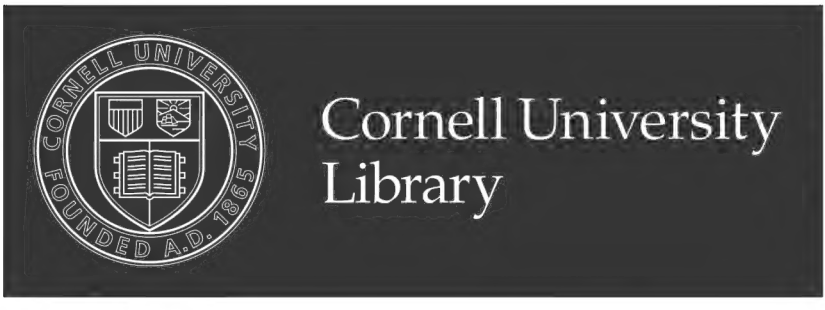

DOMINION OF CANADA

DEPARTMENT OF AGRICULTURE

GRAIN SCREENINGS

BY

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WITH

Results of Feeding Experiments

BY

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DEPARTMENT OF AGRICULTURE, OTTAWA, May, 1915.

To the Honourable MARTIN BURRELL,
Minister of Agriculture.

SIR,—Herewith we beg to submit manuscript prepared by officers of the Seed and Experimental Farms Branches. It contains the results of investigations to determine the composition, disposal, and feeding value of the screenings which accumulate at terminal elevators.

The matter contained herein is of importance to all concerned in the production, handling and uses of grain and its products. We recommend that it be printed for general distribution.

We have the honour to be, Sir,
Your obedient servants,

GEO. H. CLARK,
Seed Commissioner.

J. H. GRISDALE,
Director Experimental Farms.

CONTENTS.

Grain Screenings.

The rapid increase during the last few years in the acreage brought under cultivation in the Prairie Provinces, and the system of continuous cropping to cereals year after year has allowed a great variety of annual weeds to become widely established.

An idea of the extent to which grain is sometimes contaminated by weed seeds may be had from the following analysis of a sample of a car of western-grown flax. The weed seeds made up 16 per cent of the total weight of the car. One ounce contained the following weed seeds: *Noxious.*—Hare's-ear mustard 73, stinkweed 106, wild mustard 1051, western false flax 429, round-seeded false flax 170, tumbling mustard 1009. *Other kinds.*—Lamb's quarters 152, cinquefoil 10, black bindweed 14.

A sample representing over 25,000 bushels of wheat contained only 92·6 per cent by weight of pure wheat, the remainder being made up largely of weed seeds, chiefly wild oats, black bindweed, and lamb's quarters. These may be extreme cases, but samples as badly contaminated as the above are by no means rare.

Dockage.

Most of the grain entering commerce is shipped eastward. At Winnipeg it is graded, and on its arrival at Fort William or Port Arthur is taken into the terminal elevators and stored according to grade. That is, grain of the same grade is binned together. It often happens that a carload of grain contains too high a proportion of weed seeds and other impurities to be binned with the grade to which its quality entitles it. In such cases the grain is graded according to its quality and a dockage set representing the percentage by weight of impurities which must be removed by the cleaners before it is binned.

The total dockage set by the Inspection Department, Board of Grain Commissioners, Department of Trade and Commerce, on the wheat, oats, barley, and flax received by terminal elevators for the year ending August 31, 1913, exceeded 100,000 tons.

The Saskatchewan Grain Markets Commission placed the cost of hauling wheat from the farm to the railway station at 5 cents per bushel, local and terminal elevator charges at $2\frac{1}{2}$ cents, and average freight rates from Saskatchewan points to Fort William at 12 cents per bushel, making total charges of $19\frac{1}{2}$ cents per bushel, or $6.50 per ton.

Taking Saskatchewan points as average location for the Prairie Provinces, the charges on 100,000 tons of screenings at $6.50 per ton amount to $650,000. These charges must be met by the grain sold, and therefore represent a loss to the growers. The feeding value of the screenings is a further loss, which will be considered later.

Composition of Screenings.

Elevator screenings are so variable in composition that to get an idea of what on the average constitutes screenings, a composite sample representing thousands of tons should be examined.

Following is the analysis of such a sample representing 6,000 tons of screening from the 1912 crop, as shipped from various elevators at two or three different periods of the year from Fort William and Port Arthur to Buffalo, Chicago, and Duluth:—

37 per cent scalpings,
7 per cent succotash flax.
18 per cent buckwheat screenings.
38 per cent black seeds.

Scalpings consist of the larger grains and weed seeds in the screenings in the following proportions by weight; 65 per cent wheat; 25 per cent wild oats, oats, flax, and barley; 3 per cent weed seeds (wild buckwheat, lamb's quarters, stickseed, ball mustard, prairie rose, wolfberry, great ragweed, cow cockle); 7 per cent straw, chaff, etc.

Succotash flax is made up of 30 per cent flax; 40 per cent broken wheat; 15 per cent weed seeds (wild buckwheat, stickseed, lamb's quarters, wild oats, false flax, American dragonhead, lady's thumb, knotweed, sunflower, purple cockle, ball mustard, hare's-ear mustard hemp nettle, roadside thistle, prairie rose); and 15 per cent chaff, etc.

Buckwheat screenings consist of 58 per cent wild buckwheat; 29 per cent wheat, oats, and flax; 9 per cent weed seeds (ball mustard, stickseed, wild oats, cow cockle, purple cockle, ragweed, stinkweed, hare's-ear mustard, western false flax, Russian thistle, prairie rose); and 4 per cent chaff, etc.

Black seeds are composed of the finer weed seeds separated from the screenings by the use of the 1-14 inch perforated zinc screen. This material contains about 45 per cent lamb's quarters; 4 per cent tumbling mustard; 2½ per cent wild mustard; 6½ per cent of other mustards (western false flax, hare's-ear mustard, stinkweed, wormseed mustard, shepherd's purse, peppergrass); 8½ per cent other weed seeds (American dragonhead, hedge nettle, stickseed, green foxtail, Russian pigweed, sow thistle, catchfly, roadside thistle, Canada thistle, wormwood, cinquefoil, evening primrose, pale plantain, witch grass); and 33½ per cent dust and chaff.

COMMERCIAL SEPARATIONS.

The above separations were made by hand screens, but correspond fairly closely to the commercial separations made by the screening separators in use in most terminal elevators.

The *scalpings* include everything that does not pass through a zinc screen with triangular perforations nine-sixty-fourths of an inch to the side. Sometimes in elevators only two separations are made of the cleanings as taken from the grain, scalpings and black seeds. The scalpings will then contain both the buckwheat screenings and succotash flax. Moreover, scalpings are often further cleaned to

reclaim as much as possible of the wheat and oats contained. The term scalpings is therefore a very general one to denote the larger material in the cleanings as taken from the grain.

The *black seeds* is the material coming through a one-fourteenth inch perforated zinc screen.

After the removal of the scalpings and the black seeds, the *succotash flax* is separated from the *buckwheat screenings* by the 3 x 16 woven wire screen (contains three wires to the inch one way and sixteen the other). The succotash flax passes through this screen. This material is separated from the rest of the screenings for the sake of the flax which sometimes occurs in screenings in sufficient quantities to pay for its separation.

Disposal of Screenings

From 80 to 90 per cent of the screenings accumulating at the head of the lakes have been going to the United States. The balance, chiefly scalpings, have been shipped to Ontario and Quebec.

Uses of Screenings.

IN THE UNITED STATES.

Sheep Feeding.—Considerable quantities of screenings are fed every winter to sheep. The sheep are fed in large sheds operated in connection with railway companies on whose lines the sheep are carried from the ranges. The following sheep-feeding stations in the vicinity of Chicago are typical: On the Chicago, Milwaukee & St. Paul Railway at Kirkland, Ill.; on the Chicago, Burlington & Quincy Railway at Montgomery, Ill.; and on the Rock Island Railway at Stockdale, Ill. Besides these, other railways entering Chicago maintain similar stations. They are also provided at Osseso, New Brighton, and Anoka, in the vicinity of Minneapolis.

At the Kirkland station, which is typical of such places, there is accommodation for 50,000 sheep at one time. The sheep are fed here from one to sixty days, depending on their condition, and often too, on the markets. Shearing sheds are provided and used as required.

Sheep taken from the ranges are usually fed about thirty days. At first they are given only hay. Then a small quantity (half a pound per day) of light chaffy screenings is added. Gradually this is increased until in about a week or ten days the sheep have access to the "self-feeders," from which they eat all the screenings they want (about 2 pounds per day). At the same time the proportion of chaff is decreased and the proportion of seeds increased. The sheep are kept on a diet of pure screenings for only a day or two, and then a little cracked corn is added. The proportion of corn is increased gradually until the ration consists of half or slightly more than half corn, the sheep being given all they will eat of this mixture, as well as hay.

The aim of the feeder is to get the sheep on a diet of corn as soon as possible, but pure corn is too heavy a feed for the sheep, and so the screenings are used as a sort of "filler." Formerly, elevator screenings contained much shrunken and broken wheat, oats, and barley, but with improved methods of recleaning the screenings, practically all this material is removed, and only the smaller weed seeds and chaff are available as screenings. When corn is selling at $20 per ton, such screenings cost at the feeding stations $10 to $12 per ton. On such feed the sheep usually gain from 12 to 15 pounds during the first thirty days. After that they grain less rapidly. Fifty thousand sheep will eat about two cars of screenings and a car of corn per day. Seed-house screenings and screenings containing a large proportion of broken flax are avoided. At Kirkland much of the manure accumulating in the sheds is hauled away by farmers during the summer, and put into piles until fall. The manure, when so piled, "heats" and the vitality of many of the weed seeds which have become mixed with the manure is destroyed. Farmers who have used this manure admit that large numbers of weeds make their appearance after its application. Its use, however, has not resulted in any serious spread of noxious weeds. This is explained by the two following circumstances:—

1. In that district, as in other parts of Illinois and neighbouring states, large quantities of corn are grown. This sheep manure is put on corn ground, and by constant cultivation of the corn the weeds are destroyed before they can mature seeds.

2. Practically all of the farms around Kirkland are worked by tenants, and as rents are high and land valuable, the careless and slovenly farmer is crowded out.

It must be admitted that the farms are all practically free from noxious weeds, although one meadow was seen to be badly contaminated with tumbling mustard, very probably introduced through screenings. Although the use of this manure has resulted in no very serious spread of weeds, its use undoubtedly involves considerable risk of introducing some of the worst weeds the farmer has to fight. At Montgomery and Stockdale, the American Guano Company has put up factories where the sheep manure is dried and pulverized, and from it is made a fertilizer used largely on golf links, country estates, market gardens, etc.

The Manufacture of Mixed Feeds.—Another use that is made of elevator screenings is in the manufacture of mixed feeds, chiefly molasses feeds. Usually it is only the finest weed seeds and smaller pieces of broken wheat and flax that are used in these feeds. Mills that make a speciality of handling screenings are equipped with cleaning machinery which separates all the whole kernels of wheat, barley, oats, or flax that the elevators have failed to remove. Straw and chaff are taken out of the screenings at the same time as this separation is made. The material left after these grains are removed is separated into two grades by means of the one-fourteenth inch perforated zinc sieve. The material passing over this screen

consists largely of wild buckwheat and broken wheat, but there is often a considerable sprinkling of broken flax and of the larger weeds seeds, such as purple cockle, ball mustard, etc. Most of the buckwheat screenings so separated are used with cracked corn, Kaffir corn, barley, wheat, sunflower seed, etc., as chicken feed, although some of it is used in other ways. The seeds of wild mustard and other species of Brassica are separated from the other weed seeds by taking advantage of the fact that they are spherical and will roll if placed on an inclined surface. Before the remaining fine seeds are ready for grinding they have to be put through a reel to remove the fine sand which would otherwise injure the rolls.

The exact method and the thoroughness with which these seeds are ground varies in the different mills. The grinding is usually done by a combination of one or more rolls such as are used in flour mills, or by an attrition mill. After each "break" (*i. e.*, passage through the roll or attrition mill) the material passes to a reel, which removes the fine material and sends the coarse material on to the next "break" to be still further pulverized. To reduce to a minimum the possibility of the final product containing vital weed seeds, the mesh of the wire gauze used in these reels should be sufficiently fine to prevent the passage through it of the smallest weed seeds found in screenings.

These ground and bolted screenings are used in the manufacture of molasses feeds, mixed with various other ingredients, such as cottonseed meal, linseed meal, gluten feed, and molasses. Other mills which handle screenings make only the above separations and grind the fine black seeds to sell for use in molasses feeds, in medicinal stock foods, and occasionally for feeding in its natural condition. In its natural condition it does not make a palatable feed because of the presence of certain seeds having a pungent or otherwise disagreeable taste. The mixture of molasses with the feed tends to overcome this difficulty, besides increasing greatly the carbohydrate content of the ration.

IN WESTERN CANADA.

The use which western mills make of their screenings depends on the location of the mill and the composition of the screenings. The fine seeds are usually separated from the rest of the screenings and disposed of: (1) by shipping them to the United States where they are used in the manufacture of mixed dairy feeds; on account of heavy freight rates this is seldom possible west of Moose Jaw. (2) By burning them; on account of the high oil content of the black seeds (lamb's quarters and mustards) they burn readily and have considerable value as fuel. (3) By feeding to cattle and sheep in stock yards where it is not intended to keep animals longer than a day or two. (4) In a few places they have been fed to sheep kept in enclosures over a period of six weeks or two months.

Sometimes the whole screenings are ground up together and sold as hog and cattle feed. In Edmonton there is a demand among far-

mers of the surrounding country for this "black chop". It is usually fed to animals on pasture. In northern Alberta grain the chief weed seeds are wild buckwheat, lamb's quarters, and wild oats. The only mustard that is very prevalent is ball mustard. It is probably on account of the comparatively few mustard seeds and the greater proportion of wild oats and wild buckwheat that this feed has proven at all satisfactory. In both Calgary and Macleod, milling companies have had to remove the fine black seeds before the screenings can be marketed. A representative of a large packing house in Macloed states that the entire screenings are of no value as a hog feed. Hogs will "nose it over" and what little they do eat, according to his observation, does them no good. If water is put on it, it goes into a sort of cement—"not worth anything" is his verdict.

All through the west chop-feed made from recleaned screenings sells readily and gives excellent results. Buckwheat screenings seem to make an especially satisfactory hog feed.

Nearly all of the larger flour milling companies pulverize their entire screenings for mixing with their by-products.

IN EASTERN CANADA.

The quantity of screenings used by Eastern Canada feed manufacturers varies widely according to the abundance and price of coarse grains. Every year, however, considerable quantities of them, mostly scalpings, are shipped from the terminal elevators to Ontario and Quebec, and ground up alone or mixed with other grains.

If the scalpings have been carefully cleaned they make a cheap and valuable feed, but screenings containing any appreciable quantity of the finer weed seeds should never be accepted by eastern feed manufacturers.

Grinding Screenings.

The impossibility of pulverizing all of the seeds when the entire screenings are ground up together by an ordinary chopper is well illustrated by the analysis of a sample that had been ground with the idea of putting it on the market as a feed. One-eight ounce contained the following weed seeds: *Noxious.*—Tumbling mustard, 215; western false flax, 8; wild mustard, 2; hare's-ear mustard, 2; stinkweed, 2; small-seeded false flax, 1; stickseed, 1; campion, 1; perennial sow thistle, 1. *Other kinds.*—Lamb's quarters, 460; cinquefoil, 7; green foxtail, 6; timothy, 3; wormwood, 3; plantain, 1; evening primrose, 1; yarrow, 1; tickseed, 1; western wall-flower, 1.

This is equivalent to 29,800 noxious weed seeds and nearly 62,000 others per pound.

The complete reduction of screenings containing the black seeds is a difficult and expensive process. It requires specially constructed machines which are difficult to drive, and thus expensive to operate. Often a combination of two or more machines is employed, one of which is usually an attrition mill. The "Perplex" or "Simplex" grinder is

also in common use. For a description of the means employed in some factories where screenings are used see pages 10 and 11.

The difficulty of grinding the screenings containing all of the weed seeds is due to the hard flinty seed-coat of some, such as lamb's quarters, and the very small size of others, as tumbling mustard. These two seeds, it will be noticed, make up over 95 per cent, of the unground seeds in the feed cited above.

Screenings carefully recleaned over a screen with perforations one-fourteenth of an inch in diameter to remove the black seeds may be satisfactorily ground by an ordinary chopper. By referring to the results of the feeding experiments reported on pages 34 and 35 it will be seen that the removal of the black seeds will greatly improve the feeding value of the remainder.

Screenings in Feeding Stuffs.

The demand for mill feeds has increased enormously during the past few years. Mills that have established a reputation for supplying feeds of good quality have difficulty in supplying the demand for their products but there are some millers who take advantage of this heavy demand to practise a fraudulent and dangerous adulteration. This adulteration consists in the mixing of screenings, either ground or unground, with bran, shorts, chop-feed, etc.

Following some investigations made by the Seed Branch into the occurrence of vital weed seeds in feeding stuffs, the following amended standards of quality for grain products were adopted by Order in Council bearing date May 3, 1911, the part in italics being added:—

13. Bran is a product of the milling of wheat or other grain, and contains not less than fourteen (14) per cent of proteids, not less than three (3) per cent of fat, not more than ten (10) per cent of crude fibre, *and must be free from vital seeds of any of the noxious weeds defined by the Governor in Council under "The Seed Control Act."*

14. Shorts or middlings is the coarser material sifted out from the products of a second treatment of the grain by crushing the coarsely ground material that is sifted out from the bran after the first grinding; and contains not less than fifteen (15) per cent of proteids, not less than four (4) per cent of fat, not more than eight (8) per cent of crude fibre, *and must be free from vital seeds of any of the noxious weeds defined by the Governor in Council under "The Seed Control Act."*

15. Chop-feed is whole grain of one or more kinds more or less finely ground, and contains not less than ten (10) per cent of proteids, not less than two (2) per cent of fat, not more than (10) per cent of crude fibre, *and must be free from vital seeds of any of the noxious weeds defined by the Governor in Council under "The Seed Control Act."*

The enforcement of these regulations is in the hands of the Department of Inland Revenue.

ANALYSIS OF SAMPLES.

In the spring of 1913 the seed laboratory examined 396 samples of bran, shorts and chop feed, which had been collected throughout Canada by the inspectors of the Department of Inland Revenue. Analysis showed that 140 of these samples contained noxious weed seeds, the average number being 57 per pound. Twenty-four of the samples contained more than 100 noxious weed seeds per pound, and one sample of chop-feed held 1,104 seeds of wild oats, stickseed, catchfly, and stinkweed per pound. Only 144 samples were free from vital weed seeds of any kind. The following seeds were most common:

Noxious.—Wild oats in 74 samples; wild mustard, 30 ; hare's-ear mustard, 27; false flax, 25; stinkweed, 24; ball mustard, 23; catchfly, 21; docks, 8; ragweed, 6; Canada thistle, 5; stickseed, 5; western false flax, 5; tumbling mustard, 3.

Other Weed seeds.—Lamb's quarters, 180; wild buckwheat, 94; green foxtail, 11; lady's thumb, 9; chess, 9; American dragonhead, 7; worm-seed mustard, 7.

POSSIBLE DELETERIOUS EFFECTS OF CERTAIN WEED SEEDS.

There is another point to be considered in connection with the adulteration of feeding stuffs with weed seeds, whether whole or ground, and that is the possibility of some of the seeds being poisonous or otherwise deleterious to the health of animals. The seed of worm-seed mustard for example has an exceedingly bitter taste, and hogs cannot be induced to eat chop-feed containing traces of it. See results of feeding black seeds on page 34 in this bulletin.

The Seed Branch quite frequently receives samples of feeds of various kinds that the senders claim have caused death or serious injury to the health of animals. Analysis of such samples often reveals the presence of weed seeds of various kinds.

The following is a copy of a letter received during the past winter:—

> "I am sending you a sample of a molasses meal feed for a complete analysis, and kindly report to me at your earliest convenience.
>
> "A horse I was feeding it to commenced to fail, and died within two weeks in great pain, though otherwise we could locate nothing the matter with him. Another horse scoured violently and so did a cow, so I have stopped feeding it entirely.
>
> "It is about time the Government took active measures against all these unscrupulous feed dealers who are charging the farmer outrageous prices for mill feeds composed of quantities of weed seeds which are injuring and killing the animals they are fed to. I paid $1.75 a hundred for this feed, and I have been a month up day and night with sick stock, which I believe was caused through nothing else but this feed."

The feed referred to contained lamb's quarters, wild buckwheat, chickweed, plantain, and fragments of many other weed seeds.

DANGER OF SPREADING WEEDS THROUGH SEEDS IN FEEDING STUFFS.

In the milling of wheat for flour practically all weed seed are removed before the wheat passes to the rolls, and if weed seeds are found in the bran, shorts, or middlings, they must have been added subsequently. Whether this practice can be justified depends on the nature of the screenings added, and the thoroughness with which they are ground.

Experiments have shown that weed seeds may grow after they have passed through the digestive canal of domestic animals. In an experiment at the Maryland Experiment Station (Bulletin 128), twenty-two kinds of seeds were fed to animals and the manure spread over sterile soil. It was found that only one kind of seed, Spanish needles (*Bidens bipinnata* L.) failed to germinate. Docks, ragweed, purple cockle, tumbling mustard and peppergrass, were all capable of germination.

The following is from Bulletin 168 of the Maryland Station: "A cow and horse were each fed two pounds of the unground grain screenings with middlings, bran, and wheat straw, each morning and night for seven days. On the evening of the seventh day they were bedded with sawdust and the dung of one night collected. The sawdust and dung were thoroughly mixed and put in boxes and set on a bench in the greenhouse. The dung was collected on May 24. On June 21, the following weeds had grown:—

Cow Dung.	*Horse Dung.*
149 Lamb's quarters.	1213 Lamb's quarters.
12 Pigweed.	28 Foxtail.
14 Bindweed.	11 Pigweed.
4 Foxtail.	12 Bindweed.
2 Timothy.	6 Timothy.
	3 Clover.
	2 Morning glory.
	5 Mustard.

It has further been demonstrated that weed seeds are able to retain their vitality for a period of several years when buried in the soil, and so it cannot be doubted that the use of feeding stuffs containing live weed seeds may lead to a serious spread of noxious weeds.

Flaxseed Screenings.

In terminal elevators the screenings from flaxseed are usually mixed with those from wheat, oats, and barley to form a part of the ordinary grain screenings of commerce. A composite sample was, however, taken from a lot of several tons of fine flax screenings which had come through the lower sieve (one-fourteenth inch perforated zinc screen) of an ordinary flax cleaner in a Fort William elevator. Following is the analysis: flax and broken flax, 14 per cent; lamb's quarters, 42·5 per cent; mustards, 5·25 per cent (tumbling mustard,

false flax, wild mustard, stinkweed, peppergrass); other weed seeds, 0·65 per cent (sedge, mayweed, black bindweed, cinquefoil, wormwood); chaff and dust, 37·6 per cent.

These fine flax screenings constitute about 40 per cent of the material removed from the flax by the cleaners. The remaining 60 per cent is composed of the coarser material, including flax bolls (seed pods), wheat, oats, wild oats, wild buckwheat, wild mustard, hare's-ear mustard, ball mustard, cow cockle, etc., which passes over the upper screen in the cleaners. This material is recleaned to reclaim the valuable portions.

POISONOUS PROPERTIES.

Difficulties have been encountered in feeding flaxseed screenings unmixed with other grain products. A letter received from a Saskatchewan farmer under date May 14, 1915, is quoted in part:—

> "I am sending you a sample of cleanings from flaxseed which is deadly poison. It contains principally frozen blossom buds, which must contain the poison. I had never heard of its being poison before using it with fatal results. Since I have learned my lesson I have heard that a neighbour lost several cattle by its use a few years ago. A few weeks ago I fed about three gallons to a cow and two gallons to a heifer. Both were in convulsions in less than twenty minutes. The heifer died in about two hours, the cow in about eight hours."

An analysis of the sample gave the following: immature flax bolls and chaff, 75 per cent; flaxseed, 18 per cent; wheat, 4 per cent; weed seeds, 3 per cent. The weed seeds were chiefly lamb's quarters and wild buckwheat, with traces of tumbling mustard. None of these is suspected of being poisonous.

Dr. A. McGill, Chief Analyst, Laboratory of the Inland Revenue Department, reports on this sample of flaxseed screenings: "We find considerable quantities of prussic (hydrocyanic) acid, quite sufficient to explain the toxicity of the article."

Similar results from feeding flaxseed screenings are reported in Special Bulletins, Nos. 31 and 35 of the North Dakota Experiment Station. In one herd of nineteen all died; while in a second of ten, five died. Analyses made of several samples of flaxseed screenings showed clearly the presence of hydrocyanic acid. This poison was also found in immature seed bolls of flax analysed separately. A healthy, well-fed 2-year-old heifer which refused to eat flaxseed screenings was fed by force from a bottle with an extraction obtained from 4½ pounds of screenings. Toxic symptoms developed, from which she recovered, as was the case with a second feeding obtained from 4 pounds. An extraction from 12 pounds resulted in the death of the animal in ninety-two minutes. Quantitative determinations showed that 0·9583, 0·10736 and 4·892 gms. of hydrocyanic acid, respectively, were fed. Thus it is clearly evident that flaxseed screenings may contain hydrocyanic acid in sufficient quantities

to cause the death of animals, even when the screenings are fed in moderate quantity.

Pammel, of Iowa, in his "Manual of Poisonous Plants" records the opinion of Dr. Schaffner that the cause of death to cattle is probably due to the prussic acid (hydrocyanic acid) envolved from the plant when wilting.

Feeding Experiments.

During the winter of 1914-15 the Animal Husbandry Division of the Central Experimental Farm, Ottawa, conducted experiments in the feeding of elevator screenings and their commercial separations, with milch cows, swine, and lambs.

THE MATERIAL.

In securing material for the experiments, pains were taken to get screenings representing as nearly as possible the average cleanings taken from western grain. The following statement from Mr. F. Symes, the inspector in charge of terminal elevators, explains how the material used for these experiments was secured:—

FORT WILLIAM, ONT.
February 6, 1915.

J. R. DYMOND, Esq., Seed Analyst,
Department of Agriculture, Ottawa.

DEAR SIR,—I beg to advise you the carload of screenings which I obtained for the department was taken from the Port Arthur elevator, Empire, Grand Trunk Pacific, and the Dominion Government elevators at Port Arthur and Fort William. This would represent screenings from each road, namely, the Canadian Northern, Canadian Pacific, and Grand Trunk Pacific railways, and would be as representative a sample of the natural screenings from western points as it would be possible to obtain.

These screenings were not recleaned in any way, but came straight from the cleaning machinery. It would be impossible to get a more representative sample than that which I obtained for you.

Yours truly,
(Signed) F. SYMES,
Inspector.

These screenings were from the 1913 crop. The separations were made at the elevator of the Ogilvie Flour Mills Co., Ltd., at Fort William, by a screening separator of the type commonly

used in all terminal elevators. They therefore represent, as accurately as possible, the average run of the different materials, "entire screening," "entire screenings, black seeds removed," "black seeds," and "buckwheat screenings." These were all finely ground in the feed mill of the Ogilvie Company. The material, after passing through an attrition mill, was separated into two portions, coarse and fine, by a reel. The coarser portion was further reduced by a "Perplex" grinder.

Small samples of both the unpulverized and the pulverized screenings were taken for analysis every few minutes before and during the grinding.

BOTANICAL ANALYSES.

Following is the botanical analyses of the different materials used in the feeding experiments. The numbers after the names of weed seeds indicate the relative proportion by number of the various weed seeds found:—

Screenings.—Wheat 32 per cent, oats 2·6 per cent, flax 6·1 per cent, wild oats 2·8 per cent, wild buckwheat 11·7 per cent, lamb's quarters 20·2 per cent, wild mustard (91) 1·8 per cent, other mustards 2·5 per cent (hare's-ear mustard 53, tumbling mustard 341, worm-seed mustard 28, ball mustard 13, stinkweed 14, peppergrass 11, western false flax 8, flat-seeded false flax 1), other weed seeds 2·2 per cent (wormwood 194, cinquefoil 26, green foxtail 31, Russian pigweed 25, evening primrose 30, American dragonhead 14, plantain 10, catchfly 8, timothy 7, alsike 7, Canada thistle 6, blue grass 5, western rye grass 4, ergot 3, gumweed 3, mint 3, western cone-flower 2, purple cockle 2, crepis 1, witch grass 1, pale plantain 1, hedge nettle 1, prairie rose 1, road-side thistle 1, sow thistle 1), chaff 18·1 per cent.

Buckwheat Screenings.—Wheat 53·8 per cent, oats 1.2 per cent, flax 7·6 per cent, wild oats 1·2 per cent, wild buckwheat 25 per cent, lamb's quarters 3·1 per cent, wild mustard (30) 0·7 per cent, other mustards 2·5 per cent (ball mustard 33, stinkweed 3, western false flax 6, peppergrass 1, hare's-ear mustard 34, tumbling mustard 22), other weed seeds, 1 per cent (stickseed 12, American dragonhead 10, green foxtail 7, Russian thistle 6, cow cockle 6, Canada thistle 3, prairie sunflower 3, pigweed 2, lady's thumb 2, prairie rose 2, purple cockle 1, catchfly 1, wild carrot 1, bull thistle 1, plantain 1), chaff, etc., 3·9 per cent.

Screenings, black seeds removed.—Wheat 51 per cent, oats 8·5 per cent, barley 1 per cent, flax 5 per cent, wild oats 6·4 per cent, wild buckwheat 8·7 per cent, lamb's quarters 1·5 per cent, mustards 1·5 per cent (wild mustard 25, ball mustard 17, hare's-ear mustard 13, worm-seed mustard 1, tumbling mustard 11, peppergrass 2, false flax 1), other weed seeds 0·7 per cent (western rye grass 8, stickseed 6, Russian pigweed 4, American dragonhead 4, cinquefoil 2, wormwood 1, wolfberry 1, prairie rose 1, prairie sunflower 1, lady's thumb 1, green foxtail 1, gumweed 1), chaff, etc., 15·7 per cent.

Black Seeds.—Wheat, oats, barley and flax 17·4 per cent, wild buckwheat 4·2 per cent, lamb's quarters 45·4 per cent, wild mustard (140) 2·8 per cent, other mustards 5·6 per cent (hare's-ear mustard 180, ball mustard 28, tumbling mustard 544, peppergrass 8, worm-seed mustard 20, western false flax 28, shepherd's purse 8, stinkweed 44), other weed seeds 4·6 per cent (gumweed 18, catchfly 24, dock 2, Russian pigweed 52, evening primrose 64, plantain 10, prairie sunflower 10, coreopsis 2, mint 2, road-side thistle 2, stick-seed 8, green foxtail 70, cinquefoil 50, fragrant giant hyssop 2, sow thistle 4, Canada thistle 4, western cone-flower 6, American dragon-head 34, wormwood 66, wild oats 6, western rye grass 18, alsike 16, timothy 4, red clover 2), chaff, etc., 20 per cent.

MILCH COWS.

Object of Experiment.—To compare a good grain ration with complete elevator screenings, with black seeds, and with two of these supplemented by molasses meal in order to increase palatability.

Plan of Experiment.—Each of the following experiments was conducted in three periods of two weeks each, the necessary calculations being made from data collected during the second week of each period. The first week allowed the cows to become accustomed to any change in the ration. By averaging the results of the first and third periods a fair comparison with the intermediate period is possible.

Exp. I—Meal mixture vs. meal mixture—2 parts, and complete elevator screenings—1 part.

Exp. II—Meal mixture vs. meal mixture—2 parts, and black seeds—1 part.

Exp. III—Meal mixture vs. meal mixture—2 parts, complete elevator screenings—2 parts, and Caldwell's molasses meal—2 parts.

Exp. IV—Meal mixture vs. meal mixture—4 parts, and Caldwell's molasses meal—2 parts.

Meal mixture—
Bran—4 parts,
Gluten feed—2 parts,
Corn meal—2 parts,
Oil cake—1 part,
Cottonseed—1 part.

Value of Feeds per Ton—
Hay—$7.00
Roots and ensilage,—$2.00
Complete pulverized screenings—$10.00
Black seeds—$4.00
Caldwell's molasses meal—$34.50
Meal mixture—1·3 cents per pound.

TABLE No. 1.—Dairy Cow Feeding Experiment No. 1.—Meal versus Meal, 2 parts; Complete Pulverized Screenings, 1 part.

FEEDS.		MEAL.	MEAL.	MEAL.	MEAL AND SCREENINGS
		Period 1.	Period 3.	Average Periods 1 and 3.	Period 2.
Number of cows in test	No.	16	16	16	16
Pounds of milk produced by 16 cows	Lb.	2,732·5	2,088	2,410·3	2,450·5
Average milk per cow per day	"	24·4	18·7	21·5	21·9
Average per cent fat in milk	%	3·9	3·95	3·925	3·95
Total pounds fat produced by 16 cows	Lb.	106·56	82·47	94·6	96·77
Average pounds fat per cow per day	"	·951	·739	·845	·864
Total meal consumed	"	1,036	1,036	1,036	936
Total hay consumed	"	672	672	672	672
Total molasses consumed	"	....	....	....	....
Total roots consumed	"	....	....	....	....
Total ensilage consumed	"	3,990	3,990	3,990	3,990
Mixture consumed per 100 pounds fat produced	"	971·8	1,255·2	1,095·2	967·8
Relative value for production of fat	%	....	....	100	113·6
Mixture consumed per 100 pounds milk produced	lb.	37·9	49·6	43·2.	38·2
Relative value for production of milk	%	....	....	100	112·5
Findings from Experiment.					
Cost of meal mixture fed	$	13·46	13·46	13·46	9·67
Value of roughage fed	$	6.34	6.34	6.34	6.34
Total cost of feed	$	19.80	19.80	19.80	16·01
Cost to produce 100 pounds fat	$	18.57	24.00	20.93	16.55
" " 1 pound fat	$	0.185	0.24	0.209	0.165
" " 1 pound butter	$	0.155	0.20	0.175	0.138
Profit on 1 pound butter at 30 cents a pound	$	0.145	0.10	0.125	0.162
Cost to produce 100 pounds milk	$	0.725	0.948	0.82	0.662
Profit on 100 pounds milk at $1.70 per hundredweight	$	0.979	0.75	0.88	1.04
Total weight of cows for period	lb.	16,089	16,792	....	16,387
Gain for period	"	....	405	....	298

Deductions.—That the ration fed during Period 2 (one-third screenings) was unpalatable to a marked degree was shown by the fact that, even during its second week, when the cows had become more or less accustomed to the change, over one hundred pounds was removed and credited to the animals. Notwithstanding this, however, the production of milk during Period 2 was greater than the average of production of Periods 1 and 3. Referring to the findings from the experiment, the cost of the elevator screenings ration is, on the values adopted, considerably lower. Taking into considertion the lessened amount of meal consumed, this would explain the relatively low

cost of production. In this experiment, 312 pounds of screenings replaced 420 pounds of the meal mixture, or, at the valuation of $26 for the latter, the *complete pulverized screenings*, fed as one-third of the grain ration, acquired a *value of $34 per ton.* It must be remembered that this deduction, while correct, is made from the results of an experiment of very short duration, as will be discussed more fully.

TABLE No. 2.—Dairy Cow Feeding Experiment No. 2.—Meal versus Meal, 2 parts; Pulverized Black Seeds, 1 part.

FEEDS.		MEAL.	MEAL.	MEAL.	MEAL AND BLACK SEEDS.
		Period 1.	Period 3.	Average Periods 1 and 3.	Period 2.
Number of cows in test	No.	15	15	15	15
Pounds of milk produced by 15 cows	lb.	2,227·5	2,293·5	2,260·5	2,080
Average milk per cow per day	"	21·3	21·8	21·5	19·8
Average per cent fat in milk	%	3·9	3·6	3·75	3·6
Total pounds fat produced by 15 cows	lb.	86·8	82·5	84·8	74·9
Average pounds fat per cow per day	"	·826	·785	·807	·713
Total meal consumed	"	998	998	998	868
Total hay consumed	"	630	630	630	630
Total molasses consumed	"	....	....	....	....
Total roots consumed	"	1,260	1,260	1,260	1,260
Total ensilage consumed	"	2,240	2,240	2,240	2,240
Mixture consumed per 100 pounds fat produced	"	1,149	1,209	1,179	1,159
Relative value for production of fat	%	....	....	100	101·5
Mixture consumed per 100 pounds milk produced	lb.	44·8	43·5	44·6	41·7
Relative value for production of milk	%	....	....	100	106·9
Findings from Experiment.					
Cost of meal mixture fed	$	12.97	12.97	12.97	8.10
Value of roughage fed	$	5.71	5.71	5.71	5.71
Total cost of feed	$	18.68	18.68	18.68	13.81
Cost to produce 100 pounds fat	$	21.52	22.64	22.03	18.44
" " 1 pound fat	$	0.215	0.226	0.22	0.184
" " 1 pound butter	$	0.18	0.189	0.184	0.154
Profit on 1 pound butter at 30 cents per pound	$	0.12	0.111	0.116	0.146
Cost to produce 100 pounds milk	$	0.83	0.81	0.827	0.664
Profit on 100 pounds milk at $1.70 per hundredweight	$	0.87	0.89	0.873	1.036
Total weight of cows for period	lb.	15,670	16,390	....	16,052
Gain for period	"	....	338	....	382

Deductions.—The black seeds ration fed during one of the three periods, the results of which are given in the foregoing table, was even more unpalatable than the screenings ration fed during Experiment I, ground *black seeds* having an extremely *bitter flavour* and being of a fine, dusty nature. One hundred and thirty pounds

of the mixture were removed. The production during Period 2 was considerably less than that of the average of Periods 1 and 3 ; nevertheless, with one-third of the meal ration valued at the rate of $4.00 per ton, and with the lessened amount of meal consumed, the cost of production in the case of the black seeds ration is relatively low. As will be mentioned more in detail, the complete elimination of one-third of the ration might have resulted in still lower cost of production for this short space of time. Nevertheless, on the actual data given, the following figures may be deduced: 366 pounds black seeds, 60 pounds hay, 126 pounds roots, and 224 pounds of ensilage would be equivalent to 267 pounds meal mixture, for milk production.

TABLE No. 3.—Dairy Cow Feeding Experiment No. 3.—Meal versus Equal Parts of: Meal; Complete Pulverized Screenings; and Caldwell's Molasses Meal.

FEEDS.		MEAL.	MEAL.	MEAL.	SCREENINGS, MEAL, MOLASSES MEAL.
		Period 1.	Period 3.	Average of Periods 1 and 3.	Period 2.
Number of cows in test	No.	16	16	16	16
Pounds of milk produced by 16 cows	lb.	2,654	2,604	2,629	2,476
Average milk per cow per day	"	23·7	23·2	23·4	22·1
Average per cent fat in milk	%	3·7	3·7	3·7	3·7
Total pounds fat produced by 16 cows	lb.	98·2	96·4	97·27	91·61
Average pounds fat per cow per day	"	·876	·848	·865	·817
Total meal consumed	"	1,092	1,092	1,092	992
Total hay consumed	"	672	672	672	672
Total molasses meal consumed	"	....	....	....	.....
Total roots consumed	"	1,435	1,435	1,435	1,435
Total ensilage consumed	"	2,555	2,555	2,555	2,555
Mixture consumed per 100 pounds of fat produced	"	1,112	1,132	1,122	1,082
Relative value for production of fat	%	....	....	100	103·7
Mixture consumed per 100 pounds of milk produced	lb.	41·1	41·9	41·5	40
Relative value for production of milk	%	....	....	100	104
Findings from Experiment.					
Cost of meal mixture fed	$	14.19	14.19	14.19	11.57
Value of roughage fed	$	6.34	6.34	6.34	6.34
Total cost of feed	$	20.53	20.53	20.53	17.91
Cost to produce 100 pounds fat	$	20.90	21.29	21.10	19.55
" " 1 pound fat	$	0.20	0.21	0.205	0.19
" " 1 pound butter	$	0.16	0.17	0.172	0.15
Profit on 1 pound butter at 30 cents per pound	$	0.14	0.13	0.128	0.15
Cost to produce 100 pounds milk	$	0.769	0.788	0.778	0.72
Profit on 100 pounds milk at $1.70 per hundredweight	$	0.931	0.912	0.922	0.98
Total weight of cows per period	lb.	17,508	18,026	....	17,749
Gain in weight	"	....	277	....	241

Deductions.—As will be seen the above results do not indicate any particular increase in the palatability of the meal ration due to the addition of molasses meal. One hundred pounds of the mixture were removed from the cows and credited to them. Even with the lower production in Period 2, and after having valued molasses meal at $34.50, the cost to produce with the screenings ration is appreciably lower.

Keeping in view the limitations of this test, the following deduction is possible: A mixture of equal parts of Caldwell's molasses meal and pulverized complete screenings replaced about the same quantity of the regular meal mixture for milk production, and is worth about $25 per ton.

Comparing these results with those of Experiment No. 4, it would appear that in spite of the unpalatability of screenings, due to the presence of black seeds, the complete screenings fed as above acquire a value of $27.50 per ton.

TABLE No. 4.—Dairy Cow Feeding Experiment No. 4.—Meal, versus Meal, 4 parts; Caldwell's Molasses Meal, 2 parts.

FEEDS.		MEAL.	MEAL.	MEAL.	MEAL, CALDWELL MOLASSES MEAL.
		Period 1.	Period 3.	Average of Periods 1 and 3.	Period 2.
Number of cows in test	No.	14	14	14	14
Pounds of milk produced by 14 cows	lb.	2,443	2,324	2,379	2,308
Average milk per cow per day	"	24·9	23·6	24·3	23·5
Average per cent fat in milk	%	3·8	3·8	3·8	3·8
Total pounds fat produced by 14 cows	lb.	92·87	87·93	90·40	87·70
Average pounds fat per cow per day	"	·95	·896	·93	·895
Total meal consumed	"	952	952	952	952
Total hay consumed	"	588	588	588	588
Total molasses consumed	"	....	....	....	....
Total roots consumed	"	2,260	1,260	1,260	1,260
Total ensilage consumed	"	2,240	2,240	2,240	2,240
Mixture consumed per 100 pounds fat produced	"	1,025	1,083	1,054	1,085
Relative value for production of fat	%	....	....	100	97
Mixture consumed per 100 pounds milk produced	lb.	38·9	41	40	41·2
Relative value for production of milk	%	....	....	100	96
Findings from Experiment.					
Cost of meal mixture fed	$	12.37	12.37	12.37	13.63
Value of roughage fed	$	5.50	5.50	5.50	5.50
Total cost of feed	$	17.87	17.87	17.87	19.13
Cost to produce 100 pounds fat	$	19.25	20·32	19.76	21.81
" " 1 pound fat	$	0.192	0.213	0.197	0.218
" " 1 pound butter	$	0.161	0.17	0.165	0.183
Profit on one pound butter at 30 cents per pound	$	0.139	0.13	0.135	0.117
Cost to produce 100 pounds milk	$	0.731	0.771	0.75	0.829
Profit on 100 pounds milk at $1.70 per hundredweight	$	0.969	0.929	0.949	0.871
Total weight of cows for period	lb.	15,708	25,883	....	15,613
Gain or loss in weight	"	....	(270 Gain)	....	(85 Loss)

The foregoing is interesting for two reasons : 1st, because it corroborates results obtained previously in 1914 and already reported, to the effect that molasses meals are an expensive food, and their use in a well-balanced and already palatable ration is of doubtful benefit; 2nd, because of the very slight increase in production which it induced in comparison with corresponding periods in the previous three tables, an increase out of all proportion to the increased cost.

In this experiment, 298 pounds of meal mixture is equal to 327 pounds of Caldwell's molasses meal, 20 pounds of hay, 37 pounds roots, and 67 pounds ensilage. At the given valuations of the regular feeds, Caldwell's molasses meal has a valuation of only about $22.50 per ton.

General Conclusions from Four Experiments.—Lest too hasty deductions be made from the results given, there are several points to consider in the feeding of elevator screenings. Judging from these experiments, such material has a fair feeding value. Only in one experiment (Experiment No. 1), however, did the period when screenings were fed show any increase over the average of the first and third periods which in this instance was due to a heavy and rather unaccountable falling-off in Period 3, perhaps caused by the protracted effects of an unpalatable ration fed for the first time. In the next two comparisons the falling-off in milk flow was quite marked: wholly insufficient, however, to prevent the regular ration from suffering when compared on a cost basis.

It is safe to say that for a period of one or two weeks, one-third of the meal ration fed to a cow in average milk flow might be removed, and, provided the animal was consuming a *liberal, well-proportioned roughage ration of fair quality* and containing some succulent feed, the milk production during this short period would not be sufficiently affected to balance the consequent cheapening of the meal ration due to a removal of one-third of the latter. If this supposition be true, one is almost equally safe in assuming that the continued feeding of only two-thirds the required or optimum ration, would show a decrease that could not be balanced by the saving in meal at the end of the year.

That the same would apply to the experiment in question is probable. Furthermore, considering that certain cows refused all feed, that is, ensilage, roots, cut straw, etc., that came in contact with the meal mixture containing black seeds and pulverized screenings, it is quite probable that from the standpoints of both pounds of milk produced, and cost to produce, the entire omission of the by-product might have still further reduced the cost of production.

The attitude of the individual cows to the screenings meal rations differed widely. Some showed little preference for one or the other; others ate only portions for a few days; others refused it altogether, carefully cleaning up all the roughage with which the meal was fed, and leaving practically all of the meal in the manger; others, again, refusing throughout the entire period all food containing screenings. With the exception of certain animals that consistently refused this meal ration, however, the herd during the second week of the period as a rule consumed it cleanly.

Briefly, it would appear that on these short tests the value of screenings lies not in its power to produce, but rather in its cheapness. Whether the complete pulverized screenings or the apparently undesirable black seeds, cheap though they are, would prove economical on an extended feeding period, and whether digestive disturbances or the probable toxic effects of certain weed seed constituents might present themselves, could not be ascertained within the necessary limits of this test.

Although no test was made of the elevator screenings with black seeds removed in the experiments just reviewed, the inadvisability of using black seeds as a food for dairy cows, is apparent. Aside from their high percentage of crude fibre and the actual danger of digestive derangements due to their use, black seeds are not only highly unpalatable themselves, but are also able to render likewise any ration or mixture of which they become a part. Elevator screenings with the black seeds removed constitute a palatable and cheap foodstuff.

SWINE.

Objects of Experiment.—(1) To determine the value of the well-balanced ration in the winter feeding of young pigs for market.

(2) To compare this well-balanced ration with black seeds.

(3) To determine the value of black seeds fed in conjunction with roots and skim-milk, as compared with black seeds fed in water only.

(4) To determine the value of buckwheat screenings in swine feeding.

(5) To compare with the well-balanced ration, buckwheat screenings, black seeds, with and without milk and roots, and the value of complete elevator screenings in conjunction with feed flour (Ogilvie's "Noxol").

Plan of Experiment.—All the lots were fed in the main piggery, housed to best advantage for winter feeding. Lots of four each were fed in duplicate. The following tables represent the totals and averages for each lot and its duplicate.

The first five lots of pigs received water, roots, and skim-milk in the same quantities per pig. Lot 6, however, received no roots or skim-milk, but only the black seeds and water. The object of this was to determine whether or not the black seeds had a poisonous effect upon young pigs, and whether they would supply sufficient to maintain life.

Lot 1 (Yorkshires and Berkshires) received a grain ration composed of: shorts, 3 parts; finely ground corn, 3 parts; and oil meal, 1 part. This is the standard meal mixture for this experiment, and is termed "meal" throughout.

Lot 2 (Yorkshires and Berkshires) were fed a mixture of: meal, 1 part; and finely ground black seeeds, 1 part.

Lot 3 (Yorkshires, Berkshires and Tamworths) were fed finely ground black seeds.

Lot 4 (Yorkshires and Berkshires) were fed finely ground buckwheat screenings.

Lot 5 (Berkshires and Tamworths) were fed: complete elevator screenings, 3 parts; and Ogilvie's "Noxol" flour, 1 part.

Lot 6 (Yorkshires) were fed finely ground black seeds and water without milk and roots.

Individual weights of pigs were taken every two weeks throughout the experiment. The feed also was weighed regularly.

Valuation of foodstuffs.—The following valuations were placed on the meals and the other feeds consumed:—

Meal mixture (corn, shorts, and oil cake)..	$28.00 per ton.
Buckwheat screenings.....	14.00 "
Complete elevator screenings.....	10.00 "
Finely ground black seeds.....	4.00 "
Ogilvie's "Noxol" flour.....	28.00 "
Roots.....	2.00 "
Skim-milk.....	4.00 "

The above valuations for elevator products were taken as a fair standard for comparison.

EXPERIMENTAL PERIOD I.

Lot.	1	2	3	4	5	6
Feed.	Meal, Milk.	Meal, Black Seeds, Milk.	Black Seeds, Milk.	Buck-wheat Screen-ings, Milk.	Com-plete Screen-ings, Flour, Milk.	Black seeds and Water.
Number of animals in each group.	8	8	8	8	8	4
First weight, gross..... lb.	861	980	835	842	594	638
First weight, average..... "	107	122	104	105	74	159·5
Finished weight, gross..... "	1,205	1,237	881	1,145	754	640
Finished weight, average..... "	151	154	110	143	94	160
Number of days in experiment....No.	42	42	42	42	42	42
Total gain for period..... lb.	344	257	46	303	160	2
Average gain per animal..... "	43	32	6	38	20	·5
Average daily gain for group..... "	8·19	6.12	1.10	7·21	3·81	·05
Average daily gain per animal.... "	1·02	·76	·14	·90	·48	·01
Quantity of meal eaten by group for period..... "	866	864	432	775	481	360
Quantity of roots eaten by group for period..... "	324	324	290	324	324	.....
Quantity of skim-milk eaten by group for period..... "	1,354	1,354	1,209	1,354	1,354	.....
Total cost of feed..... $	15.13	9.89	3.52	8.43	6.49	0.72
Cost of feed per head..... $	1.89	1.24	0.44	1.05	0.81	0.18
Cost of feed per head per day.....cts.	4·5	3·0	1	2·5	1·9	·04
Cost to produce 1 pound gain..... "	4·4	3·8	7·6	2·7	4·0	36
Original cost of animals, at $4 per hundredweight..... $	34.44	39.20	33.40	33.68	23.76	25.52
Original cost plus cost of feed..... $	49.57	49.09	36.92	42.11	30.25	26.24
Selling value at $6 per hundred-weight..... $	72.30	74.22	52.86	68.70	45.24	38.40
Net profit per group..... $	22.73	25.13	15.94	26.59	14.99	12.16
Net profit per animal..... $	2.84	3.14	1.99	3.32	1.87	3.04

Deductions from Experimental Period.—The following deductions might fairly be taken from this experimental period:—

(1) The order of the various lots in relation to greatest gains is as follows: 1, 4, 2, 5, 3, 6.

(2) The order of the cheapest gains per lot is as follows: 4, 2, 5, 1, 6, 3.

(3) Comparing lot 1 (a well-balanced, palatable ration) with lot 2 (where half the meal was replaced by black seeds), it is seen that nearly one-third less gains were made, but the gains were about one-quarter cheaper, due to the low cost of the black seeds. It is seen that 287 pounds of meal gave the same gains as 573 pounds of black seeds, plus 108 pounds of roots, plus 451 pounds of skim-milk. Had no black seeds been fed, it is safe to say that the milk and roots would have produced as great if not greater gains.

(4) Comparing lots 1 and 3, it is found that lot 3 gave extremely small gains—smaller than should have been made on roots and milk alone, and at a higher cost per pound gain. It is seen that 860 pounds of meal gave the same gains as 3,316 pounds of black seeds, 1,909 pounds of roots, and 7,955 pounds of milk. At the above valuations of meal, roots, and milk, black seeds in this ration are quite useless, the 1½ ton of black seeds not only having no feeding value but actually causing *a loss of $4.98 on the value of the roots and milk of lot 3.*

(5) Comparing lots 2 and 3, it is seen that when the meal is completely replaced by the black seeds only one-sixth of the gains are made, and these gains at just double the cost per pound. That is, 460 pounds of meal would give the same gains as 1,916 pounds of black seeds plus 1,217 pounds of roots plus 5,295 pounds of milk. In other words, at the above valuations of skim-milk, roots, and meal, the black seeds are of no value and even cause *a loss on the value of the milk and roots of lot 3, amounting to $5.42.*

(6) Comparing lots 1 and 6, it is seen that lot 6 on water and black seeds alone made practically no gains, but maintained weight only for forty-two days. It would thus appear that in lot 2 the milk, roots, and meal, plus 70 pounds of black seeds are responsible for fairly large and cheap gains.

(7) Comparing lots 3 and 6, it is seen that the milk and roots of lot 3 are altogether responsible for the gains. With milk and roots at the above valuations, black seeds fed thus have only a valuation of 65 cents per ton.

To summarize the value of black seeds in this experiment, it is safe to say that the food value of this by-product is comparatively low, even when fed in small quantities in a well-balanced ration containing good variety; that it has little food value when fed in conjunction with only one or two other foodstuffs; that animals of 160 pounds weight can be made to eat 2 pounds each per day and thus retain a normal weight for a short period of about 1½ month; that this product is rather unpalatable and, if constituting any considerable proportion of the grain ration, is unpleasant to the animals.

(8) Comparing lots 1 and 4, it is seen that lot 4 on buckwheat screenings produced the second largest gains, made the cheapest

gains at the lowest cost, and proved buckwheat screenings to be worth about the same as the meal mixture. It is seen that 866 pounds of meal gave the same gains as 852 pounds of buckwheat screenings plus 32 pounds of roots plus 135 pounds of skim-milk. At the above valuations of meal, roots, and skim-milk, buckwheat screenings thus have a valuation of $27.60.

(9) Comparing lots 1 and 5, it is seen that much smaller gains were made where the complete elevator screenings and feed flour constituted the total grain ration. Nevertheless, the low valuation of the screenings shows that cheaper gains can be made, for a short period, than with the meal mixture. It is seen that 866 pounds of meal gave the same gains as 740 pounds of screenings, 250 pounds of feed flour, 325 pounds of roots, and 1,350 pounds of skim-milk. At the above valuations for meal, roots, and skim-milk, a mixture of elevator screenings, 3 parts; and feed flour, 1 part, is worth $18.40 per ton.

Finishing Period.—Owing to the limited quantities of elevator screenings and by-products, the experimental period was only conducted for forty-two days. At the end of this time all six lots were placed on a finishing period preparatory to marketing. All the lots were given the standard meal mixture, similar to that given to lot 1 of the experimental period. All the lots were given roots and skim-milk except lot 6

FINISHING PERIOD II.

Feed Given.		Meal—all same mixture.					
Lot.		1	2	3	4	5	6
Number of animals in each group		7	8	8	8	8	4
First weight, gross	lb.	1,084	1,237	881	1,145	754	640
First weight, average	"	155	154	110	143	94	160
Finished weight, gross	"	1,254	1,530	1,176	1,428	972	852
Finished weight, average	"	179	191	147	178	121	213
Number of days in experiment	Days	42	42	42	42	42	42
Total gain for period	lb.	170	293	295	283	218	212
Average gain per animal	"	24	37	37	35	27	53
Average daily gain for group	"	4·04	6·97	7·02	6·73	5·19	5·04
Average daily gain per animal	"	·57	·87	·88	·84	·65	1·26
Quantity of meal eaten by group for period	"	712	1,001	798	938	537	712
Quantity of roots eaten by group for period	"	245	310	310	310	310	.....
Quantity of milk eaten by group for period	"	1,177	1,290	1,290	1,290	1,290	.....
Total cost of feed	$	12.55	16.90	14.05	16.02	10.34	9·96
Cost of feed per head	$	1.79	2.11	1.76	2.00	1.29	2.49
Cost of feed per head per day	cts.	4·3	5·0	4·2	4·7	3·0	5·92
Cost to produce 1 pound gain	"	7·3	5·7	4·7	5·6	4·7	4·69
Original cost of animals, at $6 per hundredweight	$	65.04	74.22	52.86	68.70	45.24	38.40
Original cost plus cost of feed	$	77.59	91.12	66.91	84.72	55.58	48.36
Selling price, at $7.10 per hundredweight	$	89.03	108.63	83.49	101.39	69.00	60.49
Net profit per group	$	11.44	17.51	16.58	16.67	13.42	12·13
Net profit per animal	$	1.63	2.19	2.07	2.08	2.68	3.03

Deductions from Finishing Period.—The increased age of the various lots in the finishing period would naturally be conducive toward less gains per day and at a greater cost. This is demonstrated in lot 1, which in both the experimental and the finishing period received the same ration.

Lot 1 in the experimental period showed an average gain of 1.05 pound per pig per day and only 0·57 pound per pig per day in the finishing period. This lot stood highest in the experimental period for greatest daily gains, but stood lowest in the finishing period for daily gains. It would appear natural that the other five lots, which received much poorer rations in the experimental period, would respond more readily to a finishing period than would lot 1. One Yorkshire barrow died suddenly at the commencement of the fourth week of the finishing period. This animal had not shown any gains from the commencement of this period. Evidently the trouble was with the individual, as all the other animals in this lot made fairly satisfactory gains throughout the finishing period.

Lot 2 made greater gains, but at somewhat greater cost per pound gain, on the good feed of the finishing period.

Lot 3 made over six times the daily gain, and at only three-fifths the cost, on the superior feed of the finishing period.

Lot 4 made less gains, and at a much greater cost, on the finishing period. The actual palatability and balance of the ration of lot 4 on the experimental period was apparently about as good as lot 1 on the same period or lot 4 on the finishing period, hence the similarity to lot 1 in the results of the change of feed.

Lot 5 made one-half greater gains, and at only a slightly greater cost, on the superior feed of the finishing period.

Lot 6 showed the most marked change of any. The most rapid gains of the whole experiment were made by lot 6 when changed from the ration of blackseeds and water in the experimental period to the standard meal mixture and water in the finishing period. The cost of gains was also materially lowered in the finishing period. Attention is drawn to the fact that because of this rapid change when the animals are placed on good feed after a stunting period it is not a good practice, as the animals lost forty-two days of gains before they started to increase in weight and produce profitably.

LAMBS.

In the fall of 1914, eighty ewe and wether lambs of grade breeding and uniform size were purchased and were dipped a few days after their arrival, and together with the pure-bred lambs of the Farm flock were divided into six lots for experimental feeding.

Object of Experiment.—1. To illustrate the value of a well-balanced grain ration in lamb fattening work.

2. To compare this with elevator screenings.

3. To determine the value of elevator screenings alone.

4. To determine the value of elevator screenings less black seeds.

5. To illustrate the feasibility of feeding black seeds alone where possible.

6. To increase the palatability of black seeds by an addition of Caldwell's molasses meal.

Roughages.—All lambs were fed the same quality and quantity of roughage. The hay consisted of mixed clover and timothy and, for part of the experiment, of alfalfa hay fed at the rate of 1½ pound per lamb per day. The succulent roughage throughout the period consisted of corn ensilage and pulped turnips equal parts, mixed, fed at the rate of from 4 to 7 pounds per lamb per day.

Grains.—The following indicates the method of division of the lambs for the experimental feeding period.

Lot I received a standard meal mixture composed of: oats, 2 parts; bran, 2 parts; oil cake, 1 part.

Lot II received one part of the above mentioned mixture with one part of complete ground elevator screenings.

Lot III received complete ground elevator screenings.

Lot IV received ground elevator screenings less the black seeds.

Lot V received ground black seeds.

Lot VI received ground black seeds, 2 parts; Caldwell's molasses meal, 2 parts.

Values of Feeds—

Standard meal mixture	1.4 cents per pound.
Complete pulverized screenings	$10.00 per ton.
Screenings less black seeds	12.00 "
Black seeds	4.00 "
Caldwell's molasses meal	34.50 "
Hay	7.00 "
Roots and ensilage	2.00 "

NOTE.—For weights, methods of weighing, preparatory feeding, plan of feeding, etc., see Annual Report for 1915, C.E.F., Ottawa.

SHEEP FEEDING EXPERIMENT No. I.—Elevator Screenings for Fattening Lambs.

LOT.	1	2	3	4	5	6
Feeds.	Meal.	Meal and Screenings.	Screenings.	Screenings less Black Seeds.	Black Seeds.	Black Seeds and Molasses Meal.
Number of animals in each group.....	21	20	20	20	20	20
First weight, gross..... lb.	1,602	1,677	1,485·5	1,468·5	1,741·5	1,492
First weight, average..... "	76·3	83·9	74·3	73·4	87	74·6
Finished weight, gross..... "	2,014	2,120	1,770	1,879	2,083	1,747
Finished weight, average..... "	95·9	106	88·5	93·9	104·1	87·3
Number of days in experiment....No.	70	70	70	70	70	70
Total gain for period..... lb.	412	443	284·5	410·5	341·5	255
Average gain per animal..... "	19·6	22·1	14·2	20·5	17·1	12·7
Average daily gain for group..... "	5·8	6·3	4·0	5·8	4·8	3·6
Average daily gain per animal.... "	·28	·31	·2	·29	·24	·18
Quantity meal eaten by group for period..... "	1,442	1,383	892	1,298	650	1,383
Quantity hay eaten by group for period..... "	2,205	2,100	2,100	2,100	2,100	2,100
Quantity roots and ensilage eaten by group for period..... "	8,416	7,980	7,140	5,900	7,690	7,030
Total cost of feed..... $	36.31	27.46	19.95	22.27	16.34	27.51
Cost of feed per head..... $	1.72	1.37	0.99	1.11	0.81	1.37
Cost of feed per head per day..... $	0.024	0.019	0.014	0.016	0.011	0.019
Cost to produce 1 pound gain..... $	0.088	0.062	0.07	0.054	0.048	0.108
Original cost of animals $7.40 per cwt..... $	118.54	124.09	109.92	108.66	128.87	110.40
Original cost plus cost of feed..... $	154.85	151.55	129.87	130.93	145.21	137.91
Selling price at $8.25 per cwt..... $	166.15	174.90	146.02	155.01	171.84	144.12
Net profit per group..... $	11.30	23.25	16.15	24.08	26.63	6.21
Net profit per animal..... $	0.54	1.16	0.80	1.20	1.33	0.31

Palatability of Rations.—As to the palatability, or, from the lamb's point of view, the desirability, of the meal ration, Lot I, of course, consumed their meal, in whatever quantity fed, from the start.

With the exception of a few pounds removed during the first few days, the same might be said of Lot II, receiving equal portions of the standard meal mixture and pulverized screenings

With Lot III, receiving elevator screenings, during the first twelve days practically the entire meal ration was removed daily, and from then on in lesser quantities, until at the end of four weeks all was being consumed. That this was done more or less under protest, however, was shown by the lambs after eating the ration for about a week, refusing from one-third to one-sixth of it daily throughout the remainder of the experiment.

Lot IV, fed pulverized screenings with black seeds removed, after the first two weeks consumed their meal cleanly throughout the experiment, apparently with relish, showing the unpalatable character of the black seeds fed Lot III.

Lot V, fed pulverized black seeds, refused their ration almost entirely for five weeks, and at the conclusion of the experiment were consuming about half the quantity fed, which portion disappeared only after very apparent effort and dislike.

Lot VI, on equal portions of pulverized black seeds and molasses meal, consumed their ration cleanly from the start, showing a strong liking for it, the molasses mea apparently quite effectually neutralizing the undesirable flavour and nature of the black seeds

Texture of Pulverized Screenings.—The nature of this by-product, aside from flavour, in all its grades, was such as to render it unpalatable to sheep, the screenings being so finely pulverized as to be of a dust-like consistency. This fine pulverization was necessary to guard against possible spread of noxious weed seeds. No toxic effect was noticed from the use of the by-product in any of its grades, in fact the health of the lambs was excellent throughout, barring, of course, a few isolated cases of scours, not necessarily due to the nature of the ration, and easily controlled by simple remedies.

Deductions from Experiment No. 1.—A comparison from the standpoint of greatest gains gives the following result:—

First.—Lot II—(Screenings; standard meal;—equal parts.)
Second.—Lot I—(Standard meal.)
Third.—Lot IV—(Screenings, black seeds removed.)
Fourth.—Lot V—(Black seeds.)
Fifth.—Lot III—(Pulverized screenings complete.)
Sixth.—Lot VI—(Black seeds; molasses meal;—equal parts.)

The order of lots as to cheapness to produce 1 pound gain is as follows—

First.—Lot V—(Black seeds.)
Second.—Lot IV—(Screenings, black seeds removed.)
Third.—Lot II—(Standard meal; screenings;—equal parts.)
Fourth.—Lot III—(Complete pulverized screenings.)
Fifth.—Lot VI—(Black seeds; molasses meal;—equal parts.)
Sixth.—Lot I—(Standard meal)

First.—Comparing standard meal, Lot I, with Lot II, it is seen that with the valuation of other feeds in this mixture, 691 pounds of complete elevator *screenings* has a value equal to 851 pounds meal, 259 pounds hay, and 1025 pounds roots, or: *$39 per ton.*

Second.—Comparing Lot I and Lot III, it is seen that 1,442 pounds standard meal equal 1,248 pounds *screenings,* 735 pounds hay, and 1500 pounds roots, at valuation of *$26 per ton.*

Third.—Comparing Lot I and Lot IV, it is seen that 1,298 pounds *screenings, black seeds removed,* is equivalent to 1,442 pounds meal; 105 pounds hay, and 2516 pounds roots, or *$36 per ton.*

NOTE.—From these deductions where *complete screenings are* shown to be worth $26 and *screenings, black seeds removed,* worth $36, the value of the removal of black seeds is apparent.

Fourth.—Comparing Lots III and IV it is seen that 1,298 pounds screenings with black seeds removed is equivalent to 1,248 pounds

screenings, 750 pounds hay, and 4,096 pounds roots. The advisability of the removal of black seeds from the total screenings is again evident.

Similar deductions with Lots V and VI are practically impossible. As has been pointed out, the *effect of black seeds*, whether fed pure or mixed with other meals, *is detrimental.* In the case of Lot V, the small quantity eaten was certainly a detriment, the gains being due to the ensilage roots, and roughage ration. Similarly with Lot VI the gains may be attributed to the roughage and molasses meal. In both instances the elimination of black seeds from the ration would have, in all likelihood, resulted in increased gains. Comparing Lots V and VI it is seen that the greater amount of black seeds consumed the lower the gains, and the greater the cost of gains.

The results once more point to *the advisability of the separation of black seeds* from the screenings and to the undoubted value of the screenings with black seeds removed, for sheep feeding work.

Finishing Period (*Experiment II*).—At the close of the regular experiment a finishing period was begun in which all the lots received the same meal mixture:—oats, 2 parts; bran, 2 parts; oil cake, 1 part.

SHEEP FEEDING EXPERIMENT No. II.—Finishing Lambs for Market.

Lot.		1	2	3	4	5	6
Feed Given.		All Lots received Regular Meal Ration.					
Number of animals in each group.	No.	21	20	20	20	20	20
First weight, gross.....	lb.	2032	2160	1740	1860	2062	1725
First weight, average.....	"	97	108	87	93	103	86
Finished weight, gross.....	"	2369	2370	2108	2190	2536	2124
Finished weight, average.....	"	113	118	105	109	127	106
Number of days in experiment....	No.	55	55	55	55	55	55
Total gain for period.....	lb.	337	210	368	330	474	399
Average gain per animal.....	"	16	10·5	18	16·5	23·5	19·9
Average daily gain for group.....	"	6	3·8	6·7	6·6	8·6	7·2
Average daily gain per animal....	"	·28	·19	·33	·33	·43	·36
Quantity meal eaten by group for period.....	"	1444	1305	1305	1305	1305	1305
Quantity hay eaten by group for period.....	"	1733	1650	1650	1650	1650	1650
Quantity roots and ensilage eaten by group for period.....	"	5500	4400	4400	4400	4400	4400
Total cost of feed.....	$	31.77	28.44	28.44	28.44	28.44	28.44
Cost of feed per head.....	$	1.51	1.42	1.42	1.42	1.42	1.42
Cost of feed per head per day.....	$	0.027	0.026	0.026	0.026	0.026	0.026
Cost to produce 1 pound gain.....	$	0.094	0.135	0.077	0.086	0.06	0.071
Original cost of animals $7.75 per hundredweight.....	$	157.48	167.40	134.85	144.15	159.80	133.68
Original cost plus cost of feed.....	$	189.25	195.84	163.29	172.59	188.24	162.12
Selling price at $8.50 per hundredweight.....	$	201.36	201.45	179.18	186.15	215.56	180.54
Net profit per group.....	$	12.11	5.61	15.89	13.56	27.32	18.42
Net profit per animal.....	$	0.57	0.28	0.79	0.67	1.36	0.92

Deductions from Experiment No. II.—In reviewing the results of this experiment the deductions afforded by Experiment I should be remembered. The order of the lots from standpoint of total gains is as follows:—

First.—Lot V—(Black Seeds.)
Second.—Lot VI—(Black seeds; molasses meal;—equal parts.)
Third.—Lots III—(Complete screenings.)
Fourth.—Lot I—(Standard ration.)
Fifth.—Lot IV—(Screenings, black seeds removed.)
Sixth.—Lot II—(Screenings; regular meal; equal parts.)

Lots V, VI, and III, receiving black seeds in Experiment No. I in various percentages, apparently reached their limit of production on a roughage diet supplemented by inferior meal, and in consequence, were able to show marked gains on a superior ration. The lambs of Lot I having grown and improved in condition generally, during the regular experiment, were also in a position to make fair gains during the finishing period, while the lambs in Lots IV and II which had received the most desirable screenings rations previously, now stand fifth and sixth respectively.

This period, therefore, while primarily intended to give a uniform finish to the lambs, further bears witness to the fact that the lambs fed black seeds were held back during the experiment, as evidenced by their very rapid comparative gains during the finishing period. In spite of the fact that many of the lambs during Experiment No. I were fed meal rations known to be unpalatable, and probably actually harmful, yet, due to the finishing period, these lambs in April sold for top price on the Toronto market.

SUMMARY OF FEEDING EXPERIMENTS.

Black seeds.—1. In all experiments the black seeds were pulverized finely. This was a costly operation and may have detracted from the acceptableness for sheep, but was absolutely necessary to prevent the distribution of weeds through the manure. Any possible food value of black seeds is overcome by the cost of grinding.

2. Black seeds for sheep are very unpalatable whether fed alone or in the complete screenings.

3. Black seeds, however fed, are detrimental. When made palatable with an addition of molasses it is clearly proven that the greater the quantities consumed, the less gain and profits result.

4. Black seeds for swine are very unpalatable, however fed. In all experiments they showed little or no food value and often detracted from the value of the other constituents in the ration. Palatability is the secret of pig feeding, and black seeds will spoil a tasty ration.

5. Black seeds for dairy cows are very unpalatable whether fed alone or in the complete screenings. When compelled to eat a small quantity, the cows fall off in milk. It is safe to say that cows will produce more on two-thirds of their regular meal than when they receive the full quantity of meal, composed of one-third black seeds.

Screenings complete.—1. In the above experiments complete finely ground screenings were, to all classes of stock, somewhat unpalatable due to black seeds. It required several weeks for animals to overcome their dislike of these seeds.

2. Complete screenings proved a very valuable meal, but best when comprising only a part of the total meal ration.

3. Complete screenings for lambs in the above experiment, when compared with grains and roughages at market values, have a value of $39 per ton when comprising 50 per cent of the grain ration and $26 per ton when comprising the total grain ration.

4. Mr. W. H. Fairfield, Superintendent, Experimental Station, Lethbridge, Alta., reports screenings of about equal analysis to be worth in lamb feeding from $10 to $35 per ton depending on methods of feeding and values of other foodstuffs. Readers are referred to his annual reports for the years 1912, 1913, and 1914.

5. Complete screenings for swine give fair returns. When mixed with feed flour (Oglivie's "Noxol") in proportions of 3 to 1, the mixture is worth $18.40 per ton. Had the black seeds been removed this feed would undoubtedly have increased $10 per ton in value.

6. Complete screenings for dairy cattle were somewhat unpalatable due to black seeds. When composing 20 per cent of the grain ration, the screenings acquired a value of $34 per ton. The addition of molasses makes the ration palatable but detracts from the food value, making the mixture of screenings and molasses meal worth only $25 per ton. This is clear evidence that the most economical way of making screenings more palatable is not to add other constituents but to remove the black seeds.

Screenings, black seeds removed.—1. In the above lamb feeding experiment it is clearly proven that screenings with black seeds removed are worth $10 more per ton than the complete screenings. The increased palatability alone would account for most of this difference.

Undoubtedly this would apply equally well to the feeding of screenings to other classes of stock.

Buckwheat screenings.—In the feeding of young pigs buckwheat screenings is a valuable meal, worth in the above test $27.60 per ton.

This feed would undoubtedly have proportionate value in feeding sheep and cattle.

POULTRY.

During the winter of 1913, the Poultry Division, Central Experimental Farm, conducted experiments on the feeding value of the following material supplied by the Seed Branch: (1) complete screenings, (2) scalpings, (3) black seeds, (4) wild buckwheat (*Polygonum convolvulus* L.), (5) lamb's quarters (*Chenopodium album* L.), (6) wild mustard (*Brassica arvensis* (L) Ktze), (7) tumbling mustard (*Sisymbrium altissimum* L.). The last four weed seeds were obtained practically pure for this work.

The Complete List of Rations.—In case some of the above would be improved by feeding as a part rather than as the whole ration, each was fed alone and also as a mixture, using as part of the mixture a mash composed of equal parts corn meal and finely ground oats. Wherever the mixture was used the ration was one part of the original feed and one part of the mash. Nos. 9 and 10 were exceptions to this for it was found impossible to grind the wild mustard alone, so corn was added half and half to the original feed. Rations Nos. 17 and 18 were duplicates and composed entirely of the mash above referred to. With two exceptions the feed was finely ground and in all cases mixed with skim-milk or buttermilk. The two exceptions were rations Nos. 7 and 8. In these the seeds were boiled instead of ground. This was done to see if boiling would add to the palatability, and the indications were that it did to a very slight degree. The eighteen rations as arranged were:

Ration No. 1—Scalpings.
" " 2—Scalpings and mash.
" " 3—Screenings.
" " 4—Screenings and mash.
" " 5—Black seeds.
" " 6—Black seeds and mash.
" " 7—Black seeds boiled.
" " 8—Black seeds and mash boiled.
" " 9—Wild mustard and corn.
" " 10—Wild mustard, corn and mash.
" " 11—Tumbling mustard.
" " 12—Tumbling mustard and mash.
" " 13—Wild buckwheat.
" " 14—Wild buckwheat and mash.
" " 15—Lamb's quarters.
" " 16—Lamb's quarters and mash.
" " 17—Mash.
" " 18—Mash.

The Birds.—Seventy-two birds were used for this experiment. They were healthy and vigorous cockerels from 6 to 8 months old, divided as nearly as possible according to weight and breed, and weighed at the beginning and at the end of the period.

The Feeding.—The feeding was done in crates, four birds to a compartment, and each compartment was separated so that the feed intended for one lot could not be taken by any of the other birds. The birds were all fed five days on a mash of equal parts corn meal and finely ground oats, mixed with buttermilk. This was to get them used to confinement, after which they were given their experimental rations.

They were fed twice a day and, after taking all they would eat, that which remained in the trough was scraped out clean. Where the birds would not take to the mash at first, they were left for two or three days to see if they would eat, but on the rations that contained black seeds they would have starved to death rather than eat the feed.

When a bird refused for two or three days, the crammer was then used once or twice a day as thought best.

Wild Buckwheat the most palatable.—The most palatable ration of the eighteen was No. 13, composed of wild buckwheat entirely. This was followed very closely by No. 14, which had wild buckwheat two parts, corn meal one part, and finely ground oats one part. Then came Nos. 17 and 18. The next most palatable rations were the scalpings. Scalpings two parts, with one part cornmeal and one part oats, was slightly more palatable than the ration that was composed of scalpings alone.

This would indicate very clearly that poultry is very fond of wild buckwheat, and the fact that Nos. 17 and 18 were more palatable than Nos. 1 and 2 does not put the scalpings very far behind, as Nos. 17 and 18, composed as they were of corn and finely ground oats, is one of the most palatable rations that has been known for crate feeding poultry.

Black seeds no good at any price.—Wherever either of the mustards or lamb's quarters was present in the mixture the birds practically refused the food, and even when they were forced to take it by the use of the crammer they disliked the food so much that they lost flesh as long as the operation was continued. The results therefore clearly indicate that any ration including black seeds should not be fed, and though it is sometimes recommended to mix mustard with poultry feeds, it might be well to note that the use of commercial mustard when fed in moderation is not as objectionable as this wild mustard proved to be in this feeding experiment.

Pounds of Feed required to make one pound of gain.—From the standpoint of relative gains, that is, the amount of feed required to make one pound of gain in flesh, No. 14 was first, requiring 3·4 pounds of the ration for one pound of grain; then came No. 13 with 3·9 pounds, followed by Nos. 17 and 18 with 4·2 pounds and No. 1 with 4·7 pounds. In connection with these figures, note that the cost of milk is not included.

The quality of flesh good.—The quality of the flesh produced from the wild buckwheat seemed to be just as good as that produced from the ordinary mash, Nos. 17 and 18, and it would appear from this that the wild buckwheat might become a most valuable food for crate feeding poultry. The poultry thus fattened should be of a superior quality and would bring a high price when sold.

A Solution Suggested.

In looking for a solution of the screening problem it must be remembered that practically all grain is received at the terminal elevators uncleaned; that is, just as it comes from the threshing machine. Relatively few of the interior elevators, except those operated by farmers' co-operative organizations, have cleaning machinery and even where such facilities are available, the cleaning of grain hauled direct from the machine is impossible during the rush

season owing to the necessity of changing sieves for each different kind and lot of grain received. Where wheat, oats, barley, and flax are being hauled to an elevator at the same time by several different farmers it is quite impracticable to change the sieves in the cleaner for each load. Farmers who can store their grain until after the busy season can usually arrange to have a cleaner fitted up specially for their grain and then haul all they have and clean and load it before it is necessary to change or rearrange the sieves.

That threshing machines as at present operated do not clean grain satisfactorily is shown by the fact that nearly every carload received at the terminals must be cleaned. If the grain could be cleaned by the thresher it would effect an enormous saving to the growers of the West.

About 60 per cent of the screenings occurring in the grain produced could be used to advantage on the farm or sold for the feeding of live stock. Even if they were not used for feeding, but were burned on the farm, it would pay the producer to do this rather than be put to the expense of handling and freighting them.

It is believed that a cleaner of simple design and of comparatively small cost of construction and operation could and should be used on every threshing machine to remove the screenings which, otherwise, are not removed until the grain is taken into the terminal elevator. Such a cleaner could be placed on top of the machine and the grain passed through it after being weighed and elevated.

The thresherman is entitled to payment for every bushel he threshes whether it is grain or weed seeds, and by the above arrangement he would get credit for every pound of material threshed. Cleaning the grain in this way would of course increase the cost of threshing, but even then an enormous benefit would result to the farmer, not only by a great reduction in the expense of handling and transportation, but also through its value as a feed for livestock.

The idea of operating an efficient cleaner as an attachment to a grain thresher is not new. Cleaners are employed on threshers in the Argentine Republic and Chili which receive machines from the same American and Canadian firms as supply the prairie provinces. But the manufacturers of these machines seem to have the impression that the Canadian grain grower believes there is no advantage in having his grain cleaned in threshing, and consequently does not want even the ordinary cleaning screens supplied with the machines to be used for this purpose. In the opinion of the manufacturers, threshing machines as at present constructed might be operated to remove much of the screenings now left in the grain.

OPINIONS OF THRESHER MANUFACTURERS.

The president of the National Association of Thresher Manufacturers of the United States says:—

> "The manufacturers of threshing machinery in both the States and Canada are perfectly willing to furnish with each machine a cheat or dirt screen, and with proper use of the same the operators of threshing machinery can take the most

of the shrunken grain, dirt and weed seeds out, so that the grain can be delivered to the farmer practically clean; not perhaps to the extent that a specially built fanning mill would, but sufficiently clean so that the crops of the country and the land can ultimately be practically cleared of those foul growths by the farmer exercising reasonable care to prevent these seeds from getting back into the soil. And if farmers would insist upon thershermen so cleaning their grain they would aid very materially in accomplishing just what your Department desires.

"This is accomplished simply by permitting the threshed grain before being delivered from the machine to pass over a sieve of proper mesh for the removal of these foreign items."

This opinion is supported by similar statements from practically all of the manufacturers of the threshing machines in common use in Western Canada. A few of these statements follow:—

1. "As a matter of fact under normal conditions the modern threshing machine, if properly handled, is capable of cleaning grain very well without having a special cleaning attachment, but this requires skill and care in the adjustment of the sieves and the fans and not crowding the separator to its fullest capacity, which the average thresher does not like to do, neither does the farmer because he wants the thresher to finish his job and get off the premises at the earliest possible moment."

2. "We have for some years been doing just what you asked for in supplying an attachment to our separators, which are shipped to the Argentine Republic, where I understand they have no elevators in which to clean the grain, but it is taken direct from the fields to the railways in bags and subsequently delivered on board vessels at the ports of shipment to Europe."

3. "The machines as constructed at present can clean the grain if they really have to, it consists of the way they are operated."

4. "We are aware of this and have been furnishing our machines with a screen in the bottom of the shoes of the separators where the grain travels over and the bulk of the seed is separated from the grain and comes out by itself."

5. "All the threshing machines that we make are fitted with a screen for taking the weed seeds out of the grain. In a number of cases we have found that the threshers have closed up this screen and are not using it. The screen consists of a $\frac{3}{32}$ inch perforated piece of zinc and will take out virtually all weed seeds that will pass through this size perforation. A larger perforation than this would allow small grains of wheat to go through. The machines are arranged to close off this screen when threshing flax, as a considerable amount of the small flaxseed will pass through this perforation."

Conclusions.

THE GRAIN GROWER.

On a car of 1,200 bushels of wheat, carrying 3 per cent dockage, the grower loses 36 bushels as screenings, 60 per cent of which is valuable feed worth at least $25 per ton, when bran sells at $28. This means a loss of $16.20 in feed. Transport charges on 36 bushels from the average Saskatchewan farm to the lake front amount to $7.02, making a total loss of $23.22 on the car. Much of this loss can be avoided if the farmer will insist that the thresher operate his separator so as to clean the grain more thoroughly at threshing time. When the grain is very dirty, more attention must be given to its cleaning, which may mean slightly slower threshing, but this will pay the grower because the dirtier the grain is left the greater will be his loss. The thresherman would of course be entitled to some consideration on account of a slower rate of threshing and for the screenings separated. A grower who owns a threshing machine should fit it with a set of sieves that will make it possible for him to clean his grain more efficiently as he threshes it.

The finer weed seeds (black seeds) in screenings should be separated from the rest and burned. They decrease the feeding value of the larger and valuable portion, and are a dangerous source of weed contamination. An ordinary grinder will leave thousands of vital weed seeds in every pound of feed made from screenings containing fine seeds. See page 12. Black seeds have considerable value as fuel and will burn readily on account of the high oil content of lamb's quarters and mustard seeds which make up the larger part of these seeds.

Screenings after being carefully cleaned over a $\frac{1}{14}$ inch perforated zinc screen to remove the fine seeds make a valuable feed for any kind of stock. They may be fed to sheep unground if care is taken to prevent the spread of weeds. For hogs they may be ground or fed whole if soaked or boiled. They had better be ground for horses or cattle. They are a very valuable poultry feed.

THE THRESHERMAN.

In threshing the 1912 crop, enough weed seeds, small, broken, and immature kernels and dirt was left in the grain to require a dockage of over 100,000 tons.

Nine manufacturers of threshing machinery, including practically all machines in use in Western Canada, state very definitely that their machines are or may be fitted with screens and operated to separate most of this material.

To do efficient work in cleaning grain, threshing machines should not be crowded beyond their proper capacity. Many farmers are not convinced of the economy of having their threshing done carefully enough to leave their grain clean. When, however, a customer is willing to pay a fair price for cleaning it more thoroughly

than is ordinarily done, the thresherman should be in a position to give good service. Threshing machine manufacturers are ready to do what they can to lessen the waste entailed in shipping dirty grain. The black seeds (those that will come through a one-fourteenth inch perforated zinc screen) have considerable value as fuel and where coal is used they can be burned to advantage.

THE MILLER.

Perhaps no one interested in the grain business would be more pleased to see only clean grain marketed than the miller. To him weed seeds and other impurities are a nuisance whose separation adds considerable to the cost of milling. To clean the weed seeds from wheat as thoroughly as is essential in flour milling, involves the separation of more good grain than does cleaning in elevators, and mill screenings consequently contain a much higher percentage of wheat than do elevator screenings.

If he grinds his screenings fine enough to destroy the vitality of all the noxious weed seeds, the miller is within his legal rights in mixing this pulverized material with his by-products, provided that such admixture does not alter their chemical composition to such an extent that they no longer comply with the requirements of the Feeding Stuffs Act. As pointed out on page 12, elevator screenings containing the finer black seeds cannot be properly ground by an ordinary chopper but require special machinery expensive in itself and costly to operate. Where such machinery is not installed, it is necessary to reclean the screenings over a one-fourteenth inch perforated zinc screen before grinding. It is not difficult then to destroy the vitality of all seeds in the recleaned screenings. Experiments indicate that the increase in the feeding value due to the separation and discarding of the black seeds is sufficient to pay the cost of their separation.

The Dominion and Provincial Departments of Agriculture receive each year many complaints of the death or serious injury to the health of animals which the owners of the stock attribute to the feeding of bran, shorts and chop-feeds. Analysis often reveals the presence of certain ground and unground weed seeds, sometimes in considerable quantities. While nothing in our experiments indicates that the screenings fed were poisonous or injurious in any way, it must be remembered that the material used in the experiments represented as accurately as possible the average run of elevator screenings. It is quite probable that some of the comparatively rare seeds have toxic properties, and screenings from individual cars of grain containing considerable quantities of them may have injurious effects, because of indigestible or poisonous qualities.

In the manufacture of feeding stuffs by the blending of by-products in the large flour mills, the practice of mixing pulverized black seeds with other materials can scarcely be said to be in the best interests of the feeder, and millers should give serious consideration as to whether or not it is in their own best interests. It is also

to the millers' interests to help restrict the dissemination of noxious weed seeds, and they should remember this when they stop to consider whether it pays to include all of the weed seeds in their by-products. Their voluntary action, looking to the best interests of all concerned in this whole problem, is more to be desired than the making and securing the observance of regulations that might be devised to this end.

THE FEED MANUFACTURER.

All grain screenings and milling by-products of good feeding value should be utilized in the livestock industry. The proper use of screenings would add much to the quantity, quality and value of the feeding stuffs made available in all the provinces.

It is believed that the most economical and best solution of the problem is to separate the screenings so far as practicable on the farm where they are produced. The recleaning of grain at terminal elevators and flour mills will, however, continue to yield large quantities of screenings. It is the opportunity of manufacturers of feeding stuffs to make use of this material in supplying the demands of the feeder.

During recent years the great bulk of the screenings that have accumulated at the terminal elevators have been sold for export at prices much below their actual value as compared with other feeding stuffs, largely because feed manufacturers in Canada had not in their possession information as to proper methods for handling them in a way to give satisfactory results to the feeder

Unfortunately the blending and manufacture of ground feeding stuffs leave some opportunity for unscrupulous practices on the part of the few who may be disposed to adopt them, not only to their own but to the disadvantage of reliable competitors. The extreme difficulty and cost of destroying the vitality of the black seeds may serve to discourage their use in the preparation of ground feeding stuffs that are required to comply with the grain products standards.

It need scarcely be added that the livestock industry may be best served by feed manufacturers whose wholesome regard for their own best interests may lead them to provide for the various purposes of feeding, material that is at once wholesome, nutritious and free from vital seeds of dangerous weeds, at a cost that will enable the feeder to sell his final products in competition with those from other districts or countries. It is believed that the valuable portion of the screenings from Canadian grain, which has heretofor been largely lost to Canadian feeders, may be used to good advantage as shown by the results of feeding experiments.

THE STOCKMAN.

Buying Screenings.—In purchasing screenings or any meals such as patent meals; mill feeds, such as middlings, shorts and bran;

or any similar stock feed, do not buy any having black seeds contained therein . Black seeds are useless as feed, expensive as adulterants, and dangerous in spreading weeds.

Screenings vary widely in composition. Before buying send samples to the seed laboratory for analysis.

Feeding Screenings.—If the black seeds are not removed from the screenings, it pays to screen them out.

Screenings free from black seeds may be fed freely to all classes of live stock. However, it is more profitable to have such screenings compose not more than 50 to 60 per cent of the total grain ration. Use such screenings as the basis, and add other coarse grains or meals to make the grain ration suitable for the kind of stock being fed.

If fed whole, screenings with black seeds removed may be used to best advantage for sheep and horses. For swine it pays to either grind or soak for twenty-four hours to increase the digestibility. For cattle they should be ground and mixed with other grains, which mixture may be fed with cut roughage or separately as desired.

If possible to screen out the flax and wild buckwheat these are very valuable as the basis of a good home-made calf meal. With the addition of oat and blood meals, such a pulverized mixture makes an excellent milk substitute.

There appears to be danger in feeding flaxseed screenings.

Summary.

The dockage set on the wheat, oats, barley, and flax received at the terminal elevators at Fort William and Port Arthur for the year ending August 31, 1913, amounted to over 100,000 tons.

Transport charges on this quantity of material from the grain fields of the west to the lake front are estimated at $650,000.

The material removed from grain at terminal elevators consists of shrunken and broken kernels of wheat, oats, barley and flax, besides varying proportions of a very large number of weed seeds.

Up to the present, most of the screenings from our terminal elevators have been exported to the United States, where they have been recleaned and used in various forms in feeding livestock.

On account of the extremely small size of some, and the hard, flinty seed-coats of others, the complete pulverization of all of the weed seeds in screenings cannot be accomplished by an ordinary chopper. Special machinery, expensive in itself and costly to operate, is necessary for the proper grinding of the entire screenings.

Screenings recleaned over a one-fourteenth inch perforated zinc screen to remove the finer weed seeds (black seeds) may be satisfactorily ground by ordinary choppers, if reasonable care is taken in the separation and grinding. Recleaning in this way will remove about 40 per cent from ordinary elevator screenings.

Feeding stuffs manufactured from screenings, not properly recleaned, sometimes contain thousands of vital noxious weed seeds per pound. Such material should never be fed as it is liable to introduce weeds that will entail the loss of thousands of dollars.

Feeding experiments have proven that the black seeds are useless as feed and expensive as adulterants. Their admixture in any considerable quantity to other feed makes it unpalatable for all kinds of stock. The addition of molasses to ground screenings containing the black seeds, makes the feed palatable, but not economical. The most economical way of making screenings palatable is to remove the black seeds.

Screenings without the black seeds, may be fed freely to horses, cattle, sheep or swine, but it is more profitable to have such screenings compose not more than 50 to 60 per cent of the total grain ration. Buckwheat screenings are especially valuable as poultry feed.

The manufacturers of threshing machinery are unanimous in stating that their machines are or may be fitted with screens and operated to separate a large part of the screenings at the time of threshing.

More attention to the cleaning of grain as it is threshed will save the cost of transporting the screenings to the terminal elevators, and will leave the grower in possession of much valuable feed which, if he does not need for his own use, will find ready sale among livestockmen.

The growth of weeds entails an enormous loss each year to farmers, and while it is desirable to utilize everything in grain screenings of good feeding value, it would be better to burn them than to permit their use in ways that will bring about any increase in the number or distribution of noxious weeds.