bros., Edinburgh. East Lothian. Crop 1868.				
o. h. ·0038; i. h. ·0026 inch.				
Mean of 3 analyses, . .	17,062	44	46·94	76·53
7. W. Drummond & Sons, Stirling. Stirlingshire. Crop 1866.				
o. h. ·0036; i. h. ·0015 inch.				
Mean of 4 analyses, . .	16,125	41	46·54	75·64
8. Drummond Bros., Edinburgh. Ingliston, Mid-Lothian. Crop 1866.				
o. h. ·0036; i. h. ·0016 inch.				
Mean of 3 analyses, . .	16,750	43½	46·52	76·65
9. Thomas Kennedy & Co., Dumfries. Dumfriesshire. Crop 1866.				
o. h. ·0037; i. h. ·0020 inch.				
Mean of 3 analyses, . .	16,750	41	46·15	76·75
Test with 14 corns, . .	16,750	...	...	76·67
10. Lawson & Son, Edinburgh and London. Lothians. Crop 1866.				
o. h. 0033; i. h. ·0016 inch.				
Mean of 3 analyses, . .	16,812	42	45·98	76·24
11. Benjamin Reid & Co., Aberdeen. Thurso, Caithness-sh. Crop 1866.				
o. h. ·0040; i. h. ·0024 inch.				
Mean of 3 analyses, . .	16,937	42½	45·73	75·43
(*a*) Dried at 212°, . . .	20,375	...	...	75·53
(*b*) Seeds taken, half large, half small, ...	16,333	...	...	75·85
(*c*) Seeds taken all largest, .	13,508	...	...	77·08
(*d*) Seeds taken all smallest, .	20,069	...	...	75·89
12. Mrs. Dodds, Coleraine, County Antrim. Crop 1867.				
o. h. ·0037; i. h. ·0018 inch.				
Mean of 3 analyses, . .	16,250	...	45·61	75·60

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
SANDY VARIETY.—*continued.*				
13. Thomas Kennedy & Company, Dumfries. Dumfriesshire. Crop 1866. o. h. ·0034; i. h. ·0020 inch. Mean of 3 analyses, . .	16,750	40	45·54	76·20
14. William Smith, Aberdeen. Fraserburgh, Buchan. Crop 1866. o. h. ·0034; i. h. ·0023 inch. Mean of 3 analyses, . .	17,312	40	45·42	75·45
15. Dickson & Turnbull, Perth. Perthshire. Crop 1866. o. h. ·0036; i. h. ·0021 inch. Mean of 3 analyses, . .	15,625	...	45·01	77·35
16. Stewart & Sons, Dundee, Forfarshire (damp soil, bad climate). o. h. ·0038; i. h. ·0022 inch. Mean of 3 analyses, . .	16,250	41	44·48	75·34
17. Alexander Auld, Rothmaise, Garioch. Crop 1866. o. h. ·0037; i. h. ·0020 inch. Mean of 3 analyses, . . (Contains many unripe seeds.)	19,187	33	41·42	73·08
Average percentage of Kernel in greater weights (1-6), . .	...	...	47·37	75·66
Average percentage of Kernel in medium weights (7-12), . .	...	...	46·09	76·05
Average percentage of Kernel in lesser weights (13-17), . .	...	...	44·37	75·48
Average percentage of Kernel in Sandy Oats, ...	...	...	45·94	75·75
LOTHIAN VARIETY.				
1. Thos. Kennedy & Company, Dumfries. Dumfriesshire. Crop 1866. o. h. ·0039; i. h. ·0020 inch. Mean of 3 analyses, . .	15,437	42	46·44	76·66
Average percentage of Kernel in Lothian Oats, ...	...	...	46·44	76·66

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
Sandwich Variety.				
1. Mr. Thom, Park, Deeside, Aberdeenshire. Crop 1866. o. h. ·0035; i. h. ·0023 inch. Mean of 3 analyses, . .	14,875	...	45·75	75·92
2. Mr. Tait, Newburgh. Braicklay Tarves, Aberdeen. Crop 1866. o. h. ·0035; i. h. ·0020 inch. Mean of 3 analyses, . .	17,247	41½	45·62	75·78
3. James Stephen, Kinmundy, Aberdeenshire. Crop 1866. o. h. ·0041; i. h. ·0020 inch. Mean of 3 analyses, . .	18,687	41½	45·13	75·11
4. J. Stephen, Kinmundy. Crop 1877. Cut 2d week Oct., tested same time, thus containing more than permanent moisture, not included in Averages,	14,841	41½	44·60	78·25
5. J. Stephen, Aberdeensh. Crop 1876. Seed from a distance,	16,590	41	44·00	76·99
6. Jonathan Mess, Aberdeen. Daneston. Crop 1866. o. h. ·0036; i. h. ·0020 inch. Mean of 3 analyses, . .	16,875	39	43·97	75·25
7. Mr. Somerville, Parkhill, Aberdeen. Crop 1866. o. h. ·0034; i. h. ·0018 inch. Mean of 3 analyses, . .	16,562	40	43·67	76·26
(*a*) Dried at 212° Fahr., . .	18,875	...	43·06	76·41
Average percentage of Kernel in greater weights (1-3), . .	...	...	45·50	75·60
Average percentage of Kernel in lesser weights (5-7), ...	...	...	43·88	76·17
Average percentage of Kernel in Sandwich Oats, ...	...	...	44·69	75·88
Red Early Variety.				
1. Thos. Kennedy & Co., Dumfries. Dumfriesshire. Crop 1866. o. h. ·0034; i. h. ·0018 inch. Mean of 3 analyses, . .	17,562	41	45·31	75·85
Average percentage of Kernel in Red Early Oats, ...	...	...	45·31	75·85

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
BARBACKLAW VARIETY.				
1. Drummond Brothers, Edinburgh. Mid-Lothian. Crop 1866. o. h. ·0038; i. h. ·0022 inch. Mean of 3 analyses, . .	15,500	40	46·57	73·83
2. Lawson & Son, Edinburgh. Lothians (?). Crop 1866. o. h. ·0033; i. h. ·0015 inch. Mean of 3 analyses, . .	16,062	41¼	45·52	77·03
(*a*) Dried at 212° Fahr., .	17,125	...	...	77·45
Average percentage of Kernel in Barbacklaw Oats, . . .	...	...	46·04	75·43
BLAINSLIE VARIETY.				
1. W. Drummond & Sons, Stirling. Stirlingshire. Crop 1866. o. h. ·0038; i. h. ·0021 inch. Mean of 3 analyses, . .	14,562	40	45·87	74·64
(*a*) Dried at 212° Fahr., .	15,000	...	...	75·03
Average percentage of Kernel in Blainslie Oats, . . .	...	...	45·87	74·64
EARLY ANGUS VARIETY.				
1. Drummond Brothers, Edinburgh. Mid-Lothian. Crop 1866. o. h. ·0038; i. h. ·0023 inch. Mean of 3 analyses, . .	17,312	43	47·59	73·98
2. Drummond Brothers, Edinburgh. East Lothian. Crop 1868. o. h. ·0038; i. h. ·0023 inch. Mean of 3 analyses, . .	17,062	44¼	46·75	76·85
3. Stewart & Sons, Dundee. Carse of Gowrie. Crop 1866. o. h. ·0041; i. h. ·0022 inch. Mean of 3 analyses, . .	16,125	42	45·55	76·47
4. T. Kennedy & Co., Dumfries. Dumfriesshire. Crop 1866. o. h. ·0037; i. h. ·0023 inch. Mean of 3 analyses, . .	17,437	41	45·12	76·23

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
EARLY ANGUS VARIETY—*contd.*				
5. Jas. Ironside, Pitblain, Daviot, Garioch. Crop 1866. o. h. ·0038; i. h. ·0023 inch. Mean of 3 analyses, . .	16,375	41	44·76	76·26
6. Mr. Brebner, Blairydrine, Aberdeenshire. Crop 1866. o. h. ·0039; i. h. ·0023 inch. Mean of 3 analyses, . .	16,250	...	44·73	76·85
7. George Durno, Westerton, Fyvie, Aberdeenshire. Crop 1866. o. h. ·0032; i. h. ·0020 inch. Mean of 3 analyses, . .	17,562	41	44·39	75·09
8. John Walker, Bressay, Shetland. Crop 1867. o. h. ·0034; i. h. ·0018 inch. Mean of 3 analyses, . .	17,000	...	44·03	75·92
9. John Florence, Knowley, Garioch. Crop 1866. o. h. ·0036; i. h. ·0020. Mean of 3 analyses, . .	17,375	41	43·88	76·18
10. John Walker, Bressay, Shetland (Voehead, Eastside. Crop 1867). o. h. ·0036; i. h. ·0018 inch. Mean of 3 analyses, . .	17,875	...	41·71	75·04
Average percentage of Kernel in greater weights (1-5), . .	...	...	45·95	75·96
Average percentage of Kernel in lesser weights (6-10), . .	...	...	43·75	75·82
Average percentage of Kernel in Early Angus Oats, . . .	...	...	44·85	75·89
GREY ANGUS VARIETY.				
1. Drummond Brothers, Edinburgh. East Lothian. Crop 1866. o. h. ·0042; i. h. ·0028 inch. Mean of 3 analyses, .	14,625	42	48·53	73·41
Average percentage of Kernel in Grey Angus Oats, . . .	...	...	48·53	73·41

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
Late Angus Variety.				
1. Lawson & Son, Edin. and Londen. Lothians. Crop 1866. o. h. ·0040; i. h. ·0020 inch. Mean of 3 analyses, . .	14,750	42½	46·09	75·81
2. Stewart & Sons, Dundee. Carse of Gowrie. Crop 1866. o. h. ·0037; i. h. ·0022 inch. Mean of 3 analyses, . .	14,875	40	43·51	76·28
Average percentage of Kernel in Late Angus Oats, . . .	...	...	44·80	76·05
Shirreff Variety.				
1. Lawson & Son, Edinburgh. Lothians. Crop 1866. o. h. ·0034; i. h. ·0020 inch. Mean of 3 analyses, . .	16,000	40	43·99	76·12
Average percentage of Kernel in Shirreff Oats, ...	...	...	43·99	76·12
Fyvie Variety.				
1. Alexander Strachan, S. Haddo, Fyvie. Aberdeensh. Crop 1867. o. h. ·0038; i. h. ·0022 inch. Mean of 3 analyses, . .	16,062	44⅞	47·28	77·63
2. George Charles, Fyvie. Aberdeenshire. Crop 1866. o. h. ·0035; i. h. ·0020 inch. Mean of 3 analyses, . .	16,750	40	44·40	76·61
Average percentage of Kernel in Fyvie Oats, ...	...	...	45·84	77·12
African Variety.				
1. Peter Beattie, Dunnydeer, Garioch. Crop 1867. o. h. ·0036; i. h. ·0023 inch. Mean of 3 analyses (1st Prize),	16,812	46⅞	48·21	76·08
2. William Milne, Mains of Druminnor, Aberdeensh. Crop 1867. o. h. ·0036; i. h. ·0017 inch. Mean of 3 analyses, . .	16,312	45	46·85	76·83
Average percentage of Kernel in African Oats, ...	...	...	47·53	76·46

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
WHITE POLAND VARIETY.				
1. John Exley, Mark Lane. Sweden. Crop 1867. o. h. ·0061 ; i. h. ·0028 inch. Mean of 3 analyses, . .	12,687	44	47·64	68·54
2. Lawson & Son, Edinburgh and London. Berkshire. Crop 1866. o. h. ·0048 ; i. h. ·0030 inch. Mean of 3 analyses, . .	15,000	38	47·08	73·22
Average percentage of Kernel in White Poland Oats, . .	...	...	47·36	70·88
BLACK POLAND VARIETY.				
1. Thomas M'Kenzie & Sons, Cork. County Cork. Crop 1867. o. h. ·0039 ; i. h. ·0020 inch. Mean of 3 analyses, . .	15,937	40	45·37	70·99
Average percentage of Kernel in Black Poland Oats, . .	...	...	45·37	70·99
BROWN SWEDISH VARIETY.				
1. A. S. Wilson, N. Kinmundy. Kinmundy. Crop 1871. From seed in Swedish sample No. 2, ...	17,654	*c* 40	*c* 43·00	77·51
2. John Exley, Mark Lane. Sweden. Crop 1867. Picked from sample of White Oats. o. h. ·0038 ; i. h. ·0022, . .	13,375	40 ?	43 ?	74·88
3. A. S. Wilson, Kinmundy. Crop 1869. From foreign seed, ...	13,160	?	41·70	77·01
Average percentage of Kernel in Brown Swedish Oats, . .	...	...	42·57	76·47

III.—FUSIFORM CLASS.

BLACK TARTARIAN VARIETY.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. Raynbird & Co., Basingstoke. Hampshire. Crop 1866. o. h. ·0040; i. h. ·0018 inch. Mean of 3 analyses, . .	16,187	38	47·17	73·60
2. Drummond Bros., Edinburgh. Fifeshire. Crop 1866. o. h. ·0047; i. h. ·0023 inch. Mean of 3 analyses, . .	15,562	40	46·88	73·20
3. Lawson & Son, Edinburgh and London. Hampshire. Crop 1866. o. h. ·0042; i. h. ·0017 inch. Mean of 3 analyses, . .	14,687	38	46·21	72·68
4. Jonathan Middleton, Fearn, Ross-shire. Crop 1868. o. h. ·0038; i. h. ·0017 inch. Mean of 3 analyses, . .	15,875	40½	45·21	73·71
5. Drummond Bros., Edinburgh. East Fifeshire. Crop 1866. o. h. ·0037; i. h. ·0018 inch. Mean of 3 analyses, . .	15,250	39	44·99	73·95
6. John B. Gaynor, Borrisokane, Tipperary. Crop 1867. o. h. ·0043; i. h. ·0017 inch. Mean of 3 analyses, . .	15,187	41½	44·63	72·39
7. Lawson & Son, Edinburgh and London. Fifeshire. Crop 1866. o. h. ·0045; i. h. ·0020 inch. Mean of 3 analyses, . .	13,562	40	44·39	73·02
8. John Exley, Mark Lane. Sweden. o. h. ·0037; i. h. ·0017 inch. Mean of 3 analyses, . .	19,500	42	43·17	73·24
9. Hurst & Son, London (Benjamin Reid). Hampshire. Crop 1866. o. h. ·0044; i. h. ·0020 inch. Mean of 4 analyses, . .	16,250	...	43·11	69·47

BLACK TARTARIAN VARIETY—*continued*.	No of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
10. Mrs. Davidson, Aberdeen. Grown accidentally on shot rubbish; seed from shop packings. Crop 1869, . .	15,937	...	43·00	76·08
11. Stewart & Sons, Dundee. Carse of Gowrie. Crop 1866. o. h. ·0051; i. h. ·0017 inch. Mean of 3 analyses, . .	14,125	40	42·76	74·15
12. Thomas M'Kenzie & Sons, Cork. County Kerry. Crop 1867. o. h. ·0039; i. h. ·0015 inch. Mean of 3 analyses, . .	14,437	39	42·42	72·35
13. Wm. D. Wilson, Limerick. County Clare. Crop 1867. o. h. ·0040; i. h. ·0017 inch. Mean of 4 analyses, . .	14,875	36	42·01	71·90
14. Sam. Bale, Barnstaple. Mr. Goss, Springfield, Devonshire. Crop 1867. o. h. ·0039; i. h. ·0020 inch. Mean of 3 analyses, . .	18,688	...	41·47	71·68
15. Thos. M'Kenzie & Sons, Cork. County Wicklow. Crop 1867. o. h. ·0045; i. h. ·0016 inch. Mean of 3 analyses, . .	18,437	36	41·18	70·10
16. Raynbird & Co., Basingstoke. Hampshire. Crop 1868. o. h. ·0038; i. h. ·0018 inch. Mean of 3 analyses, . .	16,875	38	41·13	69·29
17. W. Drummond & Sons, Stirling. Stirlingshire. Crop 1866. o. h. ·0053; i. h. ·0017 inch. Mean of 4 analyses, . .	13,000	38½	40·66	72·63
18. G. W. Lloyd, Strancolly Castle, *p*. R. Brown, steward. Co. Waterford. Crop 1867. o. h. ·0042; i. h. ·0013 inch. Mean of 3 analyses, . . (Many embedded breast pickles or secondary florets in this sample.)	16,187	34	39·69	68·06

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
BLACK TARTARIAN VAR.—*contd.*				
Average percentage of Kernel in greater weights (1-6), . .	...	...	45·85	73·26
Average percentage of Kernel in medium weights (7-12), . .	...	...	43·14	73·05
Average percentage of Kernel in lesser weights (13-18), . .	...	...	41·02	70·61
Average percentage of Kernel in Black Tartarian Oats, . .	...	...	43·34	72·31
SMOOTH PANICLE VARIETY.				
1. Mrs. Davidson, Aberdeen. Garden, on shot rubbish. Seed from shop packings, accidental, in scattered stalks, . .	10,250	?	43·70	79·27
Average percentage of Kernel in Smooth Panicle Oats, . .	...	...	43·70	79·27
WHITE TARTARIAN VARIETY.				
1. Raynbird & Co., Basingstoke. Hampshire. Crop 1866. o. h. ·0045; i. h. ·0018 inch. Mean of 4 analyses, . .	14,687	37½	44·39	70·85
2. Lawson & Son, Edinburgh and London. Hampshire. Crop 1866. o. h. ·0040; i. h. ·0020. Mean of 3 analyses, . .	15,812	37½	43·79	68·73
3. Hurst & Son, London, *p.* B. Reid & Co. Hampshire. Crop 1866. o. h. ·0043; i. h. ·0015. Mean of 3 analyses, . .	14,250	...	43·55	70·71
4. Robert Copeland, Mill of Ardlethen, Buchan. Crop 1868. o. h. ·0046; i. h. ·0022. Mean of 3 analyses, . .	16,875	41	41·88	73·85

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
WHITE TARTARIAN—*continued.*				
5. Samuel Bale, Barnstaple, *p.* John Ridd, Swinebridge, Devon. Crop 1867.				
o. h. ·0043 ; i. h. ·0021 inch.				
Mean of 3 analyses, . .	16,625	...	41·65	69·77
6. Raynbird, Caldecott, Bawtree, Dowling & Co., Basingstoke, Berkshire. Crop 1868.				
o. h. ·0044 ; i. h. ·0018 inch.				
Mean of 3 analyses, . .	16,812	33	40·22	69·59
(Many of the Kernels rotten.)				
7. John S. Bean, Hull. Yorkshire. Crop 1866.				
o. h. ·0042 ; i. h. ·0015 inch.				
Mean of 3 analyses, . .	19,062	...	36·56	66·86
(This sample is so inferior and in such bad condition that it may have been sent by way of a joke.)				
Average percentage of Kernel in greater weights (1-4), . .	...	...	43·40	71·04
Average percentage of Kernel in lesser weights (5-7), . .	...	...	39·48	68·74
Average percentage of Kernel in White Tartarian Oats, . .	...	...	41·44	69·89
FINLAY VARIETY.				
1. Thomas Imrie & Sons, Ayr. Girvan, Ayrshire. Crop 1866.				
o. h. ·0031 ; i. h. ·0020 inch.				
Mean of 3 analyses, . .	16,062	38	44·20	74·91
(*a*) Dried at 212° Fahr., . .	16,687	...	...	74·90
2. Thomas Kennedy & Co., Dumfries. Dumfriesshire. Crop 1866.				
o. h. ·0034 ; i. h. ·0008 inch.				
Mean of 3 analyses, . .	16,500	39	44·10	74·82
Average percentage of Kernel in Finlay Oats, ...	...	...	44·15	74·87

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
SWISS VARIETY.				
1. Bryce Wright, Dowhill, Ayrshire (selector of this oat), Dowhill. Sown 1st and 2d week March, cut 16th July 1874. Mean of 2 analyses, 74·50, 75·21,	13,160	40	43·40	74·85
2. William Leslie of Nethermuir, Aberdeen. Nethermuir, Buchan. Crop 1875,	14,910	40	43·40	74·57
Average percentage of Kernel in Swiss Oats,	...	...	43·40	74·71
ARCHANGEL VARIETY.				
1. Mr. Smith, corn factor, Aberdeen. Archangel, Russia. Crop 1867. o. h. ·0038; i. h. ·0027 inch. 'Heavy.' Mean of 3 analyses,	24,250	$38\frac{9}{16}$	42·48	74·32
(Contains 7·2 per cent. of pease, tares, barley, rye, stones, grass seeds, etc. etc.				
2. Mr. Smith, Aberdeen. Archangel, Russia. Crop 1867. o. h. ·0032; i. h. ·0019 inch. 'Average quality.' Mean of 3 analyses,	23,812	37	40·94	73·39
(Contains 2½ per cent. tares, wheat, rye, etc.)				
3. Mr. Smith, Aberdeen. Archangel, Russia. Crop 1865. o. h. ·0031; i. h. ·0016 inch. Mean of 4 analyses,	24,562	37	40·18	73·05
(*a*) Dried at 212° Fahr.,	26,812	...	...	73·04
4. A. S. Wilson, Kinmundy. Grown at North Kinmundy, from Russian seed,	17,148	34	38·00	76·58
Average percentage of Kernel in foreign Archangel oats,	...	...	41·20	73·59

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
Black and White Small Bristle-pointed Variety.				
1. John Catto, Newmachar. Grown in Orkney as crop oats. Crop 1867, . .	32,818	?	35·00	74·31
Average percentage of Kernel in Orkney Small Oats, . .	...	...	...	74·31
Markel Variety.				
1. John Catto, Newmachar. Grown in Orkney as crop oats. Crop 1867, . .	17,284	36?	40·00?	73·70
Average percentage of Kernel in Markel Oats, ...	...	...	...	73·70
Grey Tartarian Variety.				
1. Mrs. Davidson, Aberdeen. Crop 1869. Garden, on shot rubbish, from shop packings, accidental, ...	11,937	?	41·29	77·90
Average percentage of Kernel in Grey Tartarian Oats, . .	...	...	...	77·90
Rough Panicle Variety.				
1. Mrs. Davidson, Aberdeen, Crop 1869. Garden, on shot rubbish, from shop packings, accidental, ...	12,125	?	40·50	80·95
Average percentage of Kernel in Rough Panicle Oats, . .	...	...	...	80·95
Waterloo Variety.				
1. Drummond Brothers, Edinburgh. Woodhall, Mid-Lothian. Crop 1866. o. h. ·0042; i. h. ·0021 inch. Mean of 3 analyses, . .	13,437	40	44·56	77·07

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
WATERLOO VARIETY—*continued.*				
2. Raynbird & Co., Basingstoke. Berkshire. Crop 1865. o. h. ·0038 ; i. h. ·0019 inch. Mean of 3 analyses, . . .	14,687	36	44·06	74·33
3. Lawson & Son, Edinburgh and London. Berkshire. Crop 1865. o. h. ·0041 ; i. h. ·0020 inch. Mean of 4 analyses, . . .	15,000	36	43·75	73·99
(In bad condition, many Kernels rotten.)				
4. A. S. Wilson (seed from No. 1), N. Kinmundy, Aberdeen. Crop 1869, ...	13,000	?	?	74·65
Average percentage of Kernel in Waterloo Oats, ...	...	...	44·12	75·01
WHITE SWEDISH VARIETY.				
1. ——Mahon, Turriff. Crop 1869,	12,500	42	46·00	73·75
Average percentage of Kernel in White Swedish Oats, . .	...	...	46·00	73·75
DANISH VARIETIES.				
1. John Exley, Mark Lane. Denmark. Crop 1867. Chief form, o. h. ·0049 ; i. h. ·0017 inch. Mean of 4 analyses, . . .	14,562	40	44·07	72·67
(Contains various sorts. Also 2·6 per cent. of pease, tares, barley, husks, seeds, etc. etc.)				
2. Thomas Kennedy & Co., Dumfries. Denmark. Crop 1866. Chief form, o. h. ·0044 ; i. h. ·0020 inch. Mean of 4 analyses, . . .	14,125	40	43·95	73·56
(Contains various sorts of oats. Also 2 per cent. barley, pease, tares, seeds, etc. etc.)				

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
Danish Varieties—*continued.*				
3. George Hutcheson & Co., Aberdeen. Denmark, Jutland. Crop 1866.				
Chief sort, o. h. ·0045; i. h. ·0020 inch.				
Mean of 3 analyses, . . .	15,873	40½	43·85	73·26
(Contains several sorts. Also 6·2 per cent. bere, pease, tares, and other seeds.)				
4. Jonathan Mess, Aberdeen. Denmark. Crop 1866.				
Chief form, o. h. ·0040; i. h. ·0023 inch.				
Mean of 4 analyses, . .	15,311	...	43·50	74·24
(*a*) Largest seeds taken, . .	12,250	...	...	74·71
(Contains 7·6 per cent. barley, pease, tares, stones, sand, bare kernels, wheat, rye, seeds, husks, etc. etc.)				
Average percentage of Kernel in Danish Oats, . . .	...	...	43·84	73·43
German Varieties.				
1. John Exley, Mark Lane. From Hamburg. Crop 1867 or 1868.				
Chief sort, o. h. ·0042; i. h. ·0020 inch.				
Mean of 3 analyses, . .	13,250	41½	44·91	72·02
(Contains various forms of oats.)				
2. George Hutcheson & Co., Aberdeen. From Konigsberg. Crop 1866.				
Chief sort, o. h. ·0044; i. h. ·0020 inch.				
Mean of 3 analyses, . .	18,750	38½	42·32	73·77
(*a*) Dried at 212° Fahr., . .	19,500	...	...	73·74
(Contains various sorts. Also 6·4 per cent. of pease, tares, husks, bere, wheat, rye, seeds, etc. etc.)				

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
German Varieties—*continued.*				
3. Mr. Smith, Aberdeen. From Konigsberg. Crop 1866. Chief sort, o. h. ·0040; i. h. ·0015 inch.				
Mean of 3 analyses, . .	18,812	37½	40·34	73·61
(Contains several sorts. Also 8·8 per cent. of husks, tares, bere, bromus, thistle-tops, pease, seeds, sand, etc.)				
4. Mrs. Skene, Aberdeen, from Konigsberg. Crop 1866. Chief sort, o. h. ·0040; i. h. ·0015 inch.				
Mean of 3 analyses, . .	18,687	...	40·29	72·89
(Contains several sorts. Also 7·7 per cent. of tares, pease, husks, bere, wheat, oat kernels, thistle-tops, vetches, bromus, seeds, lime, stones, etc.)				
Average percentage of Kernel in German Oats, ...	...	...	41·97	73·07
Swedish Varieties.				
1. John Exley, Mark Lane. Sweden. Crop 1866. Chief sort, o. h. ·0044; i. h. ·0020 inch.				
Mean of 3 analyses, . .	16,125	...	46·25	69·40
(Contains various sorts. Also 3½ per cent. of bere, kernels, barley, pease, husks, sand, seeds, etc.)				
2. John Exley, Mark Lane. Sweden. Crop 1866. Chief sort, o. h. ·0045; i. h. ·0018 inch.				
Mean of 4 analyses, . .	15,687	...	45·97	71·37
(Contains various sorts. Also 7 per cent. of barley, tares, rye, bromus, red wheat, sand, etc.)				

Varieties.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
Swedish Varieties—*continued.*				
3. John Exley, Mark Lane. Sweden, Helsingborg, Malmo. Crop 1867.				
Chief sort, o. h. ·0047; i. h. ·0023 inch.				
Mean of 4 analyses, . .	14,187	40	45·11	69·59
(Contains various sorts. Also 4·3 per cent. of barley, oat kernels, pease, seeds, etc.)				
4. George Hutcheson & Co., Aberdeen. Sweden. Crop 1866.				
Chief sort, o. h. ·0047; i. h. ·0023 inch.				
Mean of 4 analyses, . .	17,625	39¼	42·49	68·04
(Contains various sorts. Also 4 per cent. of bere, oat kernels, pease, tares, bromus, husks of oats, awns, chaff, seeds, sand, etc.)				
Average percentage of Kernel in Swedish Oats, ...	...	...	44·95	69·60
Russian Varieties. (*Exclusive of Archangel.*)				
1. John Exley, Mark Lane. Russia. Crop 1867.				
Chief form, o. h. ·0036; i. h. ·0016 inch.				
Mean of 3 analyses, . .	19,125	38	46·83	75·08
(Contains 4·6 per cent. of various seeds, husks, etc. Consists of various sorts of oats.)				
2. John Exley, Mark Lane. Russia. Baltic Port. Crop 1866.				
Chief sort, o. h. ·0041; i. h. ·0023 inch.				
Mean of 3 analyses, (various sorts), ...	16,625	...	45·22	73·90
(Contains 9·2 per cent. of barley, pease, tares, rye, seeds, etc.)				

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
RUSSIAN VARIETIES—*continued.*				
3. John Exley, Mark Lane. Russia. Baltic Port. Crop 1866. Chief sort, ·0044; i. h. ·0023 inch.				
Mean of 4 analyses, . . .	14,812	...	43·92	71·42
(Contains various sorts. Also 3½ per cent. of barley, oat kernels, bromus, pease, wheat, rye, etc.)				
4. John Exley, Mark Lane. Russia. Crop 1866 (various sorts). Chief sort, o. h. ·0045; i. h. ·0022 inch.				
Mean of 3 analyses, . . .	19,437	...	43·13	74·81
(Contains 5 per cent. barley, tares, rye, seeds, stones, etc.)				
5. Mr. Smith, Aberdeen. St. Petersburg. Crop 1867. Chief sort, o. h. ·0034; i. h. ·0020 inch.				
Mean of 3 analyses, . . .	22,937	36½	41·01	72·90
(Contains various forms of oats. Also 2·9 per cent. tares, barley, husks, stones, seeds, etc.)				
6. John Exley, Mark Lane. Russia. Baltic Port. Crop 1866. Chief sort, o. h. ·0032; i. h. ·0018 inch.				
Mean of 3 analyses, . . .	22,375	...	40·89	74·04
(Contains various sorts. Also 3½ per cent. of mustard stalks, mustard seed, tares, barley, rye, husks, etc.)				
Average percentage of Kernel in Russian Oats, ...	...	...	43·50	73·69

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
BLACK SMALL, OR BRISTLE-POINTED VARIETY.				
1. A. Stephen Wilson, Kinmundy. Crop 1868. o. h. ·0019; i. h. ·0015 inch. Mean of 3 analyses, . .	29,937	?	41·18	78·46
2. Various, chiefly Aberdeenshire. Collected from samples. Crop 1866. o. h. ·0023; i. h. ·0015 inch. Mean of 3 analyses, . .	30,187	?	35·31	74·91
Average percentage of Kernel in Black Small Oats, . . .	...	...	...	76·68
WHITE SMALL BRISTLE-POINTED VARIETY.				
1. A. Stephen Wilson, North Kinmundy. Kinmundy. Crop 1868. o. h. ·0022; i. h. ·0017 inch. Mean of 3 analyses, . .	32,750	?	39·46	78·02
2. Various, chiefly Aberdeenshire. Collected from samples. Crop 1866. o. h. ·0025; i. h. ·0018 inch. Mean of 3 analyses, . .	30,374	?	34·70	74·12
(*a*) Dried at 212° Fahr., . .	32,250	...	...	73·46
Average percentage of Kernel in White Small Oats, . . .	...	...	...	76·07

THE WILD OAT (*Avena fatua*, LIN.)

VARIETIES.	No. of Seeds in lb.	Ordinary Weight.	Uniform Weight.	Per cent. of Kernel.
1. WHITE (Oviform) variety, outer husk smooth. A. Stephen Wilson. Grown on Kinmundy, ...	12,281	?	?	74·03
2. TAWNY (Oviform) variety. Grown on Kinmundy. Outer husk smooth, . . .	12,281	?	?	70·17
3. WHITE (Coniform) variety. Grown on Kinmundy. Outer husk smooth, . . .	12,590	?	?	72·48
4. DUN (Fusiform) variety. Grown on Kinmundy. Outer husk hairy, ...	15,946	?	?	69·48
5. BROWN (Fusiform) variety (the common Wild Oat). Grown on Kinmundy. Outer husk hairy, ... (Weight of the awn of the Wild oat ·0352 of a grain, the above percentages being exclusive of awns.)	16,867	?	?	67·47

I.—Oviform Class of Oats.

Abstract of Percentages of Kernel and Husk in Oviform Varieties of Oats.

	Measure-Weight.	Kernel.	Husk.
1. Canadian, ...	51·00*	67·83	32·17
2. Potato, ...	46·57	76·30	23·70
3. Scots Barley, ...	45·38	75·89	24·11
4. Hopetoun, ...	46·18	75·78	24·22
5. Earlyfellow, ...	47·50	76·75	23·25
6. Finefellow, ...	46·37	76·77	23·23
7. Longfellow, ...	47·49	77·32	22·68
8. Old Black, ...	46·00	79·52	20·48
9. Early Barley, ...	46·47	77·01	22·99
10. English Barley, ...	47·25	76·78	23·22
11. Providence, ...	46·64	76·14	23·86
12. Common Dun, ...	44·01	76·49	23·51
13. Tawny, ...	44·67	74·47	25·53
14. Surprise, ...	50·00*	65·90	34·10
Averages of Oviform Class, . .	46·82	75·21	24·79
* Exclusive of Canadian and Surprise, ...	46·21	76·60	23·40
Exclusive of Canadian, Surprise, and Old Black, . . .	46·23	76·34	23·66

II.—Coniform Class of Oats.

Abstract of Percentages of Kernel and Husk in Coniform Varieties of Oats.

	Measure-Weight.	Kernel.	Husk.
1. Dun Winter, ...	44·52	79·50	20·50
2. Kildrummy, ...	45·48	75·80	24·20
3. Sandy, ...	45·94	75·75	24·25
4. Lothian, ...	46·44	76·66	23·34
5. Sandwich, ...	44·69	75·88	24·12
6. Red Early, ...	45·31	75·85	24·15
7. Barbacklaw, ...	46·04	75·43	24·57
8. Blainslie, ...	45·87	74·64	25·36
9. Early Angus, ...	44·85	75·89	24·11
10. Grey Angus, ...	48·53	73·41	26·59
11. Late Angus, ...	44·80	76·05	23·95
12. Shirreff, ...	43·99	76·12	23·88
13. Fyvie, ...	45·84	77·12	22·88
14. African, ...	47·53	76·46	23·54
15. White Poland, ...	47·36*	70·88	29·12
16. Black Poland, ...	45·37*	70·99	29·01
17. Brown Swedish, ...	42·57	76·47	23·53
Averages of Coniform Class, .	...	75·46	24·54
*Exclusive of White and Black Poland, ...	45·49	76·07	23·93

III.—Fusiform Class of Oats.

Abstract of Percentages of Kernel and Husk in Fusiform Varieties of Oats.

	Measure-Weight.	Kernel.	Husk.
1. Black Tartarian, . . .	43·34	72·31	27·69
2. Smooth Panicle, . . .	43·70*	79·27	20·73
3. White Tartarian, . . .	41·44	69·89	30·11
4. Finlay, ...	44·15	74·87	25·13
5. Swiss, ...	43·40	74·71	25·29
6. Archangel, ...	41·20	73·59	26·41
7. B. and W. Small (Orkney), .	?	74·31	25·69
8. Markel, ...	?	73·70	26·30
9. Rough Panicle, . . .	41·29*	80·95	19·05
10. Waterloo, ...	44·12	75·01	24·99
11. White Swedish (Home), .	46·00	73·75	26·25
12. Danish, ...	43·84	73·43	26·57
13. German, ...	41·97	73·07	26·93
14. Swedish, ...	44·95	69·60	30·40
15. Russian (ex. of Archangel), .	43·50	73·69	26·31
16. Black Small, ...	?*	76·68	23·32
17. White Small, ...	?*	76·07	23·93
Averages of Fusiform Class, . .	...	74·41	25·59
*Exclusive of Smooth and Rough Panicle, and Black Small and White Small (16 and 17), . .	43·30	73·23	26·77

I. II. AND III. CLASSES.

Average Percentage of Kernel and Husk in the three Classes of Oats, exclusive of varieties not in ordinary and general cultivation.

	Weight per Bushel.	Kernel.	Husk.
I. OVIFORM CLASS, . .	46·23	76·34	23·66
II. CONIFORM CLASS, . .	45·49	76·07	23·93
III. FUSIFORM CLASS, . .	43·30	73·23	26·77
Average of all Oats, . .	...	75·21	24·79

X.

Measure-weight and Milling.

INNUMERABLE experiments have been made by milling to determine the proportions of various products of grain. But there are many difficulties in thus arriving at correct results. In respect of wheat the difficulties are probably greater than in respect of oats. The same wheat ground in different hygrometric conditions will give different percentages of bran. The outer coat of a wheat-grain is as definitely separable from the kernel as the husk of an oat. But the film of honeycomb cells on the exterior of the kernel has no definite inner boundary; it separates from the mass of starch cells simply because the albuminoids and gums contained in its cells are horny and compact, and break away from the softer material below. But a portion of this material, greater or less owing to hygrometric and other conditions, adheres to the bran films. From the language frequently applied to wheat grains, one would think that they had no more structure than a dried-up drop of resin or gum; but a wheat grain is a regular structure, a tuberculated leaf, the interior cells of which are filled mostly with starch grains, and the surface cells with aleurone grains and gluten, etc. The notion that either the outer coat, or the boundary wall of honeycomb cells, becomes thicker or thinner by more or less complete ripening is entirely dispelled by the micrometer. An unripened wheat seed has a higher percentage of albuminoids than a ripened seed, simply because the deposit of starch in the interior along the midrib is arrested before being complete. And it is quite possible that in an unripe grain the bran film may break more cleanly off the starch than in a ripe grain, so that the unripe grain may give the highest percentage of flour; but the whole product of the unripe field will be less than that of the ripe.

It is quite probable that experiments have been made by milling to test the bearing of measure-weight in oats upon the out-turn of meal, but they are not known to me, and I would wish to point out the difficulties which have to be overcome by any miller who would enter upon the subject, or who would intelligently desire to see through the problem of out-turn from any sample or any variety of oats.

The first source of confusion in comparing the produce of two samples is difference of measure-weight. The bushel of the one sample weighs 40 lb. and the bushel of the other weighs 42 lb. But eight bushels of each alike form a quarter; yet the quarter of the one sample weighs 320 lb., and the quarter of the other 336 lb. Both samples are dried and ground. The heavier sample gives 202 lb. of meal, and the lighter 193 lb. Now, how is the miller to know which sample has turned out best? Or how is the farmer who employs him to determine which kind he should lay aside for seed? Let us look at this. If 320 lb. of undried oats give 193 lb. of meal; and if 336 lb. of oats give 202 lb. of meal, in both cases the meal is 60 per cent. of the undried weight of grain.

It might therefore be inferred that both samples are of the same quality, and that the higher measure-weight in the one case indicates nothing whatever. But how do the farmer and the miller know whether both samples contained the same percentage of moisture to begin with? How also does the miller know that his kiln-drying in both cases left the same percentage of moisture in the 'dried' corn. And further, how does he know that in both cases the meal during grinding and before being weighed has absorbed the same percentage of moisture from the air? The points implied in these questions are never looked at in milling experiments, and therefore the results are nearly valueless. And it is from overlooking such considerations that the proverbial dissatisfaction with millers has arisen. An extensive miller, now out of practice, gave all his customers the same percentage of meal, keeping excess to make up deficiency, and pleased everybody!

I made experiments to test the hygrosorptive action of oatmeal, and may here give a few of the results in order to show that caution is necessary in accepting milling percentages.

Meal from the mill was found to contain 3·20 per cent. of moisture when dried at 212°. The dried meal when exposed to the air outside for 20½ hours gained 9·90 per cent., being an increase on the original weight of 6·40 per cent. The meal containing 3·20 per cent. of moisture was exposed for 19 hours, and absorbed 6·50 per cent., and then contained 9·70 per cent. The 100 lb. from the mill thus became 106·5.

Oat kernels were dried, and found to contain 7·55 per cent. of moisture. They were then ground in a mortar, and in 4½ hours, inside the house (June 2), gained 4·81 per cent.; in 18½ hours, 5·68 per cent.; in 32 hours, also 5·68 per cent., and in 43 hours gained 5·79 per cent. In another trial the gain in 4½ hours was 4·30 per cent. In another similar trial the gain of moisture in 3 hours was 4·71 per cent. In another the gain in 4 hours was 2·77 per cent. In another the gain in 3 hours was 3·73 per cent.; and in 8½ hours, 6·14 per cent.; and in 20½ hours, 6·69 per cent. In another trial

14 hours' exposure to the air gave an increase of 6·67 per cent.; all upon the dry weight, and inside the house; and in the dry atmosphere of June. In open mills and damp situations, and at times when the atmosphere is highly saturated, the amount of moisture absorbed by meal will be much greater than in these experiments. So that unless moisture is properly calculated in milling experiments, these experiments are of little value.

Let us look at milling in some other aspects, and let us take the cental or 100 lb. as the unit to be dealt with, in order to avoid the complications of different quantities. It is often stated that certain farms, or certain soils, or certain localities, produce oats of higher milling quality than others. From the analyses which have been submitted, it is seen that a given variety of oat does not vary very much in percentage of kernel from one locality to another. The greatest variation in percentage of kernel in Potato oats from thirty-eight localities is only about 2. Suppose now that on a low-lying farm 100 lb. of Potato oats have a percentage of moisture of 15, and of kernel of 76. In milling this sample the drying leaves 2 per cent. of moisture. The dried corn will thus weigh 87 lb., and as there is 76 per cent. of kernel in the dried oats as well as in the undried, the weight of meal, if completely extracted, and exclusive of loss and re-absorption of moisture, will be 66·12 lb. Suppose that a cental of Potato oats of the same percentage of kernel from a high-lying dry farm contains 11 per cent. of moisture. At the mill it is not so hard dried, and is left with 4 per cent. of moisture in it. Then the weight of dried corn will be 93 lb., and the weight of meal, under the same exceptions as before, will be 70·68 lb. The clear inference therefore is, that the high and dry locality has produced the best milling oat!

Large quantities of foreign oats are imported into this country to be converted into meal. We have seen that these oats have all a low percentage of kernel, and yet the millers have a half-concealed liking for them, and say that they turn out more meal than might be expected from appearances. In some cases these oats have been kiln-dried to a certain degree before being shipped, so that they sometimes contain a low percentage of moisture, which more than makes up, in a comparison, for deficiency of kernel. I shall illustrate this from samples which have come into my hand. In a good many cases parcels of corn were correctly weighed when received, in order to find the ordinary percentage of moisture. From the table of 'Moisture in Grain,' it will be seen that a Russian sample, No. 12, contained 10·90 per cent. of moisture. The average per cent. of kernel in Russian oats, exclusive of Archangel, is 73·69. Let us suppose that these oats were completely dried before being ground; the 100 lb. will thus be reduced to (100 – 10·90) 89·10 lb. Then 73·69 per cent. of this weight of dry oats gives meal, exclusive of loss, to the weight of 65·66 lb. In the table just referred to, Sample 4 of Potato oats has 18·31 per cent. of moisture, and 76·32 per cent. of kernel, and gives to the cental, in the same way, 62·35 lb. of meal; Sample 25 of Early Angus oats, with 15·77 per cent. of moisture, and 75·92 per cent. of kernel, gives 63·95 lb. of meal. The Russian oats have thus the advantage in the mill over such samples, not because the Russian are better quality, but simply because they happen, when bought, to be driest. No account has been taken here of re-absorption of moisture during grinding and weighing up; but the actual work of testing the results of milling would necessarily involve this element of difficulty, so that, in point of practical fact, no comparison of a trustworthy kind can be expected from milling experiments. But the method of manual decortication is perfectly trustworthy, and can perfectly enable a farmer or miller to select the oat with the highest percentage of kernel, in other words the oat of the best quality, so far as quality is measured by quantity of kernel. But if the method of manual decortication fails to detect any clear law of relationship between measure-weight and quality, much more will failure attend experiments, to discover such a law, made by the mill.

But if the mealing capacity of an oat cannot be detected by the bushel, it can easily be detected by the pincers or even the thumb nails, by any farmer or miller who will take the trouble. All that is required for the operation is a small pair of scales and a set of grain weights. If the beam will turn under a load of a few ounces, with half a grain, the balance is sufficiently delicate for all practical purposes. A sample of, say 100 grains weight of the oats to be tested is then to be taken. If the quantity in the scale is a little over 100 grains, a large corn may be taken out and a small one put in till a poise is secured. There may be from 220 to 260 corns from which to remove the husks. The removal of the husks will occupy about an hour. Then if the kernels are weighed and give 75 grains, while the husks give 24·5 grains, it is seen that half a grain has been lost. During the operation, the exposure of the outside of the kernels and the inside of the husks has carried off half a grain of moisture. A correction may therefore be made by adding three-fourths of the loss to the kernels and one-fourth to the husks, making the percentage of kernels 75·37, and the percentage of husks 24·63. A hundred grains weight of the same oats may be put into a tin-plate cup, and placed in boiling water till it ceases to lose weight, which will give the percentage of moisture. Say that the weight is reduced to 86 grains; the moisture will be 14 per cent. Now, if the farmer sends this corn to the mill, what weight of meal ought he to receive? If the operations of grinding were perfect he should receive for every 100 lb. of corn 64·8 lb. of meal; that is, 75·37 per cent. of the weight of dried corn. But the weight of meal is influenced (1) by the degree of kiln drying; (2) by the greater or less completeness in removing the kernel from the husk, and the husk from the meal; (3) by the loss arising from the dispersion of the finer particles through the atmosphere of the mill; and (4) by re-absorption of moisture. So that a miller is not to be set down as either dishonest or incompetent who does not always return the same weight of meal for the same quality of corn.

XI.

The Percentages of Kernel in Wheat and Barley in relation to Measure-weight.

To some of the facts shown in the tables of percentages of kernel in wheat and barley reference has already been made. The bran of wheat does not correspond with the husk of oats and barley. The husk of oats and barley consists of the pales or inner floral envelope, the chaff being the outer. The husk is sometimes coloured pink, brown, yellow, or black, and is probably equivalent to the corolla in many other plants. The bran of wheat and rye, on the other hand, is not a part of the flower, but of the seed, and consists of the outer coat or ovary, and a varying proportion of the coat of honey-comb cells lying over the surface of the grain below the outer coat. There is a beautifully delicate coat, the ovule sac, between these two, but it is so thin as hardly to come into account; it is the membrane which has the green colour in an unripe grain. Oats and barley have the same coats on their kernels as wheat, and, consequently, also have a bran, but it is so thin as to be seldom removed from the meal. The husk of barley cannot be removed by machinery without removing the outer coats of the grain and a considerable portion of the mass of starch beneath them.

Now, while it is easy to remove the outer coat from a wheat grain, it is impossible to remove by itself, in many of the wheats, what has been called, but without any propriety, the 'embryo membrane,' referring thereby to the superficial boundary of honeycomb cells which surround the starch. In wheat, oats, rye, maize, and some of the other grasses, this coat is but one cell deep; in barley, a transverse section shows this coat to have three and four of these cells above each other before the starch cells are reached. But this coat, which terminates the deposit made within the ovule, is not a separate coat from the general endosperm, but is organically connected with the endosperm at all points, as the skin of a turnip is connected by vascular rays with the bulb. And just as, notwithstanding this connection, the skin of the turnip will peel off, so will the episperm peel off in some of the wheats, although not without taking particles of starch along with it.

I have attempted in only one sample to give the full percentage of bran. Red Rivet is a large-grained wheat, from the seeds of which the coats can be successfully removed. In that wheat the outer coat or ovary forms 3·43 per cent. of the gross weight, the embryo (which goes to the bran) forms 2·62 per cent., and the bran coat forms 5·34 per cent., in all 11·39 per cent., leaving of starch and other constituents within the bran 88·61 per cent. But no machinery can remove the bran films with so little starch adhering to them as in this analysis, and accordingly the percentage of bran is usually stated at much higher than 11·39 per cent. It is however, with organic percentages that we are here dealing, and in wheats commonly cultivated 10 per cent. is certainly not far from the amount of actual bran upon the grain; the practical percentage of the mill product called 'bran,' depends on the character of machinery, workmanship, and condition of grain.

In the table to which this chapter refers I have given the percentage of outer skin in reference to measure-weight for twenty-six samples. The highest percentage is 4·97 for a 56-lb. bushel, and the lowest is 3·03 for a 60-lb. bushel, the difference being 1·94 per cent. In two samples of white wheat, each weighing 66 lb., the one has 3·61 per cent. of skin, and the other 4·51. A sample of white wheat from Haddington, weighing 65¾ lb., has 3·69 per cent. of outer coat, while the same percentage is found on a sample from America (*Montana*) weighing 62 lb. Probably similar differences in percentage will arise on the bran coats. But the question of organic percentage of bran ceases to be important to the miller and the practical farmer, when it is seen that the mechanical percentage is regulated by causes outside the structure of the seed.

An ill-filled, ill-ripened grain will have a lower percentage of starch or flour than a well-filled grain, just as an ill-filled sack will have less percentage of corn, and more percentage of sack-cloth than a well-filled sack. But as the sacs on a wheat corn are formed and finished at an earlier part of the season than the material within them, the notion that an unripe grain has thinner coats than a ripe, is a delusion based on pure ignorance of the botany of the cereals.

In the experiments for the table on 'Percentages of Kernel and Outer Coat in Unripe Wheat, compared with the same in Ripe Wheat,' grains were taken from the same ears at different times,—before maturity, and at maturity; but the stages of immaturity were those at which reaping has frequently been recommended. The average results show that a seed, weighing ·42 of a grain, had 6·08 per cent. of outer coat; while the same seed ripe, and weighing ·55 of a grain, had 4·41 per cent. of outer coat. At the same time the outer skin advanced in weight from ·0236 to ·0241 of a grain. Thus the increase in the skin, from the unripe states to the ripe is 2·29 per cent., while the increase in the kernel during the same time is 32·67 per cent., showing that the coats are mature before the kernel is completely finished.

Probably a classification of wheat grains might be made on the same principle as that on which oat grain is here classified. It is evident from mathematical considerations that the rounder wheats, other things being equal, will give the highest measure-weight irrespective of the coats which form the bran. But, indeed, whether these coats are of greater or less specific gravity than the body of the seed would be difficult to determine. The long seeds of Polish wheat (*Tr. Polonicum*), though having thin coats, have a low measure-weight; and the short round seeds of many common varieties, though having thicker coats than the Polish, have at the same time a higher measure-weight. Both measure-weight and specific gravity in wheat are so uncertain, and so liable to be affected by imperceptible causes, as to be theoretically and practically of little or no value. One seed from an ear was first in flower, and has had a week longer of ripening than another, so that the interior has very little vacant space, and the specific gravity is high; another was later in flowering, and has a larger lacuna along the midrib, and, having thus more air confined in it, has a lower specific gravity; but to contend that the one is of better quality than the other, is to say that the starch and albuminoids in the one are different from those in the other. What part is it that is of better quality?

What is called the husk in the barleys corresponds with the husk in oats, and consists of the two pales of the flower-cup. The glumes in barley are not arranged as in oats, so as to embrace and surround the seed, but are both placed outside the main pale, and consist of little more than awns. In oats the husks are not adherent to the kernel, but in barley the husks are tightly gummed on to the kernel; they are rough with teeth on the ribs, and the outer pale terminates in an awn ten or twelve times the length of the seed.

An estimate of husk and kernel in barley, corresponding with the same estimate in oats, would include the whole awn of the barley, in husk. But as the awn is always more or less dressed off, the awn is never included. But upon the kind and degree of dressing or hummelling depends to some extent the percentages of husk and kernel, and also the measure-weight in any given sample. And the variation which can be made in these points upon barley is much greater than upon wheat and oats. If a stack of barley is thrashed with the flail, the weight of the bushel may be 50 lb.; if thrashed with an ordinary farm machine, the weight may be 53 lb.; if hard thrashed with steam machinery, the weight may be 56 or 58 lb. There can be no doubt that since the introduction of thrashing machinery a quarter of barley has advanced in alimentary value much beyond its ancient standard. This advance is probably not overstated at 8 or 10 per cent., and is an economic fact affecting the proper comparison of ancient and modern prices.

In the table of 'Percentages of Kernel,' etc., it will be seen that the percentage of husk in two-rowed barley rises as high as about 11½, and in bere or six-rowed barley, as high as about 12½. But by the hard dressing sometimes given for show purposes, the percentage of husk is considerably reduced. Thus Chevalier barley (6), having the awn dressed off to about the length of the inner husk, gave 11·46 per cent. of husk, while hard dressed it gave (7) 10·31. Bere not hard dressed (12) gave 11·16 per cent. of husk, and hard dressed (13) gave 9·59. The hard dressing also smoothed off the teeth and corrugations of the husk, and enabled 5 or 6 lb. more to be poured into the bushel. And this is one of the methods by which an improved quality of grain is put into the seed market. When the superstitious worship of the great mystery of the bushel has been abolished, common sense may apply itself to employ methods of improving the quality which shall act before the corn is reaped, and not afterwards.

From what has been said it is obvious that any attempt to give percentages of kernel or husk in barley, in relation to measure-weight, would be utter waste of labour.

Convenient figures to recollect for the barleys may be given as 90 per cent. of kernel, and 10 per cent. of husk. And if a comparison of kernel in barley and oats is wanted, in respect of alimentary value, it will stand very nearly as 90 to 75. In other words, while 100 lb. of barley contain 90 lb. of kernel, 100 lb. of oats contain 75 lb. of kernel.

Wheat.

Percentages of Kernel and Outer Skin of Wheat in relation to Measure-Weight.

Varieties.	No. of Grains in lb.	Weight of Bushel.	Per cent. of Outer Skin.	Per cent. of Kernel.
1. White Wheat, ·29 in. × ·15 in.	6,924	66	3·61	96·39
2. White Wheat. Edin. Market,	8,888	66	4·51	95·49
3. White Wheat. Mr. Nelson, Haddington, . . .	10,753	65¾	3·69	96·31
4. White Wheat. Mr. Nelson, Haddington, . . .	9·247	65¾	3·75	96·25
5. White Wheat. Mr. Nelson, Haddington, . . .	8,906	65¾	4·33	95·67
6. Red Wheat, ...	12,612	65	4·41	95·59
7. White Wheat. Jonathan Mess. Grown in Morayshire, . .	10,463	65	3·59	96·41
8. Golden Amber Winter Wheat (Yellow), 40 bushels per acre. Grown in Oregon. *P.* George Sheppard, N. Pacific Railroad, ...	7,883	65	3·38	96·62
9. White Wheat, . . .	9,383	64	3·48	96·52
10. Konigsberg Wheat. Crop 1868. Mr. Smith, Aberdeen,	15,054	63½	3·48	96·52
11. Wheat. Fully ripe. North Kinmundy, ...	9,957	63	4·41	95·59
12. Red Spring Wheat. North Kinmundy, ...	15,625	63	4·46	95·54
13. Red Spring Wheat. North Kinmundy, ...	13,011	63	4·55	95·45
14. Red Spring Wheat. North Kinmundy, ...	13,384	63	4·70	95·30
15. Red Spring Wheat. North Kinmundy, ...	13,435	63	3·95	96·05
16. Australian Club Spring Wheat (White). Grown in Oregon. From G. Sheppard, North Pacific Railroad, . . .	10,903	63	3·11	96·89
17. Premium Spring Wheat (White). Montana. Per Mr. Sheppard,	10,219	62	3·65	96·35

Varieties.	No. of Grains in lb.	Weight of Bushel.	Per cent. of Outer Skin.	Per cent. of Kernel.
18. Tappahannock Winter Wheat (Yellow). Minnesota. *P.* Mr. Sheppard, ...	12,460	62	3·20	96·80
19. Odessa Wheat. Mr. Mess, Abn.	13,208	62	3·21	96·79
20. Saxonka, extra fine. Mr. Smith,	15,730	61	4·94	95·06
21. White Wheat. Mr. Nelson, Haddington, ...	11,058	60¾	3·70	96·30
22. Hungarian Wheat. Mr. Smith, Aberdeen, ...	11,327	60	3·03	96·97
23. Saxonka ('Inferior'). Mr. Smith, Aberdeen, . .	20,231	59½	4·05	95·95
24. White Wheat. Mr. Davidson, Buxburn, ...	9,162	57	4·12	95·88
25. Red Wheat. Edin. Market, .	9,421	56	4·97	95·03
26. Red Wheat. Very shrivelled,	16,055	56	4·59	95·41
27. Red Awny Wheat. Form of seed, ·38 inch. × ·13 inch, .	6,434	?	4·73	95·27
28. Red Winter Wheat. Mr. Smith, Montreal, ...	12,750	?	3·64	96·36
29. Winter Wheat (Yellow). G. Sheppard, Minnesota, . .	11,860	?	2·88	97·12
30. Russian Wheat (Yellow). Minnesota, 35 bushels per acre. Planted May 1, reaped Aug. 1. George Sheppard, North Pacific Railroad, ...	11,111	?	3·91	96·09
31. Odessa Spring Wheat (Red). Minnesota, 30 bushels per acre. Planted April 25, reaped July 20. George Sheppard, agent, ...	15,555	?	3·11	96·89
32. Chili Club Winter Wheat (White). Oregon, 50 bushels per acre. George Sheppard,	10,903	?	3·58	96·42
33. Sonora Spring Wheat (White). Oregon, 45 bushels per acre. George Sheppard, . . .	11,609	?	3·32	96·68
34. Red Rivet. North Kinmundy.	...	...	3·43	96·57
Average weight of the Outer Skin of a grain of wheat, air dry, ·0278 troy grain.				
Weight of Outer Skin Red Rivet, ·034 troy grain.				

WHEAT.

Percentages of Kernel and Outer Coat in Unripe Wheat, compared with the same in Ripe Wheat.

	Unripe.			Ripe.		
	Average Weight of one Corn Troy Grain.	Per cent. of Outer Skin.	Per cent. of Kernel.	Average Weight of one Corn Troy Grain.	Per cent. of Outer Skin.	Per cent. of Kernel.
1. White Wheat,	·62	5·38	94·62	·70	4·41	95·59
2. Red Spring ,,	·30	6·57	93·43	·45	4·46	95·54
3. ,, ,,	·26	9·73	90·27	·54	4·55	95·45
4. ,, ,,	·43	4·44	95·56	·52	4·70	95·30
5. ,, ,,	·49	4·27	95·73	·52	3·95	96·05
Means, . .	·42	6·08	93·92	·55	4·41	95·59

Average weight of one unripe skin = ·0236.
Average weight of one ripe skin = ·0241.

RED RIVET WHEAT.

		Weight in one Corn.
Percentage of outer coat, . .	3·43	·034
,, bran coat, . .	5·34	·053
,, embryo, . . .	2·62	·026
,, starch, etc., . .	88·61	·879
Average weight of grains tested, ...		·992

Mythical Derivation of English and Scotch Weights.

Wheat Corns may be selected from several varieties, more especially the Rivets, which, as we learn from Tusser, were anciently cultivated in England, by which the subjoined Tables may be formed.

Money Weight.

1 Wheat Grain	= 1 Grain 'droit pois,' *i.e.* troy weight.		
24 Wheat Grains	= 1 Sterling	= 24	troy grains.
20 Dwts.	= 1 Ounce	= 480	„
12 Ounces	= 1 Pound	= 5760	„

Commercial Weight.

1 Wheat Grain	= 1 Grain 'droit pois,' *i.e.* troy weight.		
32 Wheat Grains	= 1 Sterling	= 32	troy grains.
20 Dwts.	= 1 Ounce	= 640	„
12 Ounces	= 1 Pound	= 7680	„
15 Ounces	= 1 Pound	= 9600	tron weight.

Barley.

Percentages of Kernel and Husk, with some references to relative Measure-Weight.

Varieties.	No. of Seeds in lb.	Weight of Bushel.	Per cent. of Husk.	Per cent. of Kernel.
1. Italian or Golden. North Kinmundy. Crop 1871, . .	6,481	...	10·10	89·90
2. Chevalier. First Prize. Crop 1870, ...	8,083	...	10·51	89·49
3. Chevalier. Crop 1869, . .	8,235	...	7·06	92·94
(In this case an ear was taken on which were ten barren florets or empty husks. These were weighed, and regarded as the husks of ten full grains from the same ear. And here the per cent. of husk is less than where the kernel is decorticated. But the barren husk is not so long as that distended by a ripe kernel, so that other analyses must be nearly correct.)				
4. Chevalier. First Prize. Crop 1871. Mr. J. Cran, Inverness, ...	9,695	60¼	8·03	91·97
(This sample very hard dressed. If average dressed it would weigh 53 or 54 lb., and show per cent. of kernel about 90.)				
5. Chevalier. First Prize. Crop 1871. Aberdeen Show, .	9,409	59¼	7·93	92·07
6. Chevalier. Dressed to the length of the inner pale or husk, ...	...	..	11·46	88·54
7. Chevalier. Same sample as No. 6, but hard dressed, .	...	...	10·31	89·69
8. Bere (six-rowed barley, thin-set spike). Crop 1871, . .	9,409	...	10·90	89·10
9. Bere. Crop 1870. Aberdeen Show, ...	11,363	...	9·42	90·58

VARIETIES.	No. of Seeds in lb.	Weight of Bushel.	Per cent. of Husk.	Per cent. of Kernel.
10. Bere. First Prize. Crop 1871. Aberdeenshire, .	12,635	53½	9·03	90·97
11. Bere. Crop 1877. North Kinmundy, ...	10,506	50	12·41	87·59
12. Bere. Aberdeen Market. Crop 1871. Not hard dressed,	13,461	47	11·16	88·84
13. Bere. Same sample as No. 12, hard dressed, . . .	13,699	52	9·59	90·41
14. Bere ('White Barley'). From Oregon, United States. Geo. Sheppard, North Pacific Railway. Crop 1872. Not hard dressed, . . .	8,040	...	11·10	88·90
15. Bere. Same sample as No. 14. Hard dressed, . .	8,083	...	10·39	89·61
16. Bere. From Egypt. Crop 1871. Not hard dressed, .	9,234	...	11·48	88·52
17. Six-rowed Barley, thick-set spike. Crop 1871. Aberdeen,	9,434	...	10·92	89·08

ITALIAN BARLEY.

The heaviest corns weigh 1·08 grain.
Average corns weigh ·89 ,,
The lb. contains 7865 corns.

CHEVALIER BARLEY.

The heaviest corns weigh ·87 grain.
Average corns weigh ·68 ,,
The lb. contains 10,294 corns.

COMMON BARLEY.

The heaviest corns weigh ·87 grain.
Average corns weigh ·72 ,,

BERE.

Average Bere corns weigh ·58 grain.
The lb. contains 12,069 corns.

All these weights are subject to much variation.

XII.

Measure-weight and Moisture.

The experiments detailed in the Table of Measure-weight and Moisture were made in order to discover in what way measure-weight varies with variation in percentage of moisture. It is popularly supposed that the drier a stock of grain is, the heavier will a bushel of it weigh. These experiments prove that this is not the case.

The way in which they were made was this: A quantity of corn was taken, and the weight per bushel accurately found from the mean of three trials. A small sample was then dried at 212° to find the percentage of moisture for the weight thus ascertained. The stock of grain was then steeped in water or laid between wet cloths for as many hours as was thought proper. It was then spread out and turned over till all appearance of water adhering on the outside had disappeared. The whole was then weighed, and the increase gave the percentage of water absorbed, which, added to the original percentage, gave the total proportion of water in the grain after steeping. Further processes will be best seen in connection with an example.

A parcel of Morayshire wheat (1) was found to weigh 65·95 lb. per bushel, and to contain 9·35 per cent. of water. After being steeped for twenty-two hours, it was found to contain 31·10 per cent. of water, and to weigh 57·43 lb. per bushel. It was then spread out to dry in the air, and when next weighed was found to contain 26·94 per cent. of moisture, and to weigh 57·66 lb. The same operations were repeated as the drying progressed. When the moisture had evaporated till 8·63 per cent. remained (the nearest point to the original percentage), the weight had not risen to the original weight of 65·95, but only to 61·98. Air-drying brought the percentage further down to 7·17, when the weight was 62·02 lb. Artificial drying was then resorted to, and when a percentage of 5·47 was reached the weight was 62·01 lb.; with 3·57 per cent. of moisture, the weight was 62·15; and with complete drying the hot grain weighed 61·75 lb., and measured cold, weighed 62·08 lb. Thus the measure-weight with no moisture in the grain was nearly 4 lb. less than at first with 9·35 per cent.

A parcel of Ghirka behaved in a nearly similar manner. It contained (as kept in a very dry room) 8·15 per cent. of moisture, and weighed 65·77 lb. Steeped in water for twenty-two hours, it contained 29·24 per cent. of moisture, and weighed 57·31 lb. When the moisture came down to 8·10, the original per cent., the weight had returned only to 63·47 lb., or 2 lb. below the original weight. With artificial drying till 0·28 per cent. of moisture remained, the weight per bushel was 63·81 lb.,—little rise of weight taking place from the point of 10·24 per cent. of moisture down to complete desiccation. Here the return is to within 2 lb. of the original weight.

In both these cases a return to the original percentage of moisture is not accompanied by a return to the original measure-weight; and the explanation of this is, that from the swelling or expansion of each grain by the water, it never again returns with an equal amount of contraction,—the seeds remain permanently bigger than they were at first.

In the details of the first experiment with wheat are given the weight of water and the weight of dry wheat in the bushel for the various percentages of moisture. It is thus seen that when the wheat contains 31·10 per cent. of moisture while the bushel weighs 57·43 lb., there are 17·86 lb. of water in the bushel and 39·57 lb. of dry wheat. Then when the wheat contains 26·94 per cent. of moisture, the bushel weighs 57·66 lb., and the weight of water in it is 15·53 lb. A bulk of ·2·33 lb. of water has been removed from the grain; and if the grain had shrunk a bulk of wheat equal in weight to 2·33 lb. of water, the measure-weight of 57·43 would have remained unchanged. But it has shrunk more than this by 0·23 lb., and the measure-weight is 57·66. When the percentage of moisture is 24·11, the bushel weighs 58·55 lb., and the grain contains

14·12 lb. of water; then when the percentage of moisture is 14·90, the bushel holds 60·97 lb., containing 9·08 lb. of water. Between the dates of these two estimations the bushel has lost by evaporation 5·04 lb. of water, while the measure-weight has risen 2·42 lb. Roughly speaking, therefore, the wheat has contracted by the bulk of 5·04 lb. of water, and 2·42 lb. of wheat. From the point at which the wheat reaches a percentage of moisture of about 10·38, the measure-weight remains permanent down to complete desiccation, so that over this range of evaporation the wheat shrinks by a bulk which is equal in weight to the weight of water lost. The shrinking decreases in rate as the point of dryness is approached.

It may be found that wheat loses its elasticity as it remains in the granary. But from these experiments it is probable that a wheat of 65 lb. cut dry and drenched in the stook, will weigh afterwards only 62 or 63 lb.; it swells and never contracts to its original size. But who will say that the quality of it has been altered? All the constituents remain within the coats the same as before the rain. And the measure-weight is no criterion of their proportions.

Barley under moisture does not behave in quite the same manner as wheat. The contraction of wheat while losing the higher percentages of moisture is rather more rapid than while losing the lower percentages; in barley the rate of contraction is much the same at the higher percentages as at the lower. Steeped for forty-one hours in water, a sample of barley (3) increases in percentage of moisture from 9·85 to 36·94, and diminishes in measure-weight from 60·51 lb. to 57·50 lb. The weight increases till the percentage of moisture arrives at 30·77, and then gradually diminishes to the point of complete dryness. Down to 30·77 the contraction of the barley rather more than makes up the weight of water lost, so that the bushel becomes heavier. From this point to desiccation, the contraction does not quite make up the weight of water lost, so that the bushel becomes lighter. But the barley, like the wheat, does not again contract to its original size. When the percentage of moisture in the wheat comes down to the point it started with, the bushel weighs about 4 lb. less; when the barley comes down to its starting-point of moisture, the bushel weighs about 3 lb. less. The elasticity is therefore imperfect. As a spiral spring of soft wire overdrawn never regains its original compactness, so the tissues of these grains of barley and wheat distended by the disrupting intrusion of water do not return to their first compactness after the water is withdrawn. Nearly the same bulk, the cubic capacity of the bushel (2,218 inches), is occupied by 56·88 lb. of perfectly dry barley, as by 30·37 lb. of barley gorged with 19·68 lb. of water. Bere behaves in the same manner under moisture as barley.

The main fact brought out in regard to wheat and barley, that from the expansion caused by large absorptions of water they never fully contract again, is equally borne out by more extended experiments with oats. The first sample given (5) is an oat containing 10·15 per cent. of moisture, and weighing per bushel 44·41 lb. Charged with 36 per cent. of moisture, and again reduced to 10, the bushel-weight has lost 2 lb. When completely dried the weight is 42·19 lb. But the same corn completely dried, without having been steeped in water, weighs 43·06 lb. Sufficient trials, however, were not made to test whether this result would generally happen.

In six cases the measure-weight is greater with the highest percentage of moisture than with any of the lower, except the original before steeping. But in most cases the measure-weight of the steeped grain rises a little as the moisture diminishes, and then gradually falls till complete dryness is reached. But the uniformity is not so complete in different samples as to warrant the formulation of a law.

With 120 hours' steeping, oats contain between 40 and 50 per cent. of water. A sample steeped 46 hours contained 33 per cent. of water, while laid between damp cloths for 63 hours, it contained 28½ per cent. Giving grain moisture by damp cloths does not seem to reduce the measure-weight so much as direct steeping in water.

Oat kernels, containing 10·50 per cent. of moisture, weighed 53·49 lb. to the bushel. When steeped for 14 hours they weighed 49·61 lb., and, dried in air down to the starting-point of 10·50 per cent., they reached, between 22nd and 27th May, to 50·56 lb. per bushel, a decrease on the original weight of nearly 3 lb. The law is the same in all cases: By steeping grain in water, the measure-weight, on again drying the grain, is permanently reduced.

The weights of water and dry grain to the bushel, for various percentages of moisture, are given in the table for one sample of wheat, one of barley, and one of oats, so that the bearing of this part of the inquiry may be seen upon the corn market. These grains are highly sensitive to the degree of humidity in the atmosphere; and, probably, an unscrupulous corn-dealer could turn this principle to considerable account. About 14 per cent. is the amount of moisture usually found in grain from the barn, so that the man who sells 100 lb. of wheat sells 14 lb. of water; or, if the bushel weighs 61 lb., he sells 8½ lb. of water with the bushel, or 68 lb. with the quarter. The addition of a few per cents. of water does not sensibly affect the measure-weight, and whether the buyer has instincts sharp enough to detect them depends on his experience. The figures for barley (3) show that a 58-lb. bushel (say 55 for ordinary measuring) may be sold with 8·71 lb. of water in it, and a bushel of the same barley and the same weight (57·50, *i.e.* 54½) with 21·24 lb. of water in it. I do not say that this would be honest work, or that an experienced buyer would not detect the great excess of water; but what I mean to point out, in deprecation of the accepted theory of measure-weight is, that an order might be sent a distance by a purchaser, for barley of 58 lb. the bushel, and might be executed with a stock containing either 15 per cent. of water or 37 per cent. The calculated experiment with oats shows that the bushel containing about the usual percentage of water, 14·63, weighs 42·47 lb., while the bushel containing 36 per cent. of water weighs very nearly the same (42·01). But the one contains 36·26 lb. of dry matter, and the other only 26·87. Probably the subtle and unsuspected variations in percentage of moisture more largely affect calculations in the corn market and the mill than any variations in the actual qualities of the grain. But, as the testing of percentage of moisture is an operation of extreme simplicity, no corn-dealer who has a real interest in his work should leave uncertainty hanging over this important element of value.

MEASURE-WEIGHT AND MOISTURE.

TABLE showing the Variation of Measure-weight under varying percentages of Moisture.

I. WHEAT.

(1.) White Wheat, Morayshire. Containing 12,866 seeds to the lb., with 9·35 per cent. of moisture.

	Per cent. of Moisture.	Measure-Weight. lb.	Weight of Water in Bushel. lb.	Weight of Dry Wheat in Bushel. lb.
As air-dried, . . .	9·35	65·95	6·17	59·78
Steeped in water 22 hours (28th May), . .	31·10	57·43	17·86	39·57
Under air-drying, . .	26·94	57·66	15·53	42·13
Do., . .	24·11	58·55	14·12	44·43
Do., . .	14·90	60·97	9·08	51·89
Do., . .	10·38	61·81	6·42	55·39
Do., . .	8·63	61·98	5·35	56·63
Do. (1st June), .	7·17	62·02	4·46	57·56
Artificial drying, . .	5·47	62·01	3·39	58·62
Do., . .	3·57	62·15	1·22	60·93
Do., . .	0·00	62·08	0·00	62·08
	Hot.	61·75	...	...

This wheat, completely dried on 27th May, had absorbed from the air by 1st June 5·79 per cent. of moisture.

(2.) Ghirka Wheat. Containing 18,256 seeds to the lb., with 8·15 per cent. of moisture.

	Per cent. of Moisture.	Measure-Weight. lb.
Air-dry (May 27th), ...	8·15	65·77
Steeped in water 22 hours (28th May),	29·24	57·31
Under air-drying (28th May), . .	25·57	58·32
Do. (28th May), ...	22·58	59·34
Do. (29th May), ...	15·12	62·53
Do. (29th May), ...	10·24	63·29
Do. (29th May), ...	8·10	63·47
Do. (1st June), ...	7·52	63·50
Under artificial drying (3d June), .	5·87	63·70
Do. (3d June), .	4·12	63·84
Do. (4th June), .	0·28	63·81

This wheat, dried to 0·00 on 27th May, had absorbed from the air inside by 1st June 6·26 per cent. of moisture.

II. Barley.

(3.) Barley. Crop 1866. Tillyfour, Aberdeenshire. Containing 10,570 seeds to the lb., with 9·85 per cent. of moisture.

	Per cent. of Moisture.	Measure-Weight. lb.	Weight of Water in Bushel. lb.	Weight of Dry Wheat in Bushel. lb.
Air-dry (30th May 1868),	9·85	60·51	5·96	54·55
Steeped in water 41 hours (1st June), . . .	36·94	57·50	21·24	36·26
Under air-drying, . .	34·50	57·05	19·68	37·37
Do., . .	32·29	58·87	19·00	39·87
Do., . .	30·77	59·45	18·29	41·16
Do. (2d June), .	24·73	58·53	14·47	44·06
Do., . .	21·52	58·43	12·57	45·86
Do., . .	19·68	58·67	11·55	47·12
Do. (3d June), .	15·00	58·07	8·71	49·36
Do., . .	8·38	57·47	4·81	52·66
Under artificial drying,	6·08	57·22	3·48	53·74
Do., .	3·89	57·18	2·22	54·96
Do. (4th June),	0·35	56·88	0·20	56·68
	Hot.	56·46	...	...

(4.) Bere. Crop 1868. Aberdeenshire. Containing 13,118 seeds to the lb., with 9·90 per cent. of moisture.

	Per cent. of Moisture.	Measure-Weight. lb.
Air-dry (27th May), ...	9·90	56·47
Steeped in water 21 hours (28th May),	30·10	54·75
Under air-drying (28th May), . .	26·07	56·16
Do. (28th May), . .	23·05	56·14
Do. (29th May), . .	17·21	56·09
Do. (29th May), . .	14·04	56·06
Do. (29th May), . .	12·51	55·81
Do. (29th May), . .	10·50	55·52
Do. (1st June), . .	6·75	54·95
Under artificial drying (3d June), .	5·13	54·69
Do. (3d June), .	2·94	54·69
Do. (4th June), .	0·00	54·57

Sample dried to 0·00 27th May, absorbed from air inside by 1st June 5·21 per cent. of moisture.

III. Oats.

(5.) Sandwich. Crop 1866. Parkhill, Aberdeenshire.

	Per cent. of Moisture.	Measure-Weight. lb.	Weight of Water in Bushel. lb.	Weight of Dry Wheat in Bushel. lb.
Air-dry (12th May 1868),	10·15	44·41	4·50	39·91
Steeped 42 hours (14th May), ...	36·07	42·01	15·14	26·87
Under air-drying, . .	32·95	41·86	13·80	28·06
Do., ...	28·72	41·90	12·03	29·87
Do. (15th May), .	17·85	43·04	7·68	35·36
Do., ...	14·63	42·47	6·21	36·26
Do. (18th May), .	9·52	42·65	4·06	38·59
Fire-dried (23d May), .	0·32	42·19	0·14	42·05
Artificially dried. Unsteeped in water, .	0·00	43·06	0·00	43·06

(6.) Potato Oats. Crop 1866. Tillyfour.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (12th May 1868), ...	10·05	46·79
Steeped in water 2 hours (12th May), .	23·52	39·79
Under air-drying (12th May), . .	19·85	40·65
Do. (13th May), . .	13·75	45·53
Do. (13th May), . .	11·31	45·79
Do. (14th May), . .	10·00	45·73
Artificially dried, (23d May), . .	5·40	45·42
Artificially dried, unsteeped (23d May),	0·65	45·21

(7.) Early Barley. Crop 1866. Tipperty, Aberdeen.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (12th May 1868), ...	10·00	46·89
Steeped 42 hours (14th May), . .	36·28	44·49
Air-dried (14th May), ...	32·46	43·49
Do. (15th May), ...	20·34	43·75
Do. (15th May), ...	15·69	44·14
Do. (18th May), ...	9·44	44·32
Artificially dried (23d May), . .	0·33	43·93

(8.) Scots Barley. Crop 1867. Aberdeenshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (12th May 1868), ...	11·00	43·92
Steeped 84 hours (16th May), . .	41·02	43·66
Air-dried (18th May), ...	13·19	41·13
Do. (19th May), ...	11·67	41·28
Artificially dried (23d May), . .	5·17	41·92

(9.) Tawny Oats. Crop 1867. Aberdeenshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (12th May 1868), ...	11·15	44·55
Steeped 14 hours (13th May) . .	26·20	41·38
Air-dried (13th May), ...	21·12	44·16
Do. (14th May), ...	10·80	44·14
Artificially dried (23d May), . .	1·22	43·06
Do. unsteeped (23d May), .	0·11	42·70

(10.) Potato Oats. Crop 1867. Aberdeenshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	11·20	45·39
Steeped 28 hours (14th May), . .	36·69	45·15
Air-dried (14th May), ...	32·73	44·11
Do. (15th May), ...	21·39	44·41
Do. (15th May), ...	17·31	44·07
Do. (18th May), ...	10·55	43·75
Artificially dried (23d May), . .	4·80	43·79

(11.) Black Tartarian. Crop 1867. Co. Clare, Ireland.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	11·30	43·12
Steeped 28 hours (14th May), . .	34·42	37·71
Air-dried (14th May), ...	30·35	38·51
Do. (15th May), ...	18·29	41·28
Do. (15th May), ...	15·16	41·09
Do. (18th May), ...	10·31	40·99
Artificially dried (23d May), . .	1·33	40·41

(12.) Potato Oats. Crop 1867. Co. Antrim, Ireland.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	11·25	46·31
Steeped 46 hours (15th May), . .	34·52	43·81
Air-dried (15th May), ...	30·33	43·50
Do. (16th May), ...	23·24	44·74
Do. (18th May), ...	11·47	44·57
Fire-dried (23d May), ...	2·61	44·11

(13.) Swedish Oats. Crop 1867.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868),	12·14	46·25
Steeped 45 hours (15th May),	36·16	41·17
Air-dried (15th May),	32·94	40·43
Do. (16th May),	24·50	43·60
Do. (18th May),	12·33	43·19
Fire-dried (23d May),	0·00	42·45

(13-*a.*) Same Sample as (13.)

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Between damp cloths 63 hours (25th May),	31·15	38·55
Air-dried (25th May),	25·11	43·44
Do. (26th May),	17·18	43·63
Do. (26th May),	12·75	44·32
Fire-dried (28th May),	8·13	44·03
Do. (29th May),	3·03	43·86

(14.) Early Angus Oats. Crop 1867. Shetland.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868),	11·85	43·04
Steeped 120 hours (18th May),	44·86	42·38
Air-dried (18th May),	41·00	41·31
Do. (19th May),	36·53	40·14
Do. (19th May),	29·01	41·20
Do. (20th May),	20·87	39·18
Do. (20th May),	12·35	39·73
Fire-dried (23d May),	0·00	39·53

(15.) Kildrummy Oats. Crop 1867. Aberdeenshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	11·50	46·38
Steeped 120 hours (18th May), . .	41·24	42·40
Air-dried (18th May), ...	37·89	42·24
Do. (19th May), ...	31·87	42·23
Do. (19th May), ...	25·19	43·97
Do. (20th May), ...	18·97	42·29
Do. (20th May), ...	10·95	42·74
Fire-dried (23d May), ...	1·81	42·29

(16.) Early Barley. Crop 1867. Buchan.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), . . .	11·15	46·99
Steeped 46 hours (15th May), . .	33·19	44·26
Air-dried (15th May), ...	29·82	44·41
Do. (16th May), ...	22·99	45·77
Do. (18th May), ...	10·71	44·35
Fire-dried (23d May), ...	2·95	44·66

(16-*a*) Same Sample as (16.)

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Between damp cloths 63 hours (25th May), ...	28·47	41·85
Air-dried (25th May), ...	23·87	45·84
Do. (26th May), ...	16·47	45·45
Do. (27th May), ...	10·14	45·49
Fire-dried (28th May), . . .	6·12	44·90
Do. (28th May), ...	1·58	44·61

(17.) White Tartarian. Crop 1867. Devonshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	11·60	42·72
Steeped 45 hours (15th May), . .	36·06	36·32
Air-dried (15th May), ...	32·35	36·57
Do. (16th May), ...	24·05	40·37
Do. (18th May), ...	9·80	40·78
Fire-dried (23d May), ...	0·67	41·37

(18.) Black Tartarian. Crop 1867. Devonshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (23d May 1868), ...	12·85	42·03
Fire-dried, unmoistened (23d May), .	0·00	40·07

(19.) Canadian Oats. Crop 1867. Devonshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), , . . .	10·75	49·45
Steeped 120 hours (18th May), . .	39·67	46·40
Air-dried (18th May), ...	35·86	45·62
Do. (19th May), ...	30·03	45·09
Do. (19th May), ...	24·44	46·78
Do. (20th May), ...	18·75	46·29
Do. (20th May), ...	12·94	47·38
Do. (21st May), ...	8·39	47·61
Fire-dried (23d May), ...	0·00	47·49

(20.) Potato Oats. Crop 1867. Aberdeenshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	10·80	48·95
Steeped 45 hours (15th May), . .	32·80	46·35
Air-dried (15th May), ...	28·91	46·72
Do. (16th May), ...	22·26	46 95
Do. (18th May), ...	10·20	45·79
Fire-dried (23d May), ...	1·87	45·44

(21.) Fyvie Oats. Crop 1867. Aberdeenshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	9·60	47·58
Steeped 45 hours (15th May), . .	30·32	45·10
Air-dried (15th May), ...	27·13	45·63
Do. (16th May), ...	21·24	46·03
Do. (18th May), ...	9·39	45·41
Fire-dried (23d May), ...	6·44	45·51

(22.) 'African' Oats. Crop 1867. Aberdeenshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	10·65	47·22
Steeped 45 hours (15th May), . .	30·62	44·54
Air-dried (15th May), ...	27·77	45·26
Do. (16th May), ...	22·22	46·31
Do. (18th May), ...	10·70	44·64
Fire-dried (23d May), ...	2·72	44·41

(22-a.) Same Sample as (22.)

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Between damp cloths 14 hours (22d May), ...	20·37	39·07
Air-dried (22d May), ...	16·63	44·57
Do. (22d May), ...	14·60	46·02
Do. (25th May), ...	9·63	46·22
Fire-dried, (28th May), ...	5·60	45·60
Do. (28th May), ...	1·13	44·83

(23.) Longfellow Oats. Crop 1867. Banffshire.

	Per cent. of Moisture.	Measure-Weight lb. per Bushel.
Air-dry (13th May 1868), ...	10·50	48·11
Steeped 120 hours (18th May), . .	39·44	47·01
Air-dried (18th May), ...	33·66	45·83
Do. (19th May), ...	28·22	45·51
Do. (19th May), ...	23·98	45·74
Do. (20th May), ...	18·50	45·02
Do. (20th May), ...	12·91	45·29
Do. (21st May), ...	7·62	44·57
Fire-dried (23d May), ...	0·10	43·98

(24.) Potato Oats. Crop 1867. Oldhamstocks Mains, Haddingtonshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), . . .	10·35	49·09
Steeped 120 hours (18th May), . .	39·29	46·61
Air-dried (18th May), ...	35·21	46·01
Do. (19th May), ...	30·08	46·23
Do. (19th May), ...	25·02	47·02
Do. (20th May), ...	18·80	45·63
Do. (20th May), ...	11·55	46·15
Do. (21st May), ...	7·90	45·57
Fire-dried (23d May), ...	3·29	45·44

(24-*a*.) Same Sample as (24.)

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Between damp cloths 14 hours (22d May).	21·94	40·46
Air-dried (22d May), ...	18·09	45·51
Do. (22d May), ...	15·66	47·70
Do. (25th May), ...	10·57	47·58
Fire-dried (28th May), . . .	6·42	47·06
Do. (29th May), . . .	2·77	46·45

(25.) English Barley Oats. Crop 1867. Banffshire.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Air-dry (13th May 1868), ...	10·45	47·88
Steeped 120 hours (18th May), . .	40·05	45·04
Air-dried (18th May), ...	36·04	43·84
Do. (19th May), ...	30·51	43·98
Do. (19th May), ...	25·66	45·06
Do. (20th May), ...	19·34	43·67
Do. (20th May), ...	13·02	44·09
Do. (21st May), ...	7·68	43·52
Fire-dried (23d May), ...	0·70	43·19

(25-*a.*) Same Sample as (25.)

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Between damp cloths 63 hours (25th May), ...	27·61	40·35
Air-dried (25th May), ...	22·15	45·94
Do. (26th May), ...	15·92	44·87
Do. (27th May), ...	9·22	44·94
Fire-dried (28th May), ...	5·38	44·93
Do. (28th May), ...	1·69 (Hot)	44·11
Do. (28th May), ...	1·69 (Cold)	44·34

(26.) Oat Kernels.

	Per cent. of Moisture.	Measure-Weight. lb. per Bushel.
Average of 3 trials, ...	10·50	53·49
Steeped 14 hours and adhering water dried off (22d May), ...	...	49·61
Air-dried (23d May), ...	...	50·89
Do. (25th May), ...	...	50·71
Do. (27th May), ...	10·50	50·56

XIII.

Moisture in Grain.

FROM what has been said it will be apparent that the variability of moisture in grain is a highly important consideration. But the moisture is not seen. It comes and goes, and the senses take no hold upon it. It is not a quality of the corn. It is not a husk. It is not a kernel. The flour cannot be influenced by it; the meal cannot be influenced by it. A thick husk may be seen, and estimated and denounced. A shrivelled kernel is an obvious thing, and must break up with thick films of bran, to the diminution of fine flour. But moisture is altogether too intangible to be made any account of. And yet there can be no doubt that this moisture has spoiled more of the miller's calculations than all the variations of quality put together.

For the Table of Moisture in Grain, the weight of parcels of oats was noted on receipt, along with the date. They were again and again weighed at subsequent dates; the weights thus found giving the percentages of moisture abstracted from them by the air of the room in which they were kept. These percentages are set down in the column headed 'Lost by natural drying.' When the process was to be completed, a quantity was completely dried at 212° Fahr., and the percentage of moisture thus driven off (set down in the second column), added to that lost by natural drying, gives the percentage in the grain when first received.

We have seen that grain is capable of containing nearly half its weight of water. But as kept in ordinary granaries and barns grain contains about one-seventh of its weight of water. In a damp situation the water may be a few per cents. higher, and in a dry situation a few per cents. lower, than average. If we say that 14 per cent. of moisture is the average, then the farmer who sells corn at a penny the pound receives for dry matter, exclusive of water, 1·163d. the pound; the farmer whose corn contains

12 per cent. of moisture receives for his dry matter 1·136d. the pound, and the farmer whose corn contains 17 per cent. of moisture receives 1·205d. the pound. These variations could not be detected by a corn-buyer or the servants who receive his purchases, but a dry atmosphere passing over his stores for a few days would insidiously find its way into his books.

The first sample in the table is one newly reaped and thrashed, and is found to contain 19·33 per cent. of moisture—8·33 per cent. went out by air drying between September 30 (1867) and April 24 (1868), and 11·00 per cent. was dried out at the heat of boiling water.

In this sample and a few others I have set down the faranalysis of the grain in its dried and undried state, to show the two aspects of the matter. Thus in 100 lb. there are :—

	Undried.	Dried.
Moisture,	19·33 lb.	0·00 lb.
Kernel,	60·89 lb.	75·10 lb.
Husk,	19·78 lb.	24·90 lb.
	100·00 lb.	100·00 lb.

We have already seen that, leaving moisture out of consideration, the percentages of kernel and husk are so nearly permanent, whether the corn is dried or not dried, that the variation is not practically worth taking into calculation. In the present sample the percentages of undried kernel and husk are 75·48 and 24·52 respectively; and the percentages after drying are, of kernel 75·10, and of husk 24·90. And since these percentages remain unaltered by drying, the percentage of moisture in both husk and kernel is the same, 19·33; and this holds good in all cases. The meaning of it seems to be that there is a free and rapid interchange of moisture between kernel and husk. If damp approaches the husk, it is rapidly transferred to the kernel, and an equipoise established.

But the farmer must not imagine that because his oats contain 75 per cent. of kernel, he should have 75 lb. of meal for every 100 lb. of oats he sends to the mill, the moisture has to be dried out and as in the sample under notice; there are 19·33 lb. of it, there will remain only 80·67 lb. of dry corn. It is 75 per cent. of this weight which he ought to receive of perfectly dry meal, and that is 60·89 lb.

It will be seen from the table that the percentages of moisture in oats fall from 19 down through the intervening numbers to about 9 or 10. The average for the ordinary commercial hygrometric condition is 13·97, or so nearly 14 per cent. that 14 may be accepted as the average of moisture in barns and grain stores. But the percentages are also given for the same grain as kept in a dwelling-house in which the air is drier from the use of fire; and the average of these percentages is 10·54 (10½); showing that the grain does not, by the exercise of any chemical affinity, retain a determinate quantity of water, but gives out and takes in according to the saturation of the environing air.

It would certainly not be at all difficult for a farmer, or a miller, or a corn-factor, to make himself acquainted with all the bearings of moisture upon his traffic in corn. With such knowledge he would be in a better position to protect his interests than without it. Suppose that a sample of Potato oats is offered to a buyer, and that it contains 77 per cent. of kernel. This percentage is above the average, and the sample will look well. The breast of the seed will be prominent, and the inner husk will be pushed outward, indicating a good kernel. The price is fixed at 8s. 6d. the cental. Another sample is shown which contains only 74¼ per cent. of kernel. The appearance is inferior to that of the first; the kernels are all concealed, and tightly wrapped up in the ill-filled husks. It is sold at 8s. But suppose now when the miller comes to manufacture both samples into meal, that the best sample contains 16 per cent. of moisture and the worst 13—and a wider range is quite within the market—the result will be that the best corn will yield ($100-16=84 \times 77$) 64·68 lb. of dry kernel, and the worst will also yield ($100-13=87 \times 74\frac{1}{4}$) 64·60 lb. Both samples will give the same weight of meal, and the worst sample will be to the buyer the better bargain.

It may be said, There is no time to test percentages of moisture in the corn market. This may be quite true. But prices could be made contingent upon a standard of moisture, and stocks be tested when delivered. And if people will not take the necessary time and means properly to conduct their business, probably they may suffer correspondingly, and may see that in the world of commerce the overruling law is the survival of the sharpest.

MOISTURE IN GRAIN.

Table showing the Percentages of Moisture in Oats under the various conditions described.

Varieties.	Undried.	Dried.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
1. Scots Barley Oats. Aberdeenshire. Newly reaped and thrashed.					
From September 30 to December 13, 1867, . . .			7·32	...	...
From December 13, 1867, to April 24, 1868, . . .			1·01	...	...
At 212° Fahr., till weight became stationary, . . .			...	11·00	19·33
Moisture, per cent.,	19·33	0·00			
Kernel, ,,	60·89	75·10			
Husk, ,,	19·78	24·90			
Kernel (irrespective of moisture), .	75·48	75·10			
Husk, do., .	24·52	24·90			
Moisture in Kernel,	19·33	...			
Moisture in Husk, .	19·33	...			
2. Tawny Oats. Aberdeenshire.					
From October 11 to December 13, 1867, ...			4·30	...	...
From December 13 to April 24, 1868, ...			1·19	...	...
At 212° Fahr., till weight became stationary, . . .			...	11·15	16·64
Moisture, per cent.,	16·64	0·00			
Kernel, ,,	62·55	74·64			
Husk, ,,	20·81	25·36			
Kernel (irrespective of moisture), .	75·03	74·64			
Husk, do., .	24·97	25·36			
Water in Kernel, .	16·64	0·00			
Water in Husk, .	16·64	0·00			

VARIETIES.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
3. Tawny Oats. Aberdeenshire.			
From October 11 to December 13, 1867, ...	2·00	...	...
From December 13 to April 24, 1868, ...	1·05	...	...
At 212° Fahr. till weight became stationary, . . .	...	9·90	12·95
4. Potato Oats. Aberdeenshire.			
From November 1 to December 13, 1867, ...	6·32	...	...
From December 13 to April 24, 1868, ...	0·79	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·20	18·31
Undried. Dried.			
Water, . . 18·31 0·00			
Kernel, . . 62·52 76·32			
Husk, . . 19·17 23·68			
Kernel (irrespective of water), . 76·53 76·32			
Husk, do., . 23·47 23·68			
Water in Kernel, 18·31 0·00			
Water in Husk, 18·31 0·00			
5. Black Tartarian. County Clare.			
From November 27 to December 31, 1867, ...	2·38	...	...
From December 31 to April 24, 1868, ...	1·86	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·30	15·54
6. Dun Winter Oats. County Limerick.			
From November 29 to December 24, 1867, ...	1·06	...	...
From December 24 to April 24, 1868, ...	1·72	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·00	13·78

Varieties.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
7. Hopetoun Oats. Co. Limerick.			
From November 28 to December 24, 1867, ...	1·48	...	...
From December 24 to April 24, 1868, ...	1·63	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·50	13·61
8. Helsingborg. Sweden.			
From December 2 to December 31, 1867, ...	1·62	...	...
From December 31 to April 24, 1868, ...	1·52	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·65	13·79
9. Various Oats. Denmark.			
From December 2 to December 31, 1867, ...	0·91	...	...
From December 31 to April 24, 1868, ...	1·50	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·75	13·16
10. White Poland. Sweden.			
From December 3 to December 25, 1867, ...	1·07	...	...
From December 25 to April 24, 1868, ...	1·72	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·30	13·09
11. Potato Oats. Ireland.			
From December 3 to December 25, 1867, ...	1·09	...	...
From December 25 to April 24, 1868, ...	1·80	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·15	13·04
12. Various Oats. Russia.			
From December 3 to December 25, 1867, ...	0·12	...	...
From December 25 to April 24, 1868, ...	0·88	...	...
At 212° Fahr., till weight became stationary, . . .	...	9·90	10·90

Varieties.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
13. Black Tartarian. Sweden.			
From December 4 to December 25, 1867, . . .	0·00	...	...
From December 25 to April 25, 1868, ...	0·43	...	...
At 212° Fahr., till weight became stationary, . . .	...	9·10	9·53
14. Dun Winter. County Cork.			
From December 4 to December 25, 1867, . . .	1·17	...	...
From December 25 to April 25, 1868, ...	1·42	...	...
At 212° Fahr., till weight became stationary, . .	...	10·70	13·29
15. Black Poland. County Cork.			
From December 5 to December 26, 1867, . . .	1·72	...	...
From December 26 to April 25, 1868, ...	1·65	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·25	14·62
16. Black Tartarian. County Kerry.			
From December 5 to December 26, 1867, . . .	2·75	...	...
From December 26 to April 25, 1868, ...	1·76	...	...
At 212° Fahr., till weight became stationary, . .	...	11·30	15·81
17. Potato Oats. County Wicklow.			
From December 19, 1867, to January 6, 1868, . .	0·99	...	...
From January 6 to April 25, 1868, ...	1·59	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·65	13·23
18. Black Tartarian Oats. County Wicklow.			
From December 19 to January 6, 1868, ...	0·99	...	...
From Jan. 6 to April 25, 1868,	1·55	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·00	13·54

VARIETIES.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
19. Potato Oats. County Antrim.			
From December 28 to January 7, 1868, ...	1·00	...	...
From January 7 to April 25, 1868, ...	4·15	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·25	16·40
Undried. Dried.			
Water, . . 16·40 0·00			
Kernel, . . 63·09 75·63			
Husk, . . 20·51 24·37			
Kernel (irrespective of water), . 75·47 75·63			
Husk, do., . 24·53 24·37			
Water in Kernel, 16·40 0·00			
Water in Husk, 16·40 0·00			
20. Tawny Oats. County Antrim.			
From December 28 to January 7, 1868, ...	1·02	...	...
From January 7 to April 25, 1868, ...	2·67	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·25	14·94
21. Tawny Oats. County Antrim.			
From December 28 to January 7, 1868, ...	1·02	...	...
From January 7 to April 25, 1868, ...	3.09	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·55	15·66
22. Sandy Oats. County Antrim.			
From Dec. 28 to Jan. 8, 1868,	1·08	...	...
From January 8 to April 25, 1868, ...	2·64	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·40	15·12
23. Black Tartarian. Tipperary.			
From Jan. 3 to Jan. 8, 1868, .	0·76	...	...
From Jan. 8 to April 25, 1868,	2·50	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·50	14·76

Varieties.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
24. Early Angus. Shetland.			
From Jan. 14 to April 25, 1868,	2·75	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·60	13·35
25. Early Angus Oats. Shetland.			
From Jan. 14 to April 25, 1868,	4·87	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·90	15·77
26. Early Barley Oats. Aberdeenshire.			
From March 3 to March 30, 1868, ...	2·09	...	...
From March 30 to April 27, 1868, ...	0·93	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·60	13·62
27. Early Barley Oats. Aberdeenshire.			
From March 3 to March 30, 1868, ...	2·71	...	...
From March 30 to April 27, 1868, ...	1·01	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·15	14·87
28. Kildrummy Oats. Aberdeenshire.			
From March 3 to March 30, 1868, ...	4·94	...	...
From March 30 to April 27, 1868, ...	1·24	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·50	17·68

	Undried.	Dried.
Water, . .	17·68	0·00
Kernel, . .	62·42	75·87
Husk, . .	19·90	24·13
Kernel (irrespective of water), .	75·83	75·87
Husk, do., .	24·17	24·13
Water in Kernel and Husk, . .	17·68	0·00

VARIETIES.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
29. White Tartarian. Devonshire			
From Mar. 3, to Mar. 30, 1868,	2·42	...	...
From March 30, to April 27, 1868, ...	0·62	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·60	14·64
30. Black Tartarian. Devonshire.			
From Mar. 3 to Mar. 30, 1868,	2·03	...	...
From March 30 to April 27, 1868, ...	0·82	...	...
At 212° Fahr., till weight became stationary, . . .	...	11·25	14·10
31. Canadian. Devonshire.			
From Mar. 4 to Mar. 30, 1868,	1·55	...	...
From March 30 to April 27, 1868, ...	0·91	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·75	13·21
32. Potato Oats. Aberdeenshire.			
From March 6 to March 31, 1868, ...	2·12	...	...
From March 31 to April 27, 1868, ...	1·08	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·80	14·00
33. Potato Oats. Aberdeenshire.			
From March 6 to April 27, 1868, ...	2·40	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·70	13·10
34. African Oats. Aberdeenshire.			
From March 12 to April 27, 1868, ...	4·21	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·65	14·86
35. Potato Oats. Aberdeenshire.			
From March 13 to March 31, 1868, ...	2·32	...	...
From March 31 to April 27, 1868, ...	1·40	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·55	14·27

VARIETIES.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
36. English Barley Oats. Aberdeen.			
From March 17 to March 31, 1868, ...	2·40	...	...
From March 31 to April 27, 1868, ...	1·16	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·55	14·11
37. African Oats. Aberdeenshire.			
From March 17 to March 31, 1868, ...	2·20	...	...
From March 31 to April 27, 1868, ...	1·20	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·45	13·85
38. Kildrummy Oats. Aberdeensh.			
From March 17 to March 31, 1868, ...	2·50	...	...
From March 31 to April 27, 1868, ...	1·24	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·00	13·74
39. Fyvie Oats. Aberdeenshire.			
From March 17 to March 31, 1868, ...	1·95	...	...
From March 31 to April 27, 1868, ...	1·11	...	...
At 212° Fahr., till weight became stationary, . . .	...	9·60	12·66
40. Early Fellow Oats. Banffshire.			
From March 17 to March 31, 1868, ...	1·73	...	...
From March 31 to April 27, 1868, ...	0·98	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·95	13·66
41. Longfellow Oats. Banffshire.			
From March 18 to March 31, 1868, ...	1·73	...	...
From March 31 to April 27, 1868, ...	0·80	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·50	13·03

Varieties.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
42. Potato Oats. Haddingtonshire.			
From March 18 to April 2, 1868, ...	1·36	...	...
From April 2 to April 27, 1868, ...	0·91	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·35	12·62
43. English Barley Oats. Banffshire.			
From March 18 to April 2, 1868, ...	2·60	...	...
From April 2 to April 27, 1868, ...	1·21	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·35	14·16
44. English Barley Oats. Banffshire.			
From March 18 to April 2, 1868, ...	3·63	...	...
From April 2 to April 27, 1868, ...	0·46	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·45	14·54
45. Finefellow Oats. Haddington.			
From March 18 to April 2, 1868, ...	0·76	...	...
From April 2 to April 27, 1868, ...	0·53	...	...
At 212° Fahr., till weight became stationary, . . .	...	9·80	11·09
46. Earlyfellow Oats. Haddington.			
From March 19 to April 2, 1868, ...	0·78	...	...
From April 2 to April 27, 1868, ...	0·67	...	...
At 212° Fahr., till weight became stationary, . . .	...	9·40	10·85
47. Longfellow Oats. Haddington.			
From March 19 to April 2, 1868, ...	0·80	...	...
From April 2 to April 29, 1868, ...	0·56	...	...
At 212° Fahr., till weight became stationary, . . .	...	9·90	11·26

VARIETIES.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
48. Sandy Oats. Banffshire.			
From March 27 to April 2, 1868, ...	1·44	...	...
From April 2 to April 29, 1868, ...	1·35	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·25	13·04
49. Potato Oats. Aberdeenshire.			
From Sept. 14 to Jan. 26, 1869, ...	1·02	...	...
At 212° Fahr., till weight became stationary, . . .	...	10·15	11·17
Average, . . .	...	...	13·97
50. English Barley Oats. Aberdeenshire.			
After standing in dry-room from September 14, 1868, to February 13, 1869.			
At 212° Fahr., till weight became stationary, . . .	..	10·00	...
51. Tawny Oats. Aberdeenshire.			
After standing in dry-room from September 25, 1868, to February 13, 1869.			
At 212° Fahr., till weight became stationary, . . .	...	10·40	...
52. Potato Oats. East Lothian.			
After standing in dry-room from October 28, 1868, to February 15, 1869, during which the weight had become stationary.			
At 212° Fahr., . . .	...	11 70	.
53. Early Angus Oats. East Lothian.			
After standing in dry-room from October 28, 1868, to February 15, 1869, weight being then stationary.			
At 212° Fahr., . . .	...	11·85	...

Varieties.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
54. Sandy Oats. East Lothian. After standing in dry-room from October 28, 1868, to February 15, 1869, weight being then stationary.			
At 212° Fahr., . . .	...	11·55	...
55. White Tartarian Oats. Berkshire. After standing in dry-room from November 5, 1868, to February 15, 1869, having lost 3·02 per cent., and the weight being stationary.			
At 212° Fahr., . . .	...	11·65	...
56. Black Tartarian Oats. Hampshire. After standing in dry-room from November 5, 1868, to February 15, 1869, having lost 2·72 per cent., and the weight being stationary.			
At 212° Fahr., . . .	...	11·50	...
57. Dun Winter Oats. Hampshire. After standing in dry-room from November 5, 1868, to February 15, 1869, having *gained* 0·25 per cent., and the weight being stationary.			
At 212° Fahr., . . .	...	10·80	...
58. Dun Winter Oats. Aberdeenshire. After standing in dry-room from September 1, 1868, to February 13, 1869, having *gained* 1·11 per cent., and the weight being stationary.			
At 212° Fahr., . . .	...	9·90	...

VARIETIES.	Lost by Natural Drying.	Lost by Artificial Drying at 212° Fahr.	Total per cent. of Moisture.
59. Dun Winter Oats. Aberdeenshire. After standing in dry-room from September 1, 1868, to January 26, 1869, gained 1·08 per cent.			
Average per cent. of moisture retained in oats kept inside dwelling-house, ...	...	10·54	...

XIV.

Doctoring Measure-weight.

WHEAT, rye, oats, beans, and similar seeds have a certain definite weight as they grow. With barley it is rather different. A bushel of barley seeds, with the awns upon them, might be extremely various in weight. But by the operations of thrashing, dressing, and measuring, all such seeds are more or less smoothed or hummelled, and acquire additional measure-weight. And the process of hummelling may be systematically carried out till the grain is polished to a high degree, so that the measure-weight attains its maximum: this process may be called doctoring measure-weight.

It is not easy to form a correct comparison of ancient and modern weights from Pliny's statement of the weight of several kinds of wheat, owing to uncertainty as to the size of the old modius and weight of the pound. But the best view of his figures would indicate that little alteration has taken place. Dr. Skene Keith, in his account of the agriculture of Aberdeenshire, tells us that in fulfilment of a wager made between the Earl of Errol and Mr. Gordon of Wardhouse about the year 1770, bere was produced which, after being cleared of all wild oats and weeds, weighed 60 lb. per Winchester bushel, equal to nearly 62 lb. the imperial bushel, Dr. Keith's contention being that the natural weight of bere (6-rowed thin-set barley) had diminished between 1770 and 1810. But bere and barley of 60 lb. the bushel sometimes turn up at our seed shows. We know that they have been doctored; and we also know that a certain amount of hummelling was absolutely required to make Mr. Gordon's bere 62 lb. The probability is greater that the hummelling was excessive than that a structural alteration has taken place in barley seeds.

I am sorry that my own method of doctoring measure-weight, that is, of improving the quality of grain, is not applicable upon a large scale. I first measured the grain as it was received by me, by the method to which reference has frequently been made. I then tied a quantity of it into a bag, and gave it such a thrashing with a heavy stick as probably killed one-half of the sweet little embryos cowering in their shrivelled corners. A blow or a pinch kills the embryo, as I have tested by experiment. An oat kernel or a wheat kernel cut transversely through the middle will ripen a plant, though not so well as the whole seed; but barleys cut through the middle carried up the young plants only a few inches, and then left them to die.

The grain was then taken out of the bag all the refuse blown away, and re-measured. The results appear in the table. Wheat was thus raised from 59·06 lb. to 62·90. Chevalier barley was raised from 54·60 to 59·61. Black Tartarian oats were raised from 42·13 to 45·59; but not thinking this enough, another round in the mysterious bag brought up the quality to 47·43 lb. Nothing better could be desired. A rather poor sample of Potato oats, weighing only about 44 lb., and which nobody could have successfully floated on to the seed market, was put into the bag for a few minutes. Ho, Ceres! Out it came weighing 49½ lb. The rise in price was still more gratifying. Another sample of Potato oats did my method of improving quality still more credit, and rose from 40·86 to 47·26. The rapture of Kepler in finding the cosmical harmonies was nothing to mine. But I dare not proceed.

In the doctoring of barley a slight percentage of husk is removed, so that a slight percentage of kernel is gained. A sample of oats (8) was tested before and after hummelling, and had lost of husk 0·37 per cent., the weight having been raised more than 3 lb. In another, raised 3¼ lb., the percentages of kernel and husk remained unaltered, the weight having been mostly gained by the smoothing of friction.

Oats poured into the measure in the ordinary way of filling the bushel weighed 42·42 lb.; the measure struck and filled up till it would admit of no more weighed 49·70, showing an amount of compression in oats, by percussion of the measure, of 17 per cent.

Barley gave a compression in the same way of 6 per cent., and wheat of 2·8 per cent.

The reprehensible practice of doctoring measure-weight for the purpose of gaining prizes at agricultural shows has its root in the assumption that measure-weight is a test of that element of quality which may be stated in percentage of kernel and husk in oats and barley, and in percentage of bran or flour in wheat. How insecure that assumption is we have already seen; for there can be no doubt that the received theory of measure-weight leads to more errors than facts.

DOCTORING MEASURE-WEIGHT.

TABLE showing how Measure-weight is varied by Dressing, Abrasion, etc. etc.

	Weight of Grain before Hummelling.	Weight of Grain after Hummelling.
1. Scots Barley Oats. Crop 1866. Mr. Bean, Auchterless, Aberdeen. (Weight given, 40 lb.), . . .	43·74	46·21
2. White Tartarian Oats. Crop 1867. John Ridd, Barnstaple, . .	42·13	45·59
Same grain further hummelled, .	42·13	47·43
3. Black Tartarian Oats. Crop 1867. Mr. Goss, Barnstaple, Devon, .	41·58	45·43
4. Potato Oats. Crop 1866. John Gammie, Rayne, Aberdeen. (Weight given, 37 lb.), . . .	43·38	48·36
5. Scots Barley Oats. Crop 1866. William Mennie, Rayne. (Weight given, 39 lb.), . . .	43·86	48·41
6. Potato Oats. Crop 1866. John Florence, Rayne, Aberdeen. (Weight given, 42 lb.), . . .	44·03	49·57
7. Potato Oats. Crop 1866. Alexander Smith, Rayne, Aberdeen. (Weight given, 37 lb.), . . .	40·86	47·26
8. African Oats. Crop 1867. William Milne, Druminnor, Aberdeen. (Weight given, 45 lb.), . . .	47·25	50·41
Per cent. kernel before hummelling, 76·83.		
Per cent. kernel after hummelling, 77·20.		
9. Canadian Oats. Crop 1866. Lawson & Son, Surrey. (Weight given, 50 lb.), . . .	53·85	56·31

	Weight of Grain before Hummelling.	Weight of Grain after Hummelling.
10. Hopetoun Oats. Crop 1866. Drummond Brothers, Mid-Lothian.		
(Weight given, 43½ lb.), . . .	44·46	47·82
Per cent. kernel before hummelling, 75·31.		
Per cent. kernel after hummelling, 75·30.		
(*a*) Measure-weight of Oat kernels,	54·02	
(*b*) Measure-weight of Oat kernels,	55·28	
(*a* and *b* stirred through filler.)		
(*c*) Measure-weight of Oat kernels (poured in), ...	52·85	57·71
Same sample shaken till no more could be put in (1/16 of bushel, 8 inches deep), ...	60·46	...
11. Chevalier Barley, ...	54·60	59·61
12. Common Barley (inferior), . .	49·70	53·65
13. Italian Barley, ...	52·88	58·94
14. Bere (6-rowed Barley), ...	49·39	55·02
15. Red Awny Spring Wheat (inferior grain), ...	59·06	62·90

DOCTORING MEASURE-WEIGHT.

Showing Increase of Weight by Striking the Measure.

	Weight by Ordinary Filling.	Utmost Weight by Percussion.
1. Oats, ... Compression 17 per cent.	42·42	49·70
2. Barley, ... Compression 6 per cent.	55·45	58·76
3. Wheat, ... Compression 2·8 per cent.	63·47	65·25

TABLE OF EQ

Showing the Number of Pounds of Oats of various Perce
having 75 per cent. of Kernel anc

75 per cent. Kernel.	14 per cent. Moist
64 ,,	14 ,,
80 ,,	16 ,,
77.5 ,,	18.5 ,,

Percentage of Kernel.	Per Cent.										
	14	10	10.5	11	11.5	12	12.5	13	13.5	14.5	
75	100	95.56	96.09	96.63	97.18	97.73	98.29	98.85	99.42	100.59	10
64	117.19	111.98	112.61	113.24	113.88	114.52	115.18	115.84	116.51	117.88	11
64.5	116.28	111.11	111.74	112.36	113.00	113.64	114.29	114.94	115.61	116.96	11
65	115.38	110.26	110.88	111.49	112.13	112.76	113.41	114.06	114.72	116.06	11
65.5	114.50	109.41	110.02	110.64	111.27	111.90	112.54	113.18	113.84	115.17	11
66	113.64	108.59	109.18	109.81	110.44	111.06	111.69	112.33	112.98	114.31	11
66.5	112.78	107.77	108.37	108.98	109.60	110.22	110.85	111.48	112.13	113.44	11
67	111.94	106.97	107.57	108.17	108.78	109.40	110.03	110.66	111.30	112.60	11
67.5	111.11	106.18	106.78	107.37	107.98	108.59	109.21	109.84	110.47	111.76	11
68	110.29	105.39	105.98	106.57	107.17	107.78	108.40	109.02	109.65	110.94	11
68.5	109.49	104.62	105.21	105.80	106.40	107.00	107.61	108.23	108.86	110.13	11
69	108.70	103.87	104.45	105.03	105.63	106.23	106.84	107.45	108.07	109.34	10
69.5	107.91	103.11	103.69	104.27	104.86	105.45	106.06	106.67	107.29	108.54	10
70	107.14	102.38	102.95	103.53	104.11	104.70	105.30	105.91	106.52	107.77	10
70.5	106.38	101.66	102.22	102.80	103.38	103.97	104.57	105.16	105.77	107.01	10
71	105.63	100.93	101.50	102.07	102.63	103.23	103.82	104.41	105.02	106.25	10
71.5	104.90	100.24	100.80	101.37	101.93	102.50	103.10	103.70	104.30	105.52	10
72	104.17	99.54	100.10	100.66	101.23	101.81	102.39	102.98	103.57	104.78	10
72.5	103.45	98.86	99.41	99.97	100.53	101.10	101.68	102.26	102.85	104.06	10
73	102.74	98.18	98.73	99.28	99.84	100.41	100.98	101.56	102.15	103.34	10
73.5	102.04	97.51	98.06	98.61	99.17	99.73	100.30	100.87	101.45	102.64	10
74	101.35	96.84	97.38	97.93	98.49	99.05	99.61	100.18	100.76	101.94	10
74.5	100.67	96.20	96.74	97.28	97.83	98.39	98.95	99.52	100.09	101.26	10
75.5	99.34	94.92	95.45	95.99	96.53	97.08	97.64	98.20	98.77	99.92	10
76	98.68	94.30	94.83	95.36	95.90	96.44	96.99	97.55	98.11	99.26	9
76.5	98.04	93.69	94.21	94.74	95.28	95.82	96.37	96.92	97.48	98.62	9
77	97.40	93.07	93.59	94.11	94.64	95.18	95.73	96.28	96.84	97.97	9
77.5	96.77	92.47	92.98	93.51	94.04	94.57	95.11	95.66	96.21	97.34	9
78	96.15	91.88	92.39	92.91	93.44	93.97	94.51	95.05	95.60	96.72	9
78.5	95.54	91.29	91.80	92.31	92.83	93.36	93.90	94.44	94.99	96.10	9
79	94.94	90.72	91.23	91.74	92.26	92.78	93.31	93.85	94.39	95.50	9
79.5	94.34	90.14	90.65	91.16	91.68	92.19	92.72	93.25	93.79	94.90	9
80	93.75	89.59	90.10	90.60	91.11	91.62	92.15	92.68	93.21	94.30	9
80.5	93.17	89.03	89.53	90.03	90.54	91.06	91.58	92.10	92.63	93.72	9
81	92.59	88.48	88.98	89.47	89.98	90.49	91.01	91.53	92.06	93.13	9
81.5	92.02	87.93	88.42	88.92	89.42	89.93	90.45	90.97	91.49	92.54	9
82	91.46	87.40	87.89	88.38	88.88	89.39	89.90	90.41	90.93	92.00	9
82.5	90.91	86.87	87.35	87.84	88.34	88.84	89.35	89.86	90.38	91.44	9
	14	10	10.5	11	11.5	12	12.5	13	13.5	14.5	
	Per cent.										

…UIVALENTS,

…tages of Kernel and Moisture which are equal to 100 lb. … 14 per cent. of Moisture. Thus—

…re.		
	100 lb.	Give equal weight of dry Kernel, viz. 64·5 lb.
	117·19 ,,	
	95·99 ,,	
	102·12 ,,	

… of Moisture.											Percentage of Kernel.
15.	15·5	16	16·5	17	17·5	18	18·5	19	19·5	20	
·18	101·78	102·38	103·00	103·61	104·25	104·88	105·52	106·17	106·83	107·50	75
·56	119·27	119·98	120·70	121·42	122·16	122·90	123·66	124·42	125·20	125·97	64
·65	118·35	119·05	119·76	120·48	121·22	121·95	122 71	123·46	124·23	125·00	64·5
·74	117·43	118·13	118·84	119·55	120·28	121·01	121·76	122·51	123·27	124·04	65
·85	116·54	117·23	117·93	118·64	119·37	120·09	120·83	121·57	122·33	123·09	65·5
·98	115·66	116·35	117·05	117·75	118·47	119·18	119·91	120·65	121·40	122·16	66
·11	114·78	115·46	116·16	116·86	117·57	118·28	119·01	119·74	120·49	121·24	66·5
·26	113·93	114·61	115·30	115·99	116·70	117·40	118·12	118·85	119·59	120·34	67
·42	113·09	113·76	114·44	115·13	115·83	116·54	117·26	117·98	118·72	119·45	67·5
·59	112·25	112·91	113·60	114·28	114·98	115·67	116·38	117·09	117·82	118·56	68
·78	111·44	112·10	112·77	113·44	114·13	114·83	115·54	116·25	116·97	117·70	68·5
·98	110·63	111·29	111·95	112·62	113·31	114·00	114·70	115·41	116·13	116·85	69
·18	109·83	110·48	111·14	111·81	112·49	113·17	113·87	114·57	115·28	116·00	69·5
·40	109·04	109·69	110·35	111·01	111·69	112·37	113·06	113·75	114·46	115·17	70
·64	108·27	108·91	109·57	110·23	110·90	111·57	112·26	112·95	113·65	114·36	70·5
·87	107·50	108·14	108·79	109·45	110·11	110·78	111·46	112·15	112·85	113·55	71
·14	106·77	107·40	108·05	108·70	109·36	110·02	110·70	111·38	112·09	112·78	71·5
·40	106·02	106·65	107·30	107·94	108·60	109·26	109·93	110·60	111·29	111·99	72
4·67	105·29	105·91	106·55	107·19	107·84	108·50	109·17	109·84	110·52	111·21	72·5
3·95	104·57	105·19	105·82	106·46	107·11	107·76	108·43	109·09	109·77	110·45	73
·25	103·87	104·48	105·10	105·73	106·37	107·02	107·68	108·35	109·02	109·70	73·5
·54	103·15	103·76	104·38	105·01	105·65	106·29	106·94	107·60	108·27	108·95	74
1·86	102·46	103·07	103·69	104·31	104·95	105·59	106·24	106·89	107·55	108·22	74·5
0·50	101·10	101·70	102·31	102·93	103·56	104·18	104·82	105·47	106·13	106·79	75·5
9·85	100·44	101·04	101·64	102·25	102·87	103·50	104·14	104·78	105·43	106·09	76
9·20	99·79	100·38	100·98	101·59	102·21	102·83	103·46	104·10	104·75	105·40	76·5
8·54	99·13	99·71	100·31	100·92	101·53	102·15	102·78	103·41	104·05	104·70	77
7·91	98·49	99·07	99·66	100·26	100·87	101·49	102·12	102·74	103·38	104·02	77·5
7·28	97·86	98·44	99·03	99·62	100·23	100·84	101·46	102·09	102·73	103·36	78
6·66	97·24	97·81	98·40	98·99	99·60	100·20	100·82	101·43	102·06	102·70	78·5
6·06	96·63	97·20	97·78	98·37	98·97	99·57	100·18	100·80	101·43	102·06	79
5·45	96·02	96·58	97·16	97·75	98·34	98·94	99·55	100·16	100·78	101·41	79·5
4·86	95·42	95·99	96·57	97·14	97·73	93·33	98·93	99·54	100·16	100·79	80
4·27	94·83	95·39	95·96	96·54	97·13	97·72	98·32	98·92	99·54	100·16	80·5
3·68	94·24	94·80	95·37	95·94	96·52	97·11	97·71	98·31	98·93	99·54	81
3·11	93·66	94·21	94·78	95·35	95·93	96·51	97·10	97·70	98·31	98·92	81·5
2·54	93·09	93·64	94·21	94·77	95·34	95·92	96·51	97·11	97·71	98·32	82
1·98	92·52	93·07	93·63	94·19	94·76	95·34	95·93	96·52	97·12	97·72	82·5
15	15·5	16	16·5	17	17·5	18	18·5	19	19·5	20	
… of Moisture											

XV.

Equivalents of different Qualities of Oats.

THE Table of Percentages of Kernel, in nearly all the different varieties of oats, from Potato oats to Thiacks or Small oats, has a value altogether irrespective of measure-weight, as showing the relationship of the grains of these varieties. And the Table of Equivalents may be used by a farmer for the purpose of enabling him, at a glance, to compare the produce of different qualities or different varieties. The standard used in constructing this table is a unit of 100 lb. of oats containing 14 per cent. of moisture, 75 per cent. of kernel, and 25 per cent. of husk; these being practically the average percentages for all oats.

The application of the table may be thus explained: Let us say that the producer or manufacturer of oats has mastered the simple processes of finding the percentages of kernel and moisture in his grain. He has one sample which he finds to contain 74 per cent. of kernel and 15 per cent. of water. He sees, where the two lines meet in the table, that 102·54 lb. of this sample are equal to the standard; and he wants to know if another sample is of more or less pabular value which has 72 per cent. of kernel and 12 per cent. of moisture. At the proper junction he finds 101·81 lb. as the equivalent of the standard, so that his first sample is better than his second in the ratio of about 100 to 99.

Or say that a producer has thrashed out two fields of oats of different varieties. One of the fields was sown with Pedigree Canadian oats procured from Major Hallett, and the other with Pedigree Potato oats from Mr. Ferguson. In each case the acre has produced 6 quarters, but while the Canadian weighs 50 lb. the bushel, the Potato weighs only 44 lb. Now, while he does not believe much in this difference as a test of quality, he is bound to believe in it as a test of quantity; and throwing both acres into centals, the Canadian presents 24·00, and the Potato 21·12. Both are found to contain 15 per cent. of moisture; and the Canadian shows 67 per cent. of kernel, while the Potato shows 75½. Looking at the proper junctions in the table he finds that 113·26 of Canadian are equal to 100·50 of Potato; and, dividing 21·12 centals by 100·50, he finds the Potato equal to 21·01 standard units; and dividing 24·00 centals by 113·26, he finds the Canadian equal to 21·19 standard units,—both crops, so far as meal is concerned, being practically the same,—the 2400 lb. of Canadian being no better than 2112 lb. of Potato.

Another use to which this Table of Equivalents may be put is the comparison of the farinal products of the different varieties of oats, with a view to directing agricultural practice. It is seen from another table that Dun Winter oats, for example, may give a kernel of 80 per cent., so that 93·75 lb. of this oat are equal to 100 lb. of a Scots barley of 75 per cent. And if the same product can be got by a Dun Winter oat at less cost than by a Scots barley, a gain will be made, and the suggestion of the table may be useful. Many other comparisons, with different percentages of kernel and moisture, may be made from the figures given,—an examination of which will render some problems in milling clearer than they have hitherto been to those not practically conversant with the subject.

XVI.

The best Unit of Exchange.

THE regulation of the corn trade and the corn measures has been an object of solicitude with the Executive throughout our Parliamentary history. But that solicitude is traceable at still earlier periods. A law of Edgar prescribes one money and one weight and one measure throughout the King's dominion, such as is observed at London and at Winchester,—the clear implication being that pennies of divers value, weights (for any given class of goods) of divers ponderosity, and measures of wine, ale, and corn, of divers capacity, were in local use all through the land. Abundant evidence is also furnished in Kemble's *Codex Diplomaticus Aevi Saxonici*, of the use of corn measures downward from the eighth century, to which corruptions of the names of the Roman measures are given, and which, there is every reason to conclude, retained, at least in some of their sub-multiples, the old Roman value. The Domesday Survey contains frequent references to the corn measures. The metrical clause of *Magna Charta* prescribes one measure of wine for the whole kingdom, and one measure of ale, and one measure of corn, namely, the quarter of London. The meaning of this clause does not seem to be that the measures of wine, ale, and corn were to be one, but that the one approved measure for each of these articles should be applied and used in all parts of the kingdom, thereby prohibiting the standards in local use.

The innumerable references to weights and measures at dates long anterior to the earliest date claimed for the fragment creating a system of weights and measures from 32 wheat-corns, make it absolutely certain that this fragment, whether having statutory value or not, was merely a device to give a popular conception of existing standards.

But no Parliamentary enactment, either in

England or Scotland, was ever effective for the unification of the corn measures,—or for the method of filling the bushel. The enactments were frequently obscure, and sometimes self-contradictory. But the probability is that the English bushel and its parts have not intentionally varied much in their legal dimensions from the remotest times. To trace the apparent variations of the Scots firlot here would be out of place. In 1621 an Act of the Scottish Parliament declares that certain Commissioners, appointed four years before, had given sentence that 'the measure and furlot of Linlithgow' was 'the just and onelie furlot;' wholly overlooking the Act of 1587, passed only thirty years before, which prescribed a firlot of dimensions different from those of the Linlithgow firlot. It is impossible to suppose that the firlot of 1587 ever was put in use, when so soon after that date the Linlithgow firlot was found in approved possession of the corn market. Clearly the Linlithgow firlot must have been in actual general use in 1587. That firlot was, for all practical purposes, the same as the English bushel, and, in all probability, both measures had the same origin in the old Roman standards, and were never out of use, very nearly in their final dimensions, in both kingdoms, notwithstanding many local corruptions, and much ignorant and ineffectual legislation.

The question now presents itself, Is this bushel which has come down to us unchanged amid so many changes the best unit of exchange? Taking into consideration what has been advanced in previous chapters, the answer must be that it is not. The chief argument against the bushel or quarter as a market unit is the perpetual variation in its amount: a quarter of wheat may consist of 432 lb. or of 528 lb.; a quarter of barley may consist of 384 lb. or of 464 lb.; a quarter of oats may consist of 264 lb. or of 400 lb. Now, it is not argument which can support a unit of such extreme variability, but general use and wont.

It is needless to refer here to all the Parliamentary Committees which have considered the claims of measure and weight for the sale of corn, or to the discussions innumerable of agricultural and commercial Societies.

Existing practice proves that the corn trade can be carried on by a unit of measure; but wherever a unit of weight has been adopted, I believe it is found more satisfactory.

Now, it is not in the interest of commercial morality that a unit of weight is here recommended; for even those best acquainted with the intricacies of a unit of measure can only work that unit permanently upon honest principles. But the use of a unit of weight such as the cental or 100 lb. would soon be felt as a distinct gain in advancing and more scientific agriculture. The use of the cental in place of the quarter, for all grain, would clear up the views of farmers in respect of the various cereals and their varieties in a way which would lead to beneficial results. Under the bushel an indifferently educated farmer cannot compare the prices of oats with those of barley,—a calculation is required; but under the cental the comparison would be perfectly clear at once. Oats of 40 lb. are selling at 26s. 8d. the quarter, and barley of 53 lb. at 35s. 4d.; and the farmer, thinking barley is fetching a higher price than oats, sows a greater breadth of it than he had intended. But if the prices had been stated by the cental, he would have seen at a glance that both oats and barley were giving 8s. 4d.

Again, say that a farmer has a field which he wishes to test as to its suitability for oats, wheat, and barley. Part of it is sown with each. An acre of the wheat gives $4\frac{1}{2}$ quarters of produce; an acre of the oats gives 6 quarters, and an acre of the barley gives 5 quarters. Well, he thinks in a vague sort of way that the oats have it. Of course, with a little calculation, he comes to see further into the relationship. But if it were the custom of the country to quantify by weight, by the cental, he would have the weight of wheat produced 22·32 centals; the weight of oats 19·20 centals, and the weight of barley 21·20 centals. He would thus see at once, so far as the nature of the comparison permits, that the largest produce would be obtained by wheat.

Simplicity and scientific accuracy equally recommend a unit of weight for agricultural products. Nothing tends to advancement more than clear ideas and easy manipulation,

—and the substitution of the cental for the bushel would change an important department of agriculture from confusion to clear order,—and, with this change, the simplest cultivator would certainly know better what he was doing, and how he ought to proceed. It is directly in the interest of agriculturists to bring about the change.

In the corn market the combination of measure and weight produces inextricable confusion. When we find that measure-weight is indeterminate as a test of any element of quality,—in point of fact no one has any determinate value attached to it,—its retention in the corn market is not only useless but mischievous. The daily papers are full of reports of the corn markets, which have a kind of use from convention, but are utterly indefinite. They are symptoms which a corn factor may interpret, but which, to ordinary farmers, have no precise meaning. Were these markets reported correctly by the cental for all classes of grain, those who are interested in the production of grain would understand the prices and the relative value of the different cereals in a moment.

No corn market in the Kingdom is reported so fully and so clearly as the Edinburgh Corn Market. And yet the use of measure throws everything into hopeless confusion. You cannot tell whether a sample at a high price is dearer than at a lower, till you make a calculation taking the weight into account. On the 19th of April 1882, the top 11 quarters of wheat sell at 46s., and weigh 63¼ lb. The third sample, of 30 quarters, sells at 44s., and weighs 60¼ lb. The first quarter thus weighs 5·06 centals, each of which sells at 9s. 1d.; the third quarter weighs 4·82 centals, each cental passing at 9s. 1½d. Which is the 'top' sample, that which sells for most by the quarter, or that which sells for most by the cental?

In the same market of the 10th of August 1881, the average price of barley is 30s. The average weight for the same date is 56·24, making the quarter 449·92 lb. The average price on the following week is 31s. 3d., the average weight being 51·66, making the quarter 413·28 lb., and it is stated in the report of the 17th that barley is 1s. 3d. 'up on the average.' Now, the quarter on the 10th is almost exactly 4½ centals, while on the 17th it is only about 4⅛ centals. The price per cental on the 10th is 6s. 8d. and on the 17th, 7s. 6¾d. And thus while 4½ centals of the barley of the 10th sell at 30s., 4½ centals of the much lighter barley of the 17th sell at 34s. The report is of course quite true upon its own theory, but that theory involves an utter confusion; on the 17th the price per quarter is up 4 per cent., but per cental it is up 13½ per cent.

With a unit of measure, the markets of different localities not fully reported cannot be compared. But I have the necessary details for comparing prices at Edinburgh with prices at Haddington. Taking the four months November and December 1868, and January and February 1869, the mean of the weekly averages of oats at Haddington is 30s. 11d. (average price 31s.); while the mean price of the corresponding seventeen markets at Edinburgh is 29s. 11d. For this period the weight at Haddington (taking the bag at 4 lb. as in Edinburgh) is 43·15, and at Edinburgh 42·09. Leaving the weight out of account, it would appear that the price (of what ?) was 1s. higher at Haddington than at Edinburgh. But placing the figures tabularly, the real facts come out thus :—

	Per Bush.	Per Qr.	Per Qr.	Per Cental.
Haddington, .	43·15 =	345·2 lb.	30s. 11d.	9s. 0d.
Edinburgh, .	42·09 =	336·7 lb.	29s. 11d.	8s. 11d.

Equal weights of oats are thus sold at nearly equal prices in both markets. By the quarter the price at Haddington is 3·34 per cent. higher than at Edinburgh, but by the cental only 0·93 of a per cent. higher.

The use of the bushel and quarter leads to a falsification of economic and agricultural history. The political economist may tell us that in a certain year the price of corn was higher than in another year, while he argues from this datum the comparative condition of the people in the periods under notice. But some of the foregoing tables will show him that he cannot know in what year the price of corn is highest or lowest. I may illustrate this feature of our inquiry by some examples.

For the year 1869 the Mid-Lothian first fiar of wheat (which is the mean of all the evidence) is 40s. 3d.; while the same fiar for the year 1875 is 40s. Is wheat dearest in the centre of Scotland in 1869 or in 1875? The answer will depend on the average measure-weight of the two years. Well, we see in the abstract of page 70 *a* that the weight of wheat in 1869 was 63·35 lb., while in 1875 the weight was 62·09 lb.; so that the cental of 1869 cost 7s. 11d., and the cental of 1875 cost 8s. 0½d.; by the quarter the price is highest in 1869, and by the cental it is lowest. Again, the price of wheat in 1878 is higher by the quarter than in 1879, and lower by the cental. In 1879 barley costs 33s. 7d. the quarter, and 7s. 10½d. the cental; and in 1880 the quarter costs 34s. 10d., and the cental 7s. 10d. In 1870 barley is 11d. higher by the quarter than in 1879, and 2¾d. lower by the cental. Again, barley in 1870 is 15 per cent. higher by the quarter than in 1872, and only 6¾d. per cent. higher by the cental. In Oats the comparisons are not so glaring, because the annual variations in measure-weight are less. The price of Oats per quarter in 1869 is 26s. 2d., and per cental

7s. 7d.; and in 1872 the price per quarter is 26s. 1d., and per cental 7s. 11½d.; that is, highest by the quarter in 1869, and highest by the cental in 1872.

If the cereal grains were incompressible like water, a unit of weight would have no advantage over a unit of measure; but it needs no argument to show that weighing gives more completely than measuring what is understood by *quantity* in corn. The cental is probably a large enough unit for the farmer or producer, and any multiple of it, such as twenty, could easily be applied to large transactions. But the use of the cental, for men with little education or aptitude for figures, would soon set up in the minds of the agricultural population a true and clear conception of *percentage*, which would speedily react upon every cultivated field in the Kingdom. The corn market ought to be regulated partly in the interests of the producer and consumer, and not wholly in the interests of the corn-dealer. And I know of no demand upon the spirit of legislation more imperative than that of giving to the agriculturist a unit for the sale of his corn, through the use of which his knowledge of the fruits he deals in would be increased, to the general benefit of the country.

Weight is thus clearly a higher appeal than measure. No doubt we see that by general convention measure may be adopted; but the advance of knowledge shows that all such goods as the cereal grains, in masses of which there may be greater or lesser vacant spaces, are more correctly quantified by units of gravity than by units of space. It is long since the exchange of meal and flour by measure had to be abandoned, from its uncertainty. And now we are beginning to see that there is no less, but rather more, uncertainty in measured units of corn; and the general introduction of the cental, or any uniform unit of weight, into the corn markets of the country, will effect a valuable reform in the corn trade and in the operations of agriculture. The comparative values of different varieties of wheat, barley, and oats can never be clearly seen, nor become motives to improvement, so long as the bushel remains in the corn market. I say this with a feeling of regret. The bushel has come down through all our commercial history as the most important of its metrical units. According to its light, it has faithfully audited the daily bread of many millions of noble men who scorned to live by bread alone, and who reclaimed the barren wastes, till they waved yellow in the harvest breeze with the golden grain which the bushel stood ready to measure. But the murmur of the relentless currents is around it, and the light that leads to change.

In all parts of the country the best opinion is coming to be in favour of a unit of exchange for corn, of pure weight. The belief that measure-weight is a test of the most important element of quality has perpetuated the use of the bushel. A most exhaustive inquiry, of a practical but almost non-scientific character, was made into the sale of corn by a Committee of Parliament in 1834. In their report it is said: 'The general result of the inquiries of your Committee is, that the Sale of Corn is conducted upon three systems, contrary to, and, taken singly, incompatible with, each other. By measure alone; by weight alone; by measure regulated by weight; or, more properly speaking, by measure with a fixed weight per measure. There is a fourth system, namely, measure, with the actual weight per measure in each case. This last system will be found to be as perfect as the nature of things will permit, and may be adapted to either of the first two.' In the system proposed by the Committee, it is said, 'Measure alone will check the quantity, but it will not give the quality. Weight alone will check the quantity, but it will not give the quality. Measure combined with a description of the weight per measure, in the particular case, gives both the quantity and the quality.' Dr. Adam Anderson, of Perth, gave the most important evidence on which this conclusion was based. He submitted to the Committee the results of the milling of eight parcels of wheat averaging upwards of 1700 stones each, and of various measure-weights; and regarding these experiments he says: 'While the mean result is that 100 st. of wheat yield 81 st. 9½ lb. of flour of all sorts, the least return is 80 st.

$1\frac{1}{2}$ lb., and the greatest 82 st. $4\frac{1}{2}$ lb. At the same time it is deserving of remark, that while the lightest wheat of the parcels yielded upwards of 82 st., the heaviest yielded little more, weight for weight.' The recommendations, however, were against the evidence, and in accordance with the general preconceptions of certain leading witnesses.

The worthlessness and uncertainty of measure-weight as a test of quality are assumed to have been shown in previous chapters of this work. Many influential centres of trade have expressed themselves in favour of the cental as the best unit of exchange. Indeed, the argument for a unit of pure weight may be said to have completely gained the field. But it takes a great deal of argument to alter the customs of a country. Yet there can be no doubt that the general adoption of the cental would be equivalent to an agricultural improvement; it would at once set up before the eye equal units of all the cereal grains and all their varieties, with the market values attached to them in letters so plain that the most uninstructed cultivator could read them and act upon them. At present, when a farmer finds Canadian oats, which may weigh 50 lb. the bushel, selling at 30s. the quarter, and Scots Barley oats, which may weigh 40 lb., selling at 25s., he is naturally induced to sow Canadian seed. But if he found the cental of Canadian oats selling at 7s. 6d., and the cental of Scots Barley at 8s. 3d., the truth of this matter would be clearly presented to him. Or, when he sent his oats to the mill by the cental, and got back his meal by the same, he would see at once the percentage of meal in the different varieties, and his practice would soon be guided by enlightened intelligence.

Now, the cental is no innovation upon British metrology. For, just as the imperial bushel was a return to the ancient English bushel, the cental would be a return to the ancient English hundredweight. The existing cwt. of 112 lb. is a mere corruption of the original unit. The name *hundredweight* could never have been applied in the first instance to a quantity of a hundred and twelve. But just as many articles, which were quantified numerically, came, by the rapacity of purchasers, to have six score to the hundred, the cental (centena) or true cwt. was gradually corrupted into a hundred and twelve. The corruption sought its justification in *tare;* and the principle at the bottom was the same as that by which grain sold with a husk upon it, such as oats or barley, came to be quantified by a heaped measure. The 'centena' in *Fleta* (lib. ii. cap. 12), by which sugar, spices, etc., were weighed, 'continet tredecim petræ et dimidia et quælibet petra continet octo libræ' (thirteen stones and a half, and each stone contained eight pounds), so that, as is further explained in *Fleta*, the number of pounds in this centena, or cwt., was 108, not 112. The latter had been reached by a gradual process—the 13½ stones were increased to 14.

But if the adoption of the cental in the exchange of corn would be no innovation on English metrical practice, neither would it be the letting in of the thin end of the wedge for the metrical system of France. The adoption of that system would strike every institution of Great Britain with historical paralysis. The continuity of our commercial life would be snapped asunder; the past would cease to be vital, would lose its organic connection with the present, and become a proud heritage only to the antiquary and the translator. Every law of the land which mentions a yard or a pound weight would be turned into a dead language. All through the records of the literary grandeur of England certain words and meanings would become obsolete. Every charter would lose its validity. The very dimensions of our houses, and homes, and roads, and walks would lose their significance. The great survey of the Kingdom would cease to be intelligible; every bench-mark upon it and every height marked upon it would speak a language unknown to the current rule. Scarcely a book in all the libraries of the land but would lose value or be placed beyond legal recognition.

But if the introduction of a unit of 100 of our own pounds for the sale of corn will be a work of extreme difficulty, fifty Acts of Parliament will not introduce the *Litre*. Any patriot who will read the preambles of our metrical statutes will be in no fear of a French invasion. He will find that these statutes have never been observed. Market customs have been too inveterate for legislation; and no unit will take the place of the bushel except by its own recommendation.

ILLUSTRATIONS.

1. Imperial Bushel (on Cover). Its dimensions are 2218·192 cubic inches. It is equal in size to the old Scots or Linlithgow wheat firlot. It holds 80 avoirdupois or Roman pounds of water. It is equal to 64 Roman sextars, and to 64 English pints, and to $21\frac{1}{3}$ Scots pints (each 3 English). It holds 8 gallons, or 64 pints of wine; and 8 gallons or 64 pounds of wheat, each pound of wheat equal in bulk to a pint of wine, according to the true meaning of the ancient fragments of English law. Its sub-multiples are mentioned in the *Domesday Survey*, and it formed the basis of the 'Quarter of London,' referred to in the metrical clause of *Magna Charta*. Four quarters or thirty-two bushels made the English celdra or chalder; sixteen Newcastle bolls of two bushels or Scots wheat firlots also made the ancient Scots chalder of thirty-two bushels. Anciently the chalder was an actual measure, not a mere arithmetical abstraction. The corruptions of the bushel, from bad intention, and from the incapacity of tradesmen to turn out a vessel equal to the legal definition, have been innumerable; but the ideal of sixty-four Roman pints, or eight gallons of 64-pound wheat, still retains its vitality.

2. VIGNETTE (on Title-page). From photograph of Standard Winchester Bushel. It represents the bronze copy of the bushel in custody of the Town of Aberdeen, and bears the following inscription: 'ANNA . D . G . MAG. BRIT. FRANC. ET HIBERN. REGINA. I. MAII. 1707. ET REGNI: VI.' The letters 'A.R.', the rose, thistle, fleur-de-lis, and harp, crowned, are also on the casting, and the word 'Linlithgow' is attached with a clamp. This is one of the copies distributed to the Scottish Burghs, in terms of the XVIIth Article of the Treaty of Union. It was adopted only in a very few localities.

3. DIAGRAMS representing the yearly variation of the measure-weight of corn in the Aberdeen and Edinburgh markets. (Facing p. 71.)

4. CLASSIFICATION OF OAT GRAIN. (Facing p. 138.) The figures represent natural size, the oat grains with their kernels. The numbers on the plate correspond with the numbers attached to the names of the varieties.

5. OAT HUSKS. These drawings represent transverse sections of the husks taken at the middle of the grain. The outer husk or pale is usually about twice as thick as the inner. In all oats, except the Naked oat (*Avena nuda*), the pales are hard and rigid; in the Naked oat the pales are limp, like the glumes or chaff scales, and seem to be chaff scales repeated, rather than true husks. The drawings are magnified 17 diameters. (Facing p. 152.)

6. OATS IN THE BUSHEL. This photograph represents Canadian and White Tartarian oats lying in their

ordinary state of compactness in boxes with glass fronts. The form of the Canadian seed enables it to fill up space and leave few vacancies; the form of the Tartarian makes it to leave much space unoccupied; and thus, while both have practically the same percentage of kernel, the Canadian weighs 50 lb. the bushel, and the Tartarian only 38 lb., showing that measure-weight is no test of quality. The grain is natural size. (Facing p. 155.)

INDEX.

Edinburgh University Press:
T. AND A. CONSTABLE, PRINTERS TO HER MAJESTY.