BULLETIN No. 116. MARCH, 1907.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

THE SAN JOSÉ SCALE

AND

EXPERIMENTS FOR ITS CONTROL

BY

H. T. FERNALD, PH. D.

An account of the life history of the San José Scale; the injuries it causes; treatments for it; experiments for its control including chemical and practical studies of the lime-sulfur wash; a summary of experimental work in the United States; and full directions for making and applying the lime-sulfur wash.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

CHARLES A. GOESSMANN, PH. D., LL. D.,	*Honorary Director and Chemist* (Fertilizers).
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
JOSEPH B. LINDSEY, PH. D.,	*Chemist* (Foods and Feeding).
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. S.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian*
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
NEIL F. MONAHAN, B. SC.,	*Assistant Botanist.*
HENRI D. HASKINS, B. SC.,	*First Assis't Chemist* (Fertilizers).
EDWARD G. PROULX, B. SC.,	*Second Assis't Chemist* (Fertilizers).
E. THORNDIKE LADD, B. SC.,	*Third Assis't Chemist* (Fertilizers).
EDWARD B. HOLLAND, M. S.,	*First Chemist* (Foods and Feeding).
PHILIP H. SMITH, B. SC.,	*Ass't Chemist* (Foods and Feeding).
LEWELL S. WALKER, B. SC.,	*Ass't Chemist* (Foods and Feeding).
WILLIAM K. HEPBURN,	*Inspector* (Foods and Feeding).
ROY F. GASKILL,	*Assistant in Foods and Feeding.*
CHARLES P. HALLIGAN, B. SC.,	*Assistant Horticulturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist*
T. A. BARRY,	*Observer.*

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

DIVISION OF ENTOMOLOGY.

The San José Scale and Experiments for its Control.

By H. T. FERNALD.

It is probable that all the towns in Massachusetts east of the Connecticut River, and many of those west are infested more or less with the San José Scale. First discovered in the State about 1892, it has become widely distributed since that time and has now increased to such an extent as to be one of our most serious pests. Indeed, in the opinion of many persons, it is even more dangerous than the Gypsy and Brown-tail Moths, for though it actually destroys fewer kinds of plants than the Gypsy Moth it is so small that its presence is rarely noted till the work of destruction is well-nigh completed. Its method of feeding, too, is such, taken in connection with its size, as to render successful treatment extremely difficult, and the rapidity with which it increases in numbers is often sufficient to cause the destruction of a tree in a single season.

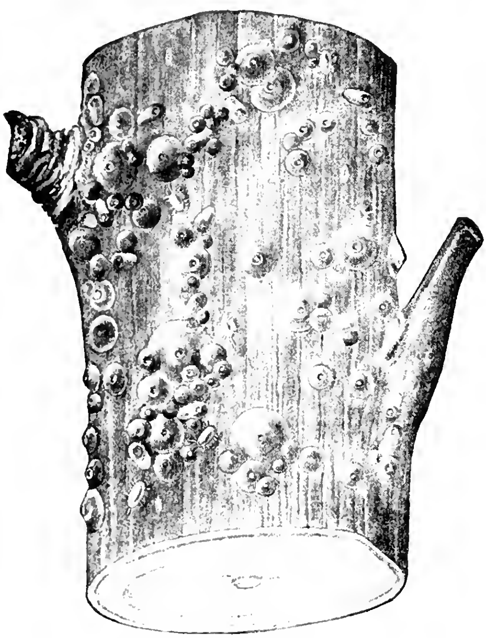
Calls for information as to the appearance, life history and habits of this pest and the best methods for its control, at the present time form quite a large part of the correspondence of the Division of Entomology of this Station, and this bulletin has been prepared to answer these calls, and also to give the results of such experimental studies on control as have thus far been made here.

HISTORY.

The San José Scale is apparently a native of China, where it seems to be held more or less in check by a tiny lady bird or lady bug, *Chilocorus similis*, which feeds upon it. How it reached this country is not known but it was discovered in the San José Valley in

California about 1879 and was named *Aspidiotus perniciosus* by Prof. J. H. Comstock who wrote at that time of it:—"I think that it is the most pernicious scale insect known in this country." A few years later it was discovered in two New Jersey nurseries which had been sending out large quantities of stock, and on this stock it was undoubtedly distributed to nearly all parts of the United States. At first it seemed probable that it would not live or at least become a serious pest in the more northern states on account of the colder climate there, but it appears to have gradually become more hardy, and is now able to thrive in all parts of Massachusetts to a most unfortunate degree.

LIFE HISTORY AND APPEARANCE.



Different stages of the San José Scale enlarged five times (From Va. State Crop Pest Commission Bulletin, 1904.)

The full grown San José Scale is about the size of a pin head, quite flat, round (circular) in outline, and varying in color, but usually grayish brown. It lies closely against the bark, leaves or fruit and the part seen is not really the insect itself but the shell or scale which covers it. If this scale be lifted with a pin a very small, orange-yellow speck will be found beneath it, and this is the scale insect.

When winter sets in, the insects are present in all stages of growth from those just born to those which are full grown and are themselves producing young. The winter, however, kills all except those which are from about one-half to two-thirds grown, so that no living adults can usually be found in early spring.

So far as is known these insects undergo no changes during the winter, but when the sap begins to flow freely in the spring the young scales which survive resume their feeding on the sap which was interrupted by the cold weather and complete their growth, becoming adult in June. Reproduction then begins, the young being born alive, and this continues for about six weeks, each female producing an average of about 400 young. The young insects are very small, and after their birth, crawl out from beneath the scale where they were born and move about, seeking a place on which to settle. This takes rather more than a day, on an average, and during this time these tiny, yellow, crawling young may be seen wandering about. On finding a good location they become quiet and each works its long beak through the bark, (or surface of the leaf or fruit as the case may be,) to where the sap of the tree can be obtained and the insect sucks this sap for its food. Its legs now disappear, its body becomes hemispherical, and white, waxy threads appear over its back. These mat together to form a white covering or scale, and such young, recently formed scales are often very noticeable. Later as the insect grows it molts or sheds its skin and the molted skin is added to the scale which because of this and by weathering becomes darker, grayish or even blackish, often showing rings of lighter and darker color. The center of the scale is the highest point and around this is a circular depressed ring. If the insect beneath the scale is a female the scale will remain nearly circular in outline; if a male, the scale is more oval or elongated in form. In a little more than a month from the time of its birth the insect becomes adult and in turn begins to produce young, the first ones appearing at about the same time as the last ones of the preceding generation. These young develop in the same way as did their parents, thus giving a constant succession of young from the middle or end of June, in Massachusetts, till winter stops the process.

It is evident that the increase in numbers of this insect is very great: estimates on this point show that an average of 1,608,040,200 females would be produced from a single female in one season, with probably at least an equal number of males, a total starting from a single female of 3,216,080,400 individuals! This estimate makes no allowance for loss by accidental destruction, but this is undoubtedly very great and is probably the main reason why we yet have any fruit trees alive, and it is fortunate that winter kills so many of the scales.

FOOD PLANTS.

The San José Scale has been found on about 125 different kinds of trees, shrubs and vines. On many of these it will hardly more than exist and the chief danger in those cases is that such plants may serve as places from which to pass to others where it would be more destructive. Nearly all our fruit trees, however, are liable to destruction by this pest. It seems to cause the greatest injury in Massachusetts to the pear, plum, apple, peach, some varieties of cherry, and currant. Among ornamental shrubs and trees the Dogwoods, particularly the Red Osier, the Hawthorne and other thorns, the Japan Quince, poplars, ornamental cherries, plums and currants, roses, Mountain Ash, willows, the Hop tree and some kinds of Spiræa are often killed by it. This list includes almost all our fruit trees and more common ornamental shrubs and if to it we add those on which this pest will live and menace the more susceptible plants, it will be at once seen that the situation in Massachusetts is certainly a dangerous one. On fruit it produces unsightly discoloration, reducing its selling value. This condition was very noticeable on the fruit exhibits at fairs in the fall of 1906 and much of the fruit for sale in our markets shows the marks of the scale.

ENEMIES OF THE SCALE.

Several kinds of minute insects are parasitic on the scale, and a fungus lives upon it, but none of these appear to accomplish much in Massachusetts, the most effective foes here being a very small black beetle, *Microweisea misella* (Lec.), and a larger one, also black, but with two red spots on its back, these spots having given to the insect the name "Twice-Stabbed Lady Bug." These two beetles are active enemies of the scale but are not sufficiently abundant to hold it in check.

In its native country the San José Scale appears to be kept under control, as already stated, according to investigations made by the United States Department of Agriculture, by a lady bug very similar in appearance to our "Twice-Stabbed Lady Bug," and colonies of these insects have been brought to this country in the hope that they might accomplish similar results here. It is too soon to determine the success of this experiment, but thus far the results are not encouraging, particularly in the more northern states, like Massachusetts.

HOW THE SCALE SPREADS.

This insect moves from one place to another only while in the crawling stage. At this time it may be caught by a gust of wind and carried from one tree to another, or it may crawl onto the feet of some bird or insect which has alighted on the infested tree and crawl off at some later resting place, which of course may be near by or more distant. In general, however, the scale is first brought to any locality on infested nursery stock and from this spreads to the neighboring trees and shrubs in one or another of the ways already mentioned.

TREATMENT.

When a tree or plant is nearly dead, the best treatment is generally to cut it down at the roots and burn it. Possibly it could be saved by the proper treatment, but it would be several years before it would recover sufficiently to be of any value. For trees less infested many methods have been tried. These naturally fall into two classes,—fumigation and spraying.

FUMIGATION.

This in many regards is the most satisfactory method of treatment for infested trees. The poisonous gas penetrates where no spray could reach, and when properly managed kills all the scales. Unfortunately, it is not usually a practicable method in orchards and as a rule its use is limited to nursery stock. In order to fumigate successfully gas-tight tents must be used unless the trees are to be dug up; the chemicals must be of a definite strength, and the fumigation must be conducted by someone familiar with the process. The cost of tents large enough to cover orchard trees is usually prohibitive in Massachusetts.

SPRAYING.

The results of spraying for the San José scale made in 1902 at Amherst were given in Bulletin 86 of the Hatch Experiment Station, but as that bulletin is now out of print they are included here together with later work in the same line.

The first spraying was done between March 24th and April 5th, 1902. Six hundred and twelve trees were treated, the kinds being apple, pear, peach, plum, cherry, quince, apricot and nectarine. They ranged in size from nursery stock set the fall before to trees twenty feet or more high and spreading twenty-five feet.

Good's Caustic Potash Whale-oil Soap No. 3 at the rate of two pounds per gallon of water; Bowker's Tree Soap used at the same strength; Good's Caustic Potash Whale-oil Tobacco Soap at the same strength; Crude Petroleum mechanically emulsified with water, at percentages varying from 15% to 45%; Kerosene emulsified in the same way, at percentages varying from 18% to 38%; and Lime, Sulfur and Salt (lime 40 lbs., Sulfur 20 lbs.; Salt 15 lbs.; water to make 60 gallons) were the chief materials tested, though other things were tried to some extent. Of these the Lime, Sulfur and Salt Mixture gave the best results, followed by Bowker's Tree Soap. Crude Petroleum and Kerosene were quite satisfactory so far as killing the scale was concerned, but it has since been shown that after being sprayed with these oils a few times the trees are liable to be injured.

The Lime, Sulfur and Salt treatment gave such good results that it seemed well to experiment farther with it and study its properties. Accordingly a quantity of this substance was prepared and placed in the hands of Dr. Chas. Wellington of the Agricultural College, for qualitative and quantitative analysis, and to his kindness I am indebted for the following statement:

COMPOSITION OF THE LIME, SULFUR AND SALT WASH.

Substances.	Per cent. in Fresh Wash.	Per cent. after 12 hours.	Per cent. after 120 hours.
Calcium monosulfid and calcium hydrosulfid CaS and $Ca(SH)_2$.	25 to 30%		21 to 26%
Calcium polysulfids CaS_3, CaS_4, CaS_5.	3 to 5%		2 to 3%
Calcium hydrate $Ca(OH)_2$.	9%	8.5%	7%
Calcium carbonate $CaCO_3$.	1.8%	2.3%	2.8%
Calcium sulfite $CaSO_3$.	0%	1%	2%
Calcium thiosulfate CaS_2O_3.		0.5%	0.8%
Calcium sulfate $CaSO_4$.			0.2%

In addition a little Iron sulfid was found, probably coming from the kettle in which the wash was prepared. The salt used did not seem to enter into any of the combinations.

Consideration of the results given above showed that the Calcium hydrate, Calcium carbonate and Calcium sulfate could at once be ruled out as having no insecticidal value.

To test the action of the remaining materials separately was the next step and again through the kindness of Dr. Wellington these were obtained though, owing to insufficient facilities for their production, it was only possible to supply them in quantities of ten gallons each. They were applied as follows :

Substance.	Per cent. Strength.	Per cent. of Lime.
Calcium monosulfid. CaS.	6.92%	8.2%
Calcium hydrosulfid. $Ca(SH)_2$.	5%	8%
Calcium polysulfids. CaS_3, CaS_4, CaS_5.	4.05%	
Calcium polysulfids. CaS_3, CaS_4, CaS_5.	4.05%	7.95%
Calcium sulfite. $CaSO_3$.	11.2%	8.1%
Calcium thiosulfate. CaS_2O_3.	7.15%	8.08%
Calcium thiosulfate. CaS_2O_3.	14.08%	8.01%
Iron sulfid. FeS.	8.25%	8%

The process of manufacture of these substances was such that when they were obtained an excess of lime was also present in most cases, but as this would have been difficult to remove at reasonable expense and could hardly be a factor in the results, it was allowed to remain, the amount being shown in the last column of the above table.

Each of these eight substances was applied about the end of March, 1903, to from three to eight quite badly infested trees and the results were studied during the following spring and summer.

As was anticipated the Iron sulfid proved worthless as an insecticide and none of the other materials was as effective as the entire lime-sulfur mixture, but the applications were made to such a small number of trees in each case that the results can only be regarded as providing suggestive data for farther investigations along this line. With this in mind, however, the following conclusions were reached. The calcium monosulfid and calcium sulfite failed to improve the condition of any of the trees to which they were applied, and the hydrosulfid gave but little better results. The weak thiosulfate showed evidence of some insecticidal value and the strong thiosulfate benefited every tree to which it was applied. The polysulfids in which an excess of lime was present and those without it were of nearly equal value, the preference perhaps being slightly in favor of the latter, the results they gave being about like those obtained with the strong thiosulfate.

From this the conclusion was reached that the main insecticidal value of the lime-sulfur wash resides in the calcium polysulfids and the thiosulfate. Farther tests seemed desirable however before publishing these views, which have accordingly been held back for nearly four years, awaiting an opportunity for verification.

During this period one or two articles bearing on the subject have appeared, and the results given in them may here be touched upon. Haywood (Journ. Am. Chem. Soc., XXVII, pp. 244-255, 1905) finds only small quantities of calcium monosulfid, and thiosulfate at the beginning, the latter increasing with longer boiling, and he is of the opinion that polysulfids and a small amount of thiosulfate are produced at first but that on continued boiling the polysulfids gradually combine with oxygen to form thiosulfate and sulfur and that the thiosulfate also gradually changes, forming sulfite and sulfur. The sequence of the changes then, beginning with the polysulfids is that these oxidize forming thiosulfate and sulfur ; that the thiosulfate decomposes, forming sulfite and sulfur, and finally that the sulfite changes to sulfate.

The experiments already described, showed that the sulfite was not an insecticide, so that the interest in these changes centers on the polysulfids and thiosulfates.

Thatcher (Bull. 76, Wash. Ex. Station, 1906) goes farther than Haywood, claiming that "only two of these (substances), namely calcium pentasulfid and calcium thiosulfate are produced by the direct action of sulfur upon slaked lime." Though this is a rather sweeping statement and not entirely in accord either with Haywood's results or with the analyses made here, it nevertheless also brings these two substances forward as the insecticidal factors of the wash. In at least a general way then, the chemical work of Haywood and Thatcher sustains the conclusions reached in Massachusetts nearly four years ago.

If the calcium polysulfids or calcium thiosulfate are the insecticides of the lime-sulfur wash it still remains a question how they act. Results at this station pointed to both as being valuable, but the polysulfids oxidize quickly so that the beneficial results on the trees sprayed with these substances were very likely to have really come from the thiosulfate into which they were soon converted.

Haywood mentions a suggestion that the action of the wash is caused by the production of sulphur dioxide, though he advances certain arguments against this view; and also that it may be due to the finely divided sulfur set free during the oxidation. To the writer this last seems a more probable explanation, particularly when it is remembered that the sulfur thus liberated would be nascent sulfur and would probably possess powers not evident at other times, as the result of its nascent condition. It seems most likely therefore, that the efficiency of the lime-sulfur wash is due either to the direct action of calcium thiosulfate or to that of sulfur in a nascent condition.

To obtain the most effective lime-sulfur wash it should, theoretically be so made as to contain the largest amount of calcium thiosulfate. This can be done by boiling the lime and sulfur for a long time, and a wash which is immediately active will be the result. This boiling, however, when long continued, obtains its larger amount of thiosulfate at the expense of the polysulfids which are oxidized. One of the valuable characters of the wash is the long period during which it acts, and it seems probable that this is due to the fact that as the stock of thiosulfate decreases it is renewed from the polysulfids which oxidize, forming more thiosulfate. From this standpoint therefore, it would seem wiser to use such amounts of lime and sulfur and boil them for such a time as to produce the largest amount of the polysulfids, which as they decompose would continually renew the stock of thiosulfate available. If nascent sulfur is the active agent this last method of making would also be the best as nascent sulfur will be produced both by the oxidation of the polysulfids and the breaking down of the thiosulfate.

Turning to the question whether a long or a short boiling is the better, with these conclusions in mind it is at once evident that boiling for so short a time that the sulfur does not all enter into chemical combination produces a wash less effective than it should be. As examination of the sediment at the bottom of the kettle after boiling for half an hour has frequently shown that this consists to quite a degree of sulfur coated externally with lime, it is clear that in such cases the boiling has not been sufficient, and Haywood finds that it takes longer than this to dissolve all the sulfur.

The writer appreciates that the foregoing, together with what immediately follows is liable to criticism on the ground that the conclusions are drawn from too limited experiments, but in view of the fact that we have no more extensive tests in this line to make use of, the conclusions may at least have a tentative value and may be summarized as follows:

1. Take sufficient lime to combine with all the sulfur.
2. Calcium thiosulfate is the active insecticide and more of this is gradually formed by the decomposition of the polysulfids: therefore, boil to obtain as much of the polysulfids as possible.
3. Too long boiling produces more thiosulfates and free sulfur at the expense of the polysulfids present. The wash will be more active when first applied under these conditions but will not act during as long a time, and it is desirable that it should be active as long as possible.
4. Letting the wash stand after being made may perhaps give an opportunity for the polysulfids and thiosulfate to decompose in part, forming substances having no insecticidal value and thus reducing its effectiveness.
5. From the study of a large number of experiments it seems probable that forty minutes to an hour of actual boiling will be needed in order to obtain the greatest amount of the polysulfids.

SELF-BOILING WASHES.

Perhaps the main objection to the use of the lime-sulfur wash is the necessity of boiling it, involving expense for a large iron kettle where steam is not available, and the time required. To avoid this, several self-boiling washes have been tested in different places. In all these tests some chemical has been added which would produce heat in the wash, to continue that produced by the slaking of the lime, sufficiently long to bring the lime and sulfur into combination without the use of a fire.

The results obtained in this way have been very variable. Sometimes they have been nearly or quite as good as those obtained by the use of a fire while sometimes they have been very unsatisfactory. The cost of the chemical added should of course be considered in tests of this kind, as well as the time required by this method as compared with that by the other.

In the spring of 1906 tests of sodic sulfid, caustic soda and sal soda as self-boilers were made at the Hatch Experiment Station. The formula used with the sodic sulfid was lime twenty lbs., sulfur ten lbs., sodic sulfid ten lbs., water forty gals. The sodic sulfid cost $3.20 per barrel of wash, the lime fourteen cents, and the sulfur twenty-eight cents, making the cost of the materials $3.62 per barrel of wash. The results obtained were only fair, many living scales being present on the trees at the first examination after treatment and becoming extremely abundant later.

The caustic soda treatment was made by taking lime twenty lbs., sulfur fourteen lbs., caustic soda five lbs., water forty gals. The caustic soda cost fifteen cents per pound, making the total cost for materials $1.28 per barrel of wash. The results were about like those with the sodic sulfid.

The same formula substituting sal soda for caustic soda cost eighty-seven cents per barrel for the materials and gave better results than either of the others though not as good as those obtained from the boiled lime-sulfur wash which cost about fifty cents per barrel for the materials. The time taken by the self boiling washes averaged about a half an hour per barrel, so that the amount of time actually saved by this method was less than had been anticipated.

These results are not as good as some which have been reported but represent a fair average of them as given from all parts of the

United States, and the conclusions they warrant would be that, considering the higher cost of the self boiling washes, the small amount of time they save in preparation, and their reduced effectiveness in most cases, offset only by the fact that no kettle to boil in is needed, these self boiling mixtures are not a success and should only be recommended where such a small number of trees is to be treated that the expenditure of fifteen dollars or so for a kettle would be unwise.

THE K-L MIXTURE.

This material has been highly recommended by the Delaware Experiment Station and has been tested at a number of places. It was tried here last spring, the formula used being—limoid 33 1/3 lbs., kerosene 8 1/3 gals., water 25 gals. The limoid cost one and a quarter cents per pound in barrel lots in Delaware, the nearest place at which it could be obtained, and the kerosene at that time cost eleven cents per gallon, making the cost of the materials $1.34 per barrel besides the freight charges.

It was found quite difficult to produce a satisfactory emulsion of the materials, considerable time being needed, and the results on the scales were far from satisfactory, the trees being badly infested again as early as July twenty-first, while others all around them, treated with the ordinary lime-sulfur wash costing about one-third as much, were in excellent conditon.

This is the result of only one test, but so far as it goes, it would lead the writer to hesitate to advise the use of the K-L mixture.

SUMMARY OF EXPERIMENTAL WORK IN THE UNITED STATES.

The San José Scale has probably been the subject of a larger number of tests of treatment in this country than any other insect, over five hundred separate experiments having been published. To summarize these is a difficult and perplexing task, but has been undertaken in the hope that at least a few general facts might be brought to light, and the following statements represent what has been found.

Potash Whale-oil Soap at the rate of two pounds per gallon of water is a fairly good winter treatment though more expensive than some others. As no boiling is needed it is quite convenient to prepare. Among the best Whale-oil soaps on the market are Bowker's Tree Soap, Good's Caustic Potash Whale-oil Soap No. 3 and Leggitt and Bro's. Anchor Brand. The addition of tobacco seems to be somewhat beneficial but at an additional cost.

Soda Soaps so far as tests of them have been observed seem to be much less effective than the Potash soaps.

Crude Petroleum and Kerosene have generally given fair results so far as killing the scale goes, when thoroughly applied, but the effect on the trees has often been serious and these materials are in consequence not held in great favor, as in addition to this objection they are more expensive than other and better materials now in use.

The K-L Mixture is a recent addition to the list of materials and the results obtained from its use have been very variable, some being excellent and others poor. It is difficult to obtain a satisfactory mixture of the materials, and the cost is considerably greater than with other treatments. From these facts it is hardly likely that it will come into general use.

The lime, sulfur and salt washes first used on the Pacific coast and now in general use throughout this country have been made according to many different formulas, but the results when certain factors were given due attention, have been very satisfactory. The salt which was at first considered an important ingredient is now generally omitted, the earlier idea that it added to the adhering power of the wash being for the most part rejected. What the nature of the action of the wash is has not been understood and in consequence the length of time it was necessary to boil it, and the amount of each ingredient to use have been unknown.

From what has already been stated it seems probable that the amounts of lime and of sulfur taken, and the time they are boiled should be such as to produce the greatest amounts possible of the higher sulfids, and to obtain these the writer is of the opinion that for fifty gallons of water about twenty-two pounds of lime and twenty pounds of sulfur boiled together for from forty minutes to an hour will be likely to give the greatest amount of the desired sulfids and correspondingly the best results. An interesting series of experiments which does not as yet seem to have been consistently made would be to prepare washes using fifteen, twenty, twenty-five and thirty pounds of lime to fifteen pounds of sulfur, boiling in each case for the same length of time; a similar series wherein the amount of sulfur should be the variable factor; a third series in which for each combination of lime and sulfur the time of boiling should vary and a fourth in which the amount of water used during the boiling should be the varying factor, as it is possible that this has something to do with what might be termed the "opportunity" the materials would have to combine in different ways. It has been noticeable, in comparing the results obtained in different parts of the country, that in general the best results have been reported where quite large amounts of lime and sulfur have been taken and the boiling has been for at least three-quarters of an hour in a considerable amount of water.

The cost of the materials for the lime-sulfur wash is less than for any of the other sprays thus far considered, and the drawback it has is the cost of apparatus for boiling and the time required.

Self-boiled Washes have been quite widely tested to avoid the difficulty just mentioned, caustic soda, sal soda or sodium sulfid being added to continue the boiling begun by the slaking of the lime and thus produce the chemical combinations desired. The cost of a boiling apparatus is saved in this way but that of the chemical added in part offsets this and the results have been very variable, due probably to a more or less partial failure to obtain sufficient heat for a sufficient length of time. While excellent results have occasionally been reached the average of the reports indicates that this method fails to equal the results from the boiled wash.

Blue Vitriol added to the boiled wash has been tested with some apparent success, but Thatcher finds that this combines with the higher sulfids rendering them insoluble and the value of this wash on the theory of its action given above would then depend entirely upon the thiosulfate present at the time of application.

Miscellaneous materials mainly in the form of "Proprietary Insecticides" have been placed upon the market in great numbers and many of them have proved to be of no value whatever, so far as tests show. The more important of these and the average results given by their use follow.

Calcothion, a ready made lime-sulfur wash has given good results but is expensive.

Rex Lime and Sulfur Solution has proved to be of some value, but not as efficient as the boiled material. Made in Omaha, the cost of obtaining it in the east, added to its price which will be about $12.00 per barrel at retail would probably be too great to admit of its general use in this locality.

Con-sol which is more or less of a lime-sulfur mixture does not seem to be of much value, judging from such tests of it as have been noticed.

Horicum. Reports on this material vary from fair to poor in the results which have been met with in preparing this summary.

Caustic Soda applied at the rate of one pound in six gallons of water was widely recommended at one time, but uniform failure to destroy the scales at this strength or at any strength unless used strong enough to injure the buds also, has led to dropping this substance.

Kil-O-Scale. A number of tests with this substance indicate that it is not always an entirely satisfactory material, though the best reports state that a large per cent of the scales was killed.

Scalecide. This so-called "soluble oil" which is really a mixture of distillate oil of petroleum, a vegetable oil and resin oil according to the statements of persons interested, has obtained very variable reports in different tests. Applied at the rate of one gallon to twenty gallons of water it does not seem to be particularly effective, but at the strength of one to twelve or one to fifteen, when applied twice under pressure of one hundred pounds or more at the nozzle it seems to be a very effective spray. It may perhaps be termed at the present time a promising insecticide.

Target Brand Scale Destroyer appears to be somewhat similar to Scalecide in many ways, and the results obtained from its use have been quite good in some cases, though when applied at the rate of one gallon to twenty gallons of water the results have not been entirely satisfactory. The reports seen would place this material below Scalecide in effectiveness.

After a careful study of all the reports on Scalecide and Target Brand Scale Destroyer available, together with some personal experience, the writer is of the opinion that aside from the lime-sulfur wash these are probably the most promising materials now on the market, of which he has knowledge. To obtain success with them however it seems necessary to apply them as strong as one part to fifteen of water, under great pressure at the nozzle, and to be very thorough in the application. The lime-sulfur wash applied under similar conditions will do as good and perhaps even better work, while used with less care but under the same exact conditions the lime-sulfur wash gave better results. The writer would therefore advise the use of Scalecide or Target Brand Scale Destroyer only where it is not possible to make the boiled lime-sulfur wash, and where a thorough application under the conditions named can be given.

Other materials which have been tested and which have either given poor results or were worthless so far as these reports go, for the purpose of destroying the San José Scale are, Naphcin, Fruitolin, Surekil, Tak-a-nap Soap, San José Exterminator, Webcide, Standard Disinfectant, Ska-kil, Derror Tree Fluid, Bordeaux Mixture, Whitewash and Crude Carbolic acid. Undoubtedly many others are on the market, but no reports of their value are at hand.

Conclusion. From what has been written it follows that where a kettle or steam for boiling is available the lime-sulfur wash properly prepared is the most satisfactory and probably the cheapest material to use. Scalecide or Target Brand Scale Destroyer would naturally be chosen if boiling is for any reason impracticable, and perhaps in some cases would be preferable on account of the trouble to boil where only a few trees or shrubs are to be treated. It should be stated that only the statements of State and Station officials have here been considered in preparing this summary.

Recommendations. Where any considerable amount of spraying is to be done, use the lime-sulfur wash prepared according to directions given below. Where only a few shrubs or trees are to be treated, or where for any reason boiling is not practicable, use Scalecide or perhaps Target Brand Scale Destroyer at the rate of one gallon of the material to fifteen gallons of water, well mixed, applied twice—preferably late in the fall and again early in spring before the buds open —with as great pressure at the nozzle as posssible, and applied very thoroughly so that every twig even may be covered by the spray.

HOW TO MAKE THE LIME-SULFUR WASH.

The lime used in making the wash must be good stone lime (Magnesia lime is not desirable) which is as fresh as possible. Where the lime has air-slaked to any degree results are far less satisfactory. The sulfur should be Flowers of Sulfur or Sulfur flour, the former being the better for the purpose.

Place six or eight gallons of water in the kettle, start a fire under it, and slake the lime,(22 lbs.) getting this as fine as possible in the slaking. When this is well under way gradually add the sulfur, (20 lbs.) stirring it in well, and keep the fire going to continue the heat begun by the slaking lime. Keep the mixture boiling, adding water (preferably hot) from time to time, till it has boiled at least forty minutes and is dark orange red in color. If there seems to be a considerable amount of sediment at the bottom of the kettle this may be taken as an indication, either that the boiling has not continued long enough or that the lime was not of very good quality. When the boiling has been completed strain the liquid into the spray pump barrel through a strainer of copper wire of at least twenty threads to the inch, and add whatever water may be needed to make the fifty gallons or thereabout, which the barrel holds. Then spray at once, as in many cases where a lot of the wash has been made one afternoon and sprayed the next morning it has proved less effective, due probably to chemical changes which took place while it was standing.

That this method of making the wash is inconvenient to say the least, is evident, and experiments which may show that we can do away with the necessity for any boiling are in progress, but the results are not yet available, though it is hoped that they may prove successful.

HOW TO SPRAY FOR THE SCALE,

Every scale must be touched by the spray in order to be killed, but a very small droplet on each will be sufficient. To spray successfully then, *spray thoroughly*.

There are numerous pumps on the market which work well for the purpose. Those which have happened to be used at the Massachusetts Experiment Station, and which were entirely satisfactory, were the "Pomona" and "Fruitall," made by the Goulds Manufacturing Co. of Seneca Falls, N. Y., and the "Hardie" Pump, made by the

Hardie Manufacturing Co. of Hudson, Mich. All working parts of the pump should be of brass or bronze.

From the pump one or two lines of hose can be run as may be most convenient. Each should be joined to an extension rod with a " shut off " valve at its base. At the end of the extension rod a " Y " should be connected and a nozzle placed at the end of each arm of the " Y ". The best nozzle is one which will throw a fine mist, as even then one droplet should be sufficient for each scale, and by turning the two nozzles so that they will spray in different directions the tree can be much more quickly covered. Eight or ten different kinds of nozzles have been tried in the course of this work at Amherst, but the best results in the way of thoroughly covering the tree with the least waste of material were obtained with nozzles of the Vermorel type, and of these the " Mistry " has been the most satisfactory.

If the trees can be well pruned before spraying much extra time and trouble will be saved as the most difficult parts of a tree to cover well are the smaller twigs. In spraying it is well to begin at the top and work downward, rapidly following each branch toward the trunk with the nozzles, and if there is a wind, working on that half of the tree which is to windward. If there is little or no wind, the tree can be treated from all sides before it is left, but with much wind blowing it may be better to spray all the trees from one side only, treating the other side as soon afterwards as the weather will permit. It must be remembered however, that the object is to cover every particle of the surface *everywhere* with the spray. As the wash shows plainly when it dries this can often be taken advantage of to " touch up " later any spots which were missed at first. In spraying, pump so as to put on as much pressure as possible, and hold the nozzles as near the branches as can be done, to drive the mist into all the tiny crevices in the bark under which the scales appear to like to conceal themselves.

Treatment as thus directed will usually result in the larger limbs and trunk being more or less soaked by surplus spray which runs down from above, but this should do no harm and in fact is likely to be advantageous.

WHEN TO SPRAY.

It is generally considered unsafe to spray for the San José Scale while the leaves are on the trees, the materials used are so strong:

though in certain cases, trees have been sprayed when in full leaf in June, with the lime-sulfur wash without the slightest injury resulting. Treatment in summer is not advisable, however, and the best and safest time to apply the wash is from the time the leaves have fallen till the buds begin to open in spring. Where the trees are badly infested two treatments—one late in the fall and the other early the next spring—are most desirable, but where only one is needed or possible for any reason, the results obtained in Massachusetts point to the spring as the time when the best results are to be obtained.

SUMMER TREATMENT.

In case trees are found during the summer which are so badly infested that it seems probable they will die before winter, a mild treatment to hold the scales in check is needed. It is not safe to use the treatments already discussed, at this time of year and the best material under the circumstances is one of the Whale-oil soaps at the strength of one pound of soap to five gallons of water.

This will destroy all the crawling young it reaches and thus prevent as rapid increase in numbers of the scale as would otherwise be the case. The treatment may need to be repeated several times however, as the old scales are not affected and more young will be constantly appearing. Spraying at this time is particularly unsatisfactory too, as the leaves render it difficult to cover the twigs and branches as thoroughly as is desirable.

SUMMARY.

1. The San José Scale is present nearly everywhere in Massachusetts and is causing great injury and financial loss.
2. Its life history is such that enormous numbers of individuals are quickly produced.
3. It feeds on about 125 different kinds of plants including our most important fruit trees and ornamental shrubs.
4. None of its enemies seem able to keep it under control in this state.
5. Treatment of the plant affected varies according to its condition. If nearly dead, cut it down and burn it. If less seriously affected, fumigation is the best treatment, but this is not usually practicable except for nursery stock.

6. Spraying experiments at this Station and almost everywhere in the United States show that the lime-sulfur wash gives the best average results.
7. The insecticide in this wash is probably either calcium thiosulfate or nascent sulfur produced as the materials present break up chemically.
8. Long boiling of the wash (40 minutes to one hour) has given better average results than boiling for half an hour or less.
9. Letting the wash stand for a day after it has been made is not safe, though exceptions where good results under these conditions are obtained, are frequent.
10. Self-boiling washes are sometimes fairly successful but good results cannot be safely counted on.
11. The K-L Mixture has not proved a success at Amherst and in many other places. It is very expensive as compared with the lime-sulfur wash.
12. A summary of the experimental treatments for the scale, made in this country, indicates that there is nothing better than the lime-sulfur wash where boiling is possible.
13. Where boiling is impossible or where only a very few trees are to be treated, Scalecide used under certain conditions named, may prove a satisfactory substitute.
14. Most of the "proprietary insecticides" for the scale are either pure "fakes;" give poor results, or are so expensive as to be unprofitable to use.
15. Directions for making the wash, and how and when to apply it are given fully.
16. Summer spraying with whale-oil soap will often hold the scale in check till winter applications can be made.

BULLETIN No. 117. MARCH, 1907.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

TRADE VALUES

AND

Fertilizer and Soil Analyses

BY

C. A. GOESSMANN, L.L. D. and H. D. HASKINS, B. Sc.

I. Discussion of trade values of fertilizer ingredients for 1907.

II. Analyses of manurial substances and soils forwarded for examination.

III. Instructions regarding the sampling of materials to be forwarded for analyses.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

CHARLES A. GOESSMANN, PH.D., LL.D.,	*Honorary Director and Chemist* (Fertilizers).
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
JOSEPH B. LINDSEY, PH. D.,	*Chemist* (Foods and Feeding).
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. S.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian*
HENRY J. FRANKLIN, B. SC.,	*Assistant in Entomology.*
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
NEIL F. MONAHAN, B. SC.,	*Assistant Botanist.*
HENRI D. HASKINS, B. SC.,	*First Assis't Chemist* (Fertilizers).
E. THORNDIKE LADD, B. SC.,	*Second Assis't Chemist* (Fertilizers).
*	*Third Assis't Chemist* (Fertilizers).
EDWARD B. HOLLAND, M. S.,	*First Chemist* (Foods and Feeding).
PHILIP H. SMITH, B. SC.,	*Ass't Chemist* (Foods and Feeding).
LEWELL S. WALKER, B. SC.,	*Ass't Chemist* (Foods and Feeding).
WILLIAM K. HEPBURN,	*Inspector* (Foods and Feeding).
ROY F. GASKILL,	*Assistant in Foods and Feeding.*
CARL S. POMEROY, B. SC.,	*Assistant Horticulturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist*
T. A. BARRY,	*Observer.*

* A vacancy exists at present.

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

DIVISION OF CHEMISTRY.

Trade Values and Fertilizer and Soil Analyses

By C. A. GOESSMANN and H. D. HASKINS.

I.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1906 AND 1907.

	1906	1907
	Cents per pound.	
Nitrogen in ammonia salts,	17.5	17.5
" " nitrates,	16.5	18.5
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	18.5	20.5
" " " fine bone and tankage,	18.0	20.5
" " " coarse bone and tankage,	13.0	15.0
Phosphoric acid soluble in water,	4.5	5.0
" " soluble in ammonium citrate,	4.0	4.5
" " in fine ground fish, bone and tankage,	4.0	4.0
" " in cottonseed meal, castor pomace and wood ashes,	4.0	4.0
" " in coarse fish, bone and tankage,	3.0	3.0
" " insoluble (in water and in neutral citrate of ammonia) in mixed fertilizers,	2.0	2.0
Potash as Sulphate, free from Chlorides,	5.0	5.0
" " Muriate (chloride),	4.25	4.25
" " Carbonate,	8.0	8.0

The above schedule of trade values for 1907 was adopted by representatives of the Massachusetts, Connecticut, Rhode Island, Maine, Vermont and New Jersey Experiment Stations at a conference held during the month of March, 1907, and is based upon the condition of the fertilizer market in centers of distribution in New England, New York and New Jersey during the six months preceding March, 1907, and refers to the current market prices, in ton lots, of the leading standard raw materials, which furnish nitrogen, phosphoric acid and potash, and which enter largely into the manufacture of our commercial fertilizers. The following is a list of such materials:

Sulphate of ammonia,
Nitrate of soda,
Dried blood,
Cotton seed meal,
Castor pomace,
Linseed meal,
Dry ground fish,
Bone and tankage,
Crude saltpetre,
Dissolved bone,
Ground phosphate rock,
Acid phosphate,
Refuse bone black,
Carbonate of potash,
High grade sulphate of potash,
Muriate of potash,
Sulphate of potash-magnesia,
Kainit,
Sylvinite.

A comparison of the trade values of the essential elements of plant food for 1907, with the previous season, shows nitrogen in the form of nitrates two cents higher in cost than during the season of 1906. The different forms of organic nitrogen show an increase in cost over that of the previous season of from two to two and one-half cents per pound.

Both the water soluble phosphoric acid and the citrate soluble (reverted) phosphoric acid show an increased cost of one-half cent per pound over that for 1906.

The cost of the various forms of potash remains the same as for the previous year.

Valuation. The approximate value of a compound fertilizer or any material used for fertilizing purposes is obtained by calculating the value of each of the three essential elements of plant food (nitrogen, phosphoric acid and potassium oxide, including the different forms of each wherever different forms are recognized in the table) in one hundred pounds of the fertilizer, and multiplying each product by twenty to change it to a ton basis. The sum of these values will give the total approximate value of the fertilizer per ton at the principal places of distribution.

EXAMPLE:—Supposing a fertilizer shows the following analysis:

Nitrogen,	2.5%
Soluble Phosphoric acid,	6.5
Reverted " "	3.5
Insoluble " "	1.6
*Potassium oxide,(as sulphate),	8.4

2.5 pounds nitrogen at 20½ cents=51.25 cents x 20=	$10.25
6.5 pounds soluble phosphoric acid at 5 cents=32.5 cents x 20=	6.50
3.5 pounds reverted phosphoric acid at 4.5 cents=15.75 cents x 20=	3.15
1.6 pounds insoluble phosphoric acid at 2 cents=3.2 cents x 20=	.64
8.4 pounds potassium oxide at 5 cents=42 cents x 20=	8.40
Value per ton,	$28.94

In case of bone and tankage, we calculate separately the nitrogen and phosporic acid value of each grade of mechanical fineness by multiplying the pounds of nitrogen and phosphoric acid per ton by the per cent. of each grade, and multiplying these products by the trade values per pound, of nitogen and phosphoric acid in each grade, and express the final product in cents. Adding the separate values of each grade of both ingredients, we have the valuation of the material in question.

EXAMPLE:—Supposing a bone shows the following analysis:

Nitrogen,	2.5%
Total phosphoric acid,	22.5%

*The term "potassium oxide" in this bulletin designates the compound now generally known as potash in agricultural literature.

WM. P. BROOKS, Director.

MECHANICAL ANALYSIS.

Fine bone,	40.%
Coarse bone,	60.%

Nitrogen, 2.5 pounds x 20=50. x .40=20.00 x 20.5 cents=	$4.11
Nitrogen, 2.5 pounds x 20=50. x .60=30.00 x 15 cents=	4.50
Phosphoric acid, 22.5 pounds x 20=450 x .40=180.00 x 4 cents=	7.20
Phosphoric acid, 22.5 pounds x 20=450 x .60=270.00 x 3 cents=	8.10
Value per ton,	$23.91

In figuring the commercial value of a compound fertilizer, a suitable amount should be added to cover the expenses incurred in the manufacture and sale of the goods.

The trade value of a fertilizer does not necessarily indicate its exact agricultural value. The trade value of a given fertilizer simply shows its cost in our general markets. The agricultural value of a fertilizer shows its capacity in producing certain agricultural crops, and depends not only upon the condition of the fertility of the soil upon which the fertilizer is used, but also upon the physical condition of the soil, the mode of cultivation, the season and the crop to be raised. Experience alone can determine the general fitness and approximate agricultural value of compound commercial fertilizers and fertilizing materials.

II.

ANALYSES OF FERTILIZER SUBSTANCES, REFUSE MATERIALS, AND SOILS FORWARDED FOR EXAMINATION.

NITROGEN COMPOUNDS.

2016-2019. I. Nitrate of soda, received from Bradstreet, Mass.
II. Nitrogenous chalk, received from New York, N.Y.
III. Tartar pomace, received from New York, N. Y.
IV. Saltpetre waste, received from Concord, Mass.
V. Calcium cyanamide, received from Boston, Mass.

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100°C.,	2.55	—	—	2.93	.75
Nitrogen,	14.69	9.88	4.04	2.44	19.80
Potassium oxide,	—	—	*	38.30	—
Calcium oxide,	—	*	*	1.30	61.24
Chlorine,	—	*	*	21.76	—
Iron and aluminum oxides,	—	*	*	*	2.10
Carbonaceous matter (carbon),	—	*	*	—	14.16
Insoluble matter,	—	*	*	*	1.04

* Not determined.

COTTON SEED MEAL.

Laboratory Number.	RECEIVED FROM	Moisture.	Nitrogen in 100 lbs.
2020	Hatfield, Mass..................	8.97	5.98
2021	Hatfield, Mass..................	8.12	5.50
2022	North Hadley, Mass..............	8.40	6.41
2023	Hatfield, Mass..................	6.97	6.52
2024	Hatfield, Mass..................	8.02	6.28
2025	Hatfield, Mass..................	6.27	6.42
2026	Hatfield, Mass..................	8.32	3.53
2027	Bradstreet, Mass................	7.08	6.64
2028	Bradstreet, Mass................	8.08	6.13
2029	North Hadley, Mass..............	8.24	7.00
2030	North Hadley, Mass..............	8.34	6.78
2031	Hatfield, Mass..................	5.67	4.10
2032	Hatfield, Mass..................	7.62	6.57
2033	North Hadley, Mass..............	8.25	6.35
2034	Sunderland, Mass................	2.95	6.36
2035	North Hadley, Mass..............	5 65	6.37
2036	Hatfield, Mass..................	6.07	6.66
2037	Sunderland, Mass................	7.62	6.29

NOTE.—Cottonseed meal contains from 2 to 3% of phosphoric acid, and from 1.5 to 2.5% of potassium oxide, of which about 1.25% is soluble in water.

CLEVELAND FLAX MEAL, GLUTEN, AND LEATHER WASTE.

2038-2041. I and II. Cleveland Flax Meal, received from Hatfield, Mass.

III. Gluten paste, received from North Wilbraham, Mass.

IV. Leather Waste, received from Norwood, Mass.

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C.,	7.92	7.18	66.10	56.85
Nitrogen.	5.70	5.91	5.00†	4.89
Ash,	*	*	.075	14.89
Phosphoric acid,	*	*	.03	.18
Potassium oxide,	*	*	*	.20
Calcium oxide,	*	*	*	1.33

NOTE.—Linseed meal contains about 1.52% potassium oxide and 1.47% phosphoric acid.

POTASH COMPOUNDS.

2042-2046. I. High grade sulphate of potash, received from Feeding Hills, Mass.

II and III. High grade sulphate of potash, received from Bradstreet, Mass.

(Sample II, light color. Sample III, brown.)

IV. Carbonate of potash, received from Hatfield, Mass.

V. Carbonate of potash, received from Bradstreet, Mass.

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100°C.,	.53	.52	.07	none	1.94
Potassium oxide,	53.60	50.95	50.68	64.41	62.04

†The percentage of Nitrogen in the Gluten paste when figured to 100 parts of dry matter is 14.74%.

* Not determined.

GROUND BONE, TANKAGE, DRY GROUND FISH AND BONE FIBRE.

2047-2050. I. Ground bone, received from Littleton Common, Mass.
II. Tankage, received from Concord. Mass.
III. Dry ground fish, received from Bradstreet, Mass.
IV. Bone fibre, received from Natick, Mass.

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100°C.,	6.96	6.46	8.11	5.38
Total phosphoric acid,	27.20	2.08	6.01	12.44
Available phosphoric acid,	6.40	1.40	2.03	6.76
Insoluble phosphoric acid,	20.80	.68	3.98	5.68
Nitrogen,	2.41	11.22	8.63	4.61

DISSOLVED BONE BLACK AND BURNED BONE.

2051-2052. I. Dissolved bone black, received from Bradstreet. Mass.
II. Burned bone, received from Taunton, Mass.

	PER CENT.	
	I.	II.
Moisture at 100°C.,	11.26	.68
Total phosphoric acid,	18.64	35.78
Soluble phosphoric acid,	15.50	*
Reverted phosphoric acid,	2.50	*
Insoluble phosphoric acid,	.63	*

MISCELLANEOUS REFUSE SUBSTANCES.

2053-2056. I and II. Mill dust, received from East Walpole, Mass.
III. Refuse from washing wool, received from Clinton, Mass.
IV. Cotton dirt. received from Amherst, Mass.

* Not determined.

	PER CENT.			
	I.	II.	III.	IV.
Moisture,	3.75	6.20	37.05	7.48
Nitrogen,	2.04	1.52	.31	1.51
Phosphoric acid,	trace	.17	.09	*
Potassium oxide,	.44	.46	.41	*
Calcium oxide,	2.56	.60	1.45	*
Insoluble matter,	14.83	6.05	49.60	*

2057-2060. I. Tannery refuse, taken from filter beds, received from Walpole, Mass.

II. Tannery refuse, taken from vats in cellar, received from Walpole, Mass.

III. Salt from manufacture of gun powder, received from Boston, Mass.

IV. Liquid by-product, received from East Walpole, Mass.

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100°C.,	60.36	44.36	.05	94.93
Nitrogen,	.99	.64	.28	.15
Phosphoric acid,	.15	.11	—	none
Potassium oxide,	.10	.33	3.75	.15
Calcium oxide,	4.76	1.67	.99	1.04
Insoluble matter,	13.40	36.07	—	.11
Chlorine,	—	—	28.60	—

The above class of substances are, in many instances, of only local interest. Whenever they can be purchased at a reasonable price and under the control of a chemical analysis, they oftentimes furnish a valuable source of plant food. The high percentage of moisture in many of these materials prohibits their transportation by rail on account of the cost of freight.

* Not determined.

CHINCHA PERUVIAN GUANO.

2061-2063. I. Received from Westborough, Mass.
II. Received from Sunderland, Mass.
III. Received from Concord, Mass.

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	13.07	12.32	11.80
Total phosphoric acid,	10.50	10.64	11.12
Soluble phosphoric acid,	3.40	2.98	3.43
Reverted phosphoric acid,	5.48	5.20	4.19
Insoluble phosphoric acid,	1.82	2.46	3.50
Potassium oxide,	1.92	2.10	2.12
Nitrogen,	7.49	7.18	7.81

NOTE.—Analysis shows that about 1% of the nitrogen in the Chincha Guano is in the form of nitrates, 3.25% in the form of ammoniates, and the remainder in the form of organic nitrogen.

PULVERIZED SHEEP MANURE.

2064-2065. I. Received from Amherst, Mass.
II. Received from Boston, Mass.

	I.	II.
	PER CENT.	
Moisture at 100° C.,	4.25	6.69
Nitrogen,	2.27	1.12
Potassium oxide,	2.35	1.86
Phosphoric acid,	1.66	.81
Calcium oxide,	2.30	1.20
Insoluble matter,	14.40	11.88

COMPLETE FERTILIZERS AND HOME MIXTURES—PERCENTAGE COMPOSITION.

Laboratory Number.	RECEIVED FROM.	Moisture.	Nitrogen.	Phosphoric Acid.				Potassium Oxide.
				Soluble.	Reverted.	Insoluble.	Total.	
2066	West Springfield, Mass.	8.07	7.45	5.57	1.89	1.54	9.00	12.61
2067	West Springfield, Mass.	11.90	4.25	2.20	6.36	11.30	19.86	3.52
2068	West Springfield, Mass.	6.45	3 79	2.96	5 08	5.12	13.16	7.29
2069	West Sprihgfield, Mass.	9.16	3.87	2.97	2.57	2.46	8.00	5.07
2070	West Springfield, Mass.	7.01	3.82	6.95	2.75	1.68	11.38	5 67
2071	Ludlow, Mass...............	12.66	3.36	2.03	2.73	3.74	8.50	6.92
2072	Boston, Mass................	.15	13.22	23.16	—	—	23.16	27.70
2073	Northampton, Mass.........	4 45	2 42	4.50	3.38	3.94	11.82	11.44
2074	Northampton, Mass.........	3.94	2.36	4.43	3 93	4.00	12.36	11.40

GRANITE AND CAVE DEPOSITS.

2075-2077. I. Ground granite, received from East Milton, Mass.
II. Cave deposits, received from Northampton, Mass.
III. Stalactite from cave in Va., received from Northampton, Mass.

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	none	.82	.09
Nitrogen,	—	.25	.35
Potassium oxide,	3.50	.64	.76
Phosphoric acid,	—	trace	trace
Calcium oxide,	trace	6.51	49.47
Ferric and aluminum oxides,	19.53	8.12	3.30
Magnesium oxide,	.10	5.44	.76
Carbonic acid,	—	7.00	40.44
Insoluble matter,	70.25	72.12	3.72

The potash in the ground granite was wholly insoluble in distilled water. We would caution the users of commercial fertilizers against purchasing feldspathic rocks as a source of potash. Sample No. 2 is an earthy deposit impregnated with carbonate of lime. Sample No. 3 is largely carbonate of lime.

INSECTICIDES.

2078-2081. I. Arsenate of lead, received from Boston, Mass.
II. Paris green, received from Westport, Mass.
III. Acetate of lead, received from Boston, Mass.
IV. Arsenate of soda, received from Boston, Mass.

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C.,	49.62	.58	11.92	13.85
Lead oxide,	32.27	—	58.51	—
Arsenious oxide,	10.37	56.59	—	15.30
Copper oxide,	—	34.68	—	—
Acetic acid,	6.76	—	—	—
Insoluble matter,	.66	.25	—	—
Sodium oxide,	—	—	—	32.10
Potassium oxide,	—	—	—	1.00
Chlorine,	—	—	—	35.00

The above arsenate of lead is what is usually called "Arsenate of lead paste" and is more often sold in this form. When brought to the dry state it does not mix with water readily, and is therefore not so easily applied.

The above sample of acetate of lead and arsenate of soda were used for the making of arsenate of lead. The lead compound tested about 85.21% acetate of lead. The arsenate of soda tested about 28.3% arsenate of soda, 1.58% potassium chloride and 56.53% sodium chloride or common salt. The mixture of arsenate of lead resulting from a chemical combination of the lead acetate and sodium arsenate did not prove efficient in destroying potato bugs:—its inefficiency was probably due to the poor quality of the arsenate of soda used in the mixture.

WOOD ASHES—PERCENTAGE COMPOSITION.

Laboratory Number.	RECEIVED FROM.	Moisture.	Potassium Oxide.	Phosphoric Acid.	Calcium Oxide.	Insoluble Matter (sand).
2082	Sunderland, Mass.	20.45	4.32	1.30	42.48	10.30
2083	Sunderland, Mass.	2.85	4.76	4 40	28.04	24.17
2084	Northfield Farms, Mass.	14.61	4.88	1.54	36.16	7.12
2085	Cushman, Mass.	8.95	7.80	1.36	38.88	9.87
2086	Hatfield, Mass.	9.11	4.40	1.46	37.93	10.48
2087	Sunderland, Mass.	14.18	4.16	1.02	36.60	12.20
2088	Belchertown, Mass.	6.40	4 74	1.54	37.84	—
2089	Amherst, Mass.	22.44	4.44	1.34	26.77	16.08
2090	Taunton, Mass.	19.17	4 16	1.02	24.72	23.74
2091	Hatfield, Mass.	17.77	4.76	1.10	27.60	16.69
2092	Westminster, Mass.	3.95	1.12	1.28	9.80	60.28
2093	Concord, Mass.	15.74	4.36	.98	28.87	12.76
2094	Sunderland, Mass.	16.40	4.46	1.13	25.79	9.84
2095	Concord, Mass.	1.24	7.84	2.26	25.37	19.36
2096	North Amherst, Mass.	13.79	5.64	1 56	27.97	13.66
2097	South Deerfield, Mass.	20.09	5.60	1.46	31.40	6.50
2098	South Deerfield, Mass.	21.32	5 64	1.26	30.48	7.67
2099	South Deerfield, Mass.	20.31	7.52	1.58	21.33	18.80
2100	Bridgewater, Mass.	61.79	1.70	.86	3.97	10.84

COTTON HULL ASHES AND LIME ASHES.

2101-2104. I. Cotton hull ashes, received from Suffield, Conn.
II. Lime ashes, received from Hadley, Mass.
III. Lime ashes, received from Sunderland, Mass.
IV. Lime ashes, received from South Deerfield, Mass.

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.45	1.25	none	5.14
Potassium oxide,	13.44	1.64	1.68	3.78
Phosphoric acid,	10.68	.64	.40	1.41
Calcium oxide,	7.13	52.64	55.12	61.25
Magnesium oxide,	6.88	—	—	—
Chlorine,	slight trace	—	—	—
Insoluble matter,	19.38	4.11	3.19	3.73

AGRICULTURAL LIME.

2105-2108.

I. and II. Received from Amherst, Mass.
III. Received from West Springfield, Mass.
IV. Received from Hatfield, Mass.

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C.,	none	none	none	.12
Calcium oxide,	63.08	58.00	63.60	40.12
Carbonic acid,	15.15	25.85	*	*
Iron and aluminum oxides,	*	1.80	*	*
Magnesium oxide,	*	2.09	*	*
Insoluble matter,	1.35	1.27	*	1.57

Samples No. 1 and No. 2 represent the product from the Rockport Lime Co. One of the claims of the company is that the lime is so finely ground that it will not absorb carbonic acid from the atmosphere. The two analyses shown above represent the same sample, No. 1 was analyzed in July, 1906. No.2, which is the same sample, was exposed to the action of the atmosphere, being protected from dust, etc. by

* Not determined.

covering the glass dish which contained it with a towel. The sample was analyzed the last of February, 1907, and showed an absorption of 10.70% carbonic acid.

When analyzed in July, 1906, there was enough carbonic acid present to form 34.47% carbonate of lime and when analyzed in February, 1907, there was enough to form 58.79% carbonate of lime.

WOOD AND LEAF MOULD, AND RIVER MUD.

2109–2111. I. Wood and Leaf Mould, received from Worcester, Mass.

II. Earth and Vegetable matter, received from Swift River, Mass.

III. River Mud, received from Hanover, Mass.

	PER CENT. I.	II.	III.
Moisture at 100°C.,	68.94	4.59	58.49
Nitrogen,	.35	.60	.32
Ash,	4.90	68.94	27.93
Phosphoric acid,	.05	.18	.03
Potassium oxide,	.05	.22	.11
Calcium oxide,	.19	.52	.34

SOILS—PERCENTAGE COMPOSITION.

Laboratory Number.	RECEIVED FROM.	Moisture.	Organic and Volatile Matter.	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Calcium Oxide.
2112	Northampton, Mass...	23.27	1.22	.13	.25	.33	.80
2113	Northampton, Mass...	18.93	4.25	.10	.10	.31	.86
2114	Northampton, Mass...	19.65	3.08	.09	.11	.28	.72
2115	Hadley, Mass.........	22.05	4.99	.13	.06	.44	.64
2116	Turkey, Asia.	6.48	8.80	.06	none	.61	1.01
2117	Merrick, Mass........	12.21	4.29	.11	.31	.26	.70
2118	Sunderland, Mass.....	2.22	13.87	.63	.68	.48	.53
2119	Westminster, Mass ...	32.40	6.26	.25	.10	.24	.22
2120	Boston, Mass.	5.33	5.22	.30	.08	.59	1.50
2121	Bisbee's, Mass........	20.47	—	.17	.10	.20	.26
2122	Boston, Mass.	29.60	9.58	.39	.81	.27	1.40
2123	Boston, Mass.	9.54	3.04	.08	.10	.27	.51
2124	Worcester, Mass......	20.86	7.92	.17	*	*	*
2125	Worcester, Mass......	22.02	7.68	.12	*	*	*
2126	Worcester, Mass......	23.26	8.01	.15	*	*	*
2127	Worcester, Mass......	19.41	8.08	.14	*	*	*

* Not determined.

No. 2122 was a sample of soil from a rubber plantation in Mexico. The large amount of phosphoric acid and lime may be accounted for by the fact that the sample contained some fragments of bones from some small animal.

No. 2123 was from a rubber plantation adjoining No. 2122, but produced an inferior growth.

III

INSTRUCTIONS REGARDING THE SAMPLING OF MATERIALS TO BE SENT ON FOR EXAMINATION WITH STATEMENTS OF CONDITIONS TO SECURE ANALYSES FREE OF CHARGE.

It has been deemed advisable to republish in detail the instructions regarding the proper mode of sampling soils, fertilizers and other materials, both in bag and in bulk, and also the instructions regarding the packing, marking and shipment of same to insure prompt delivery; and that the results ot analyses may fairly represent the *average composition* of the material in question. Unless the sample forwarded for analysis is an average representative sample, the results of our chemical investigation of the same become of little value. We are much pleased to say, however, that we have every reason to believe that the many samples received during the past year have, as a whole, been taken intelligently, and there are indications that greater care is being exercised by parties sampling material for analysis than ever before. It is our wish, however, that this subject may be called to the attention of as many farmers as possible, as there is still chance for improvement.

It is of the utmost importance that parties forwarding fertilizing substances for examination should take particular pains in sampling, packing and forwarding such materials, in order that the analyses obtained may represent the average composition of the goods sampled, and that no addition or loss of moisture in transportation may happen. The samples received are entered on our records in the order of their arrival at this office, and each sample is assigned a number and is taken up for investigation in the order in which it has been received.

The name of the sender should be inclosed in an envelope and placed inside the receptacle, together with a statement of the nature of the material forwarded for analysis ; whether it is an agricultural chemical, mixed fertilizer, a wood ash, or the by-product of some manufacturing industry, or a sample of soil.

The results of all analyses of samples made at the Station, free of charge, are considered at the disposal of the managers for publication, if deemed advisable.

All samples should be addressed to Dr. C. A. Goessmann, Chemical Department of the Massachusetts Agricultural Experiment Station, Amherst, Mass., to prevent possible delay. Express charges ought to be prepaid.

SAMPLING OF MATERIAL IN BULK.

In sampling such material as wood ashes, cotton hull ashes, and, in fact, any material in bulk, portions should be taken from various parts of the heap and placed on a thick, smooth piece of paper and thoroughly mixed; from this mixture should be drawn a sample of about one pound, which should be placed in a clean bottle, jar or tin can, tightly stoppered and sealed, in order to retain the moisture of the material unchanged.

SAMPLING OF MATERIAL IN BAGS.

In sampling material which is shipped in bags, portions should be drawn from at least ten per cent of the number of bags present. A fair sample may be obtained by emptying about ten per cent of the bags present on a clean floor or other smooth surface, and thoroughly mixing; small amounts are then taken from different parts of the heap and an average sample drawn as has been previously described.

SAMPLING OF SOILS.

The taking of representative soil samples, when such are desired for chemical investigation, is of the first importance, as without proper care in taking samples the results of a careful chemical analysis become of little value. The sample should be taken from different portions of the field and to a depth not exceeding the downward limit of the surface soil. After selecting a place where a sample is to be taken, pull up all growing vegetation and remove all surface matter which is not a part of the soil. Dig a hole in the soil about two feet square, making the sides smooth and clean by means of a sharp bladed shovel or other instrument; now place a sharp bladed shovel at the point of separation of the surface soil from the sub-soil, and by means of another flat bladed instrument shave off a portion (about two inches) from all four sides of the aperture, letting the soil fall into a shovel which is held in a proper position to receive the same. Place the soil in a suitable receptacle, and proceed to take other samples in a like manner from several different parts of the field. The large bulk of soil which has thus been taken is now placed on a clean floor or on a large piece of thick paper and thoroughly broken up and mixed, after which an average sample is drawn and placed in a glass jar or bottle. The bottle is then securely stoppered and sealed, properly labelled and forwarded for the subsequent chemical examination.

Statements should accompany the sample or be sent in a sealed letter, setting forth the locality, depth at which the sample was taken, nature of subsoil and depth, the mode of fertilization and crop rotation which has been in practice, general fitness of land for cultivation and all other information that would be of interest or assistance to the chemist in formulating his report.

Care should be exercised in sampling when the weather conditions are normal, and no time should be lost between the drawing of the sample and the forwarding of same to the laboratory. This point applies with equal force to all materials forwarded for investigation.

APPLICATION FOR FREE ANALYSIS OF FERTILIZERS AND FERTILIZING MATERIAL.

Name of Material..
Name of manufacturer or dealer ....
Address of manufacturer or dealer ....
Date of purchase...
Price paid per ton...
Whether bought for own use or for sale.......................
Signature of applicant.......................................
Post Office Address..

A printed copy of the above stated questions will be sent hereafter from this office *to every applicant for analysis free of charge*, to be answered by him according to his best information, before his request can be considered.

We occasionally receive samples that bear no mark of identification and therefore have to be thrown away. For this reason we have had shipping tags printed and applicants for analysis will upon request be furnished printed shipping tags which will facilitate the shipping of samples and insure their safe delivery and recognition.

BULLETIN No. 118. NOVEMBER, 1907.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION.

MOLASSES AND MOLASSES FEEDS FOR FARM STOCK,

BY

J. B. LINDSEY, E. B. HOLLAND and P. H. SMITH.

This bulletin contains information relative to the composition, digestibility and nutritive effects of molasses and molasses feeds for dairy stock, horses and swine. In addition to a brief description of the experiments carried on at this station, reference is also made to the results of foreign investigations. The principal object of the bulletin is to make clear to the feeder the place of these feed stuffs in the farm economy.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

CHARLES A. GOESSMANN, PH.D., LL.D.,	*Honorary Director and Consulting Chemical Expert.*
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
JOSEPH B. LINDSEY, PH. D.,	*Chemist.*
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. S.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian.*
HENRY J. FRANKLIN, B. SC.,	*Assistant in Entomology.*
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
GEORGE H. CHAPMAN, B. SC.,	*Assistant Botanist.*
EDWARD B. HOLLAND, M. S.,	*Associate Chemist* (Research Div.).
ROBERT D. MACLAURIN, PH. D.,	*Assistant Chemist* (Research Div.).
HENRI D. HASKINS, B. SC.,	*Chemist in Charge* (Fertilizer Div.).
E. THORNDIKE LADD, M. SC.,	*First Ass't Chemist* (Fertilizer Div.).
WALTER E. DICKINSON, B. SC.,	*Second Ass't Chemist* (Fertilizer Div.).
PHILIP H. SMITH, B. SC.,	*Chemist in Charge* (Feed and Dairy Div.).
LEWELL S. WALKER, B. SC.,	*Ass't Chemist* (Feed and Dairy Div.).
WILLIAM K. HEPBURN,	*Inspector.*
ROY F. GASKILL,	*Assistant in Animal Nutrition.*
CARL S. POMEROY, PH. B.,	*Assistant Horticulturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist.*
T. A. BARRY.	*Observer.*

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

Molasses and Molasses Feeds for Farm Stock.

J. B. Lindsey, E. B. Holland and P. H. Smith.

PART I. MOLASSES.

CONTENTS.

INTRODUCTION.

Residuum molasses from the sugar beet factories is used in Europe as a food for all kinds of farm stock. It is fed either diluted with water as a drink, or mixed by the feeder with a variety of substances, such as cut hay, finely ground straw, brewers' dried grains, malt sprouts, wheat bran, cocoanut cake, dried beet pulp and dried potato residue. Many manufactured foods are also offered, among which may be mentioned the dried mixture of straw and molasses made according to the formula of Lambert-Toury, and known as *pail-mel*; *Torf Melasse*, composed of dried peat and molasses; *Klimax Melasse*, consisting of ground twigs, ground horse-chestnuts and molasses; *Blut-Melasse*, containing small quantities of dried or fresh blood mixed with barley, peanut, oat and rice hulls. Many of the above products have a relatively low digestibility, and the price is frequently out of proportion to their nutritive value[1].

[1] Kellner, Die Ernährung der Landw. Nützthiere, pages 349-356.

In New England, cane molasses brought in tank steamers from Porto Rico, has been freely offered at some 13 to 14 cents a gallon of 12 pounds, in barrel lots. In the southern part of the country (especially in Louisiana) cane molasses is used quite freely as a food for horses and mules in quantities varying from 5 to 15 pounds or more daily. There are likewise many cattle foods made and sold in the northern United States which contain considerable quantities of molasses; they are known as Sucrene dairy and Sucrene horse feeds, Green Diamond, Holstein and Molac sugar feeds, Hammond dairy feed, dried molasses-beet pulp and Mueller's molasses grains.

In view of the prominence now given to molasses and to molasses feeds as a food for farm stock, the station has conducted a variety of experiments with them, and in the present bulletin submits a somewhat concise outline of the investigations and a statement of the results secured, as well as various suggestions relative to the feeding and economic value of these feed stuffs.

COMPOSITION OF MOLASSES.[2]

Molasses may be defined as the residue resulting from the extraction of sugar from the juice of the sugar cane or sugar beet. The following analyses represent the composition of several samples of Porto Rico (cane) molasses.

		1904 Samples.		1905 Samples.		1906 Samples.		Beet Molasses.[3] (Average.)
Water,			24.40		28.50		24.98	21.90
Ash,			7.13		6.04		5.57	7.20
Crude Protein	Albuminoids,	1.24	3.17	0.96	2.82	—	2.19	10.50
	Amids,	1.93		1.86		—		
Extract Matter	Cane sugar,	29.72	65.30	36.26	62.64	37.86	67.26	60.40
	Invert sugars,	25.03		19.38		20.48		
	Undetermined,	10.55		7.00		8.92		
			100.00		100.00		100.00	100.00

Molasses is shown to consist of about one-fourth water, consider-

[2] For a very full description of the manufacture, composition, digestibility and feeding value of beet molasses see Ann. Sci. Agron. 2e Serie Tome I 1904—pages 213-271, 358-375 and Tome II pages 98-209, par MM. J. Alquier et Dr. A. Drouineau; also Presslinge, Diffusionschnitzel, Melasse, von M. Schmoeger. Landw. Versuchsstationen Bd. LIX. p. 145.

[3] German origin.

able ash, a little nitrogen and the balance of non-nitrogenous extract matter. Two analyses of the ash have shown traces of phosphoric acid and 3.66 and 4.84 per cent of potash.[4] The small amount of crude protein consists largely of amids and allied substances. The larger part of the solid matter of molasses is composed of sucrose (cane sugar), invert sugars (dextrose, levulose, etc.) and some gummy matter that will not crystallize. Fiber and fat are naturally not present.

Beet molasses contains more nitrogen than cane molasses but it exists largely in the form of amids, betaine, leucine and ammonia.

Molasses has the same type of composition as corn meal, both being low in protein and very high in carbohydrates. The dry matter of molasses differs chemically from corn meal in containing less nitrogenous matter with an inferior nutritive value, more ash, and in having its extract matter in the form of sugars rather than starch.

Fertilizer Ingredients. The following figures give one an idea of the fertilizer ingredients in molasses and in corn meal.

	PORTO RICO MOLASSES.		CORN MEAL.	
	Per Cent.	Pounds in 2000.	Per Cent.	Pounds in 2000.
No. of analyses, - -	2	—	3	—
Nitrogen, - - - - -	0.44[5]	8.8	1.57[6]	31.4
Phosphoric acid, - -	traces.	—	.71	14.2
Potash, - - - - -	4.25	85.00	.34	6.8
Value a ton,[7] - - -	—	$5.75	—	$6.39

EFFECT OF MOLASSES ON DIGESTIBILITY.

It can be assumed with safety that molasses, being soluble in water, is easily digested and assimilated. It is a well known fact,

[4] For a more extended analysis of the ash of Louisiana molasses, see Bulletin 91 of the Louisiana Experiment Station, page 92.

[5] Average of 3 samples.

[6] Average of 93 samples.

[7] Nitrogen at 17 cents, potash and phosphoric acid at 5 cents a pound.

however, that the addition of considerable quantities of starch, sugar, and similar substances causes a distinct depression in the digestibility of the materials with which they are fed. By digestion depression is meant the checking of the digestion and assimilation of the other feeds.

A number of experiments have been made to study the influence of Porto Rico molasses upon the digestibility of the other ingredients of the ration. The results thus far secured may be stated briefly.[8]

1. When molasses fed together with hay constituted from 10 to 15 per cent of the total dry matter of the ration, little if any depression was noted.

2. With molasses composing some 20 per cent of the dry matter of the hay ration, a depression of 4.5 per cent was noted in the digestibility of the hay, the digestibility of the dry matter of the latter being 58 per cent without the molasses and 55.4 per cent with the molasses.

3. Molasses and hay would not make a satisfactory combination for any kind of farm stock. A more suitable ration would consist of hay, together with one or more protein concentrates and molasses. Consequently the effect of molasses was tested upon a combination of hay and gluten feed. The results of six single trials in which molasses composed from 17 to 24 per cent of the dry matter of the ration (average 20 per cent) show that the dry matter of the combination of hay and gluten without molasses was 72.3 per cent digestible and 66.5 per cent digestible when fed with the molasses, hence the molasses caused a depression of 8 per cent in the digestibility of the hay and gluten.

4. Stated in terms of molasses it may be said that with molasses composing some 20 per cent of the dry matter of the hay-molasses ration, for every 100 grams fed the depression noted was equivalent to 7 per cent of dry matter and 4 per cent of organic matter.

5. When molasses composed from 17 to 24 per cent of the dry matter of the hay-gluten-molasses ration, for every 100 grams fed the depression noted was equivalent to 17 per cent dry matter and 15 per cent organic matter.

By deducting 15 per cent from the 68 per cent of total organic

[8] Nineteenth report of the Massachusetts Experiment Station pages 144-149. Also unpublished data.

matter found in Porto Rico molasses, one obtains 53 per cent equal to 1060 pounds;[9] *or in round numbers 1100 pounds* which may be said to represent the available organic matter in 2000 pounds.

Kellner[10], a prominent German investigator, states that the value of beet sugar molasses for cattle and sheep consists in its 55 per cent of digestible carbohydrates (1100 pounds to the ton), allowance being made for a digestion depression of 9 per cent.

Lehmann[11], another prominent worker, as a result of three digestion experiments (9 single trials) with sheep, obtained a digestion depression of 11 per cent which he deducts from the 71 per cent of total organic matter in beet molasses, thus securing 60 per cent or 1200 pounds of digestible organic matter in one ton.

Grandeau and Aleken[12] have shown that molasses, when fed to horses, causes rather more of a depression than when fed to ruminants. (In case of horses the addition of 3 pounds of molasses per 1000 pounds live weight caused a depression of 4.5 per cent, while with ruminants the feeding of 4 pounds of molasses per 1000 pounds live weight produced an average depression of 3 per cent in the digestibility of the ration).

Patterson[13] reported that in case of two steers when molasses constituted some 12 per cent of the total dry matter of the ration, an improvement of some 24 per cent in the digestibility of the hay was noted. Molasses fed to four steers in combination with hay and grain, and comprising 14 per cent of the total dry matter of the ration, improved the digestibility of the hay and grain ration 14.5 per cent. (Coefficient of digestibility of the dry matter of hay and grain without molasses 55.1 per cent; with molasses 63.1 per cent.) Patterson's results are quite the opposite of all previous work along this line.

DIGESTION COEFFICIENTS OF MOLASSES.

Because of the depression caused by molasses on the feeds with which it is fed, the digestion coefficients secured make it appear that the molasses itself is not fully digested. The following coefficients have been obtained:

[9] If it should be shown as has been claimed by the Boston Molasses Co., that Porto Rico molasses averages 22 per cent of water (the average of German beet molasses), then the 1060 pounds would be increased to 1140 pounds to the ton. The samples thus far examined by us have shown it to average nearly 26 per cent.

[10] Kellner, Die Ernährung der Landw. Nützthiere, p. 350.

[11] Landw. Jahrbücher. Vol. XXV, Ergänzungsband II, 1894.

[12] Resumé in Ann. Sci. Agron. 2e Serie 1904 Tome 1, pages 249-254.

[13] Molasses Feeds, Bulletin 117, Maryland Experiment Station.

Nutrients.	LINDSEY, (American.) Cane Molasses fed with Hay and Grain.	KELLNER, (German.) Beet Molasses fed with Hay and Grain.	Corn Meal for Comparison.
Dry Matter, - -	76	83	90
Ash, - - - - -	67	—	—
Protein, - - - -	—	52	66
Extract Matter, -	86	91	92
Fat, - - - - -	—	—	91

Relative values of molasses and corn meal. Allowing a ton of molasses to contain 1100 pounds and a ton of corn meal to contain 1470 pounds of digestible organic matter; if the latter retails at $25.00 a ton, the molasses would be worth $18.70 a ton or molasses would have 75 per cent of the value of corn meal as a source of digestible carbohydrates.[14]

MOLASSES FOR DAIRY COWS.

Object of the Experiment: Molasses compared with corn meal as a partial component of the daily grain ration in its effect: (1) upon the health, weight and physical appearance of the animals; (2) upon the production of milk and milk ingredients; (3) upon the chemical composition of the milk; (4) upon the cash income and outgo, were the principal problems to be investigated.

Plan of the Experiment: The experiment was conducted upon the reversal plan. Six grade Jersey cows, all fresh in milk during the late summer, were divided into two lots of three each. In the first half of the experiment proper, lasting five weeks, one lot was fed the corn meal ration and the other lot the molasses ration; the rations were then reversed and after an interval of two weeks, the second half of the experiment was continued for another five weeks.

[14] The particularly favorable effect which molasses is believed to have upon the general health of the animal is naturally not included in the above calculations; neither does the lack of protein as compared with corn meal nor the extra cost and bother of handling molasses enter into the above estimate of its value.

HISTORY OF COWS.

Name.	Breed. (Grade)	Age.	Last Calf Dropped.	Yield at Beginning of Trial (Pounds).
Dora, - -	Jersey	11	Aug., 1905	22
Daisy, - -	Jersey	8	Aug., 1905	22
Molly, - -	Jersey	9	July, 1905	20
May, - -	Jersey	10	July, 1905	24
Fancy, - -	Jersey	5	Aug., 1905	26
Samantha,	Jersey	2½	Aug., 1905	21

DURATION OF EXPERIMENT.

Dates.	Molasses Ration (Cows).	Corn Meal Ration (Cows).
Oct. 7 thru Nov. 10.	Daisy, Dora, Molly.	May, Fancy, Samantha.
Nov. 25 thru Dec. 29.	May, Fancy, Samantha.	Daisy, Dora, Molly.

Care of the Cows: The experiment was conducted in the experiment barn especially set apart for such work. Each animal was kept in a roomy stall, and was well carded and turned daily into a yard from one to eight hours whenever the weather permitted.

Method of Feeding: The cows were fed twice daily and watered by the aid of a self watering device placed in each stall. The several grains were well mixed and fed in two equal portions daily. The molasses was weighed out, diluted with about an equal portion of water, and well mixed with the dry grain.

Character of the Feeds. All the feeds were free from objectionable characteristics, such as musty or bad flavors or odors. The spring wheat bran tested rather lower in protein than the average (12.95 per cent). The cottonseed meal tested 37.05 per cent, and the corn meal 8.57 per cent of protein. The Porto Rico molasses was of the usual character but contained rather more water than is commonly found (28.10 per cent). The first cut hay was a mixture of timothy, Kentucky blue grass and clover.

Sampling the Feeds. Small samples of grain were taken daily and preserved in glass stoppered bottles. At the end of each half the composite samples were tested for moisture, and at the end of the experiment the two composites were mixed and analyzed. Each barrel of molasses was carefully sampled, dry matter determined, and the several samples mixed and analyzed. Samples of hay were taken at the beginning, middle and end of each half of the period, run through a cutter, dry matter determined, and the several samples composited and further examined. Sufficient of each kind of feed was procured to last during the entire experiment.

Weighing the Animals. Each cow was weighed for three consecutive days at the beginning and end of each half of the experiment, the weighing being done in the afternoon before feeding and watering.

Sampling the Milk. The milk of each cow was sampled twice daily for seven consecutive days in each week, and preserved with formalin in glass stoppered bottles. The method of sampling consisted in slowly mixing the entire quantity of freshly drawn milk with a disk mixer and immediately removing a small dipper full[15].

AVERAGE RATION CONSUMED BY EACH COW DAILY (Pounds).

Character of Ration.	First Cut Hay.	Wheat Bran.	Cottonseed Meal.	Corn Meal.	Molasses.
Molasses Ration, - -	18.5	3	1	—	3.8
Corn Meal Ration, - -	18.1	3	1	3.8	—

The basal rations were alike in each half of the trial, excepting that two cows ate slightly less hay while receiving the corn meal ration. All of the cows received daily four pounds of molasses, excepting Samantha, which received three pounds.

AVERAGE DRY AND DIGESTIBLE ORGANIC NUTRIENTS CONSUMED DAILY BY EACH COW[16] (Pounds).

Character of Ration.	Dry Matter.	Digestible Organic Nutrients.				Nutritive Ratio.
		Protein.	Carbohydrates.	Fat.	Total.	
Molasses Ration,	22.65	1.32	11.98	.34	13.64	1 : 9.7
Corn Meal Ration,	23.16	1.55	12.45	.48	14.48	1 : 9.0

15 In several instances because of an imperfect mixing of the daily additions the composite became clotted or lumpy after a few days. It was necessary, therefore, to discard these few samples and to take others, so that in a few cases the samples only represented the milkings of three or four days in each week.

16 Calculated from analyses of feeds and digestion coefficients.

The total digestible nutrients contained in the corn meal ration were in accord with those prescribed by Wolff-Lehmann and by Haecker, altho the ration lacked somewhat in digestible protein. Haecker calls for some .30 pounds more of protein daily. This protein deficiency was due to the unusually low percentages of protein in the hay, bran and cottonseed meal. The molasses ration fell short of the Haecker standard about .8 of a pound of total digestible nutrients which includes .5 of a pound of digestible protein. This deficiency was due primarily to the high water content of the molasses and to its lack of protein. The nutritive ratio of each ration was rather wide. The cows ate both rations clean and evidently would have consumed more, and it therefore appears that, other things being equal, the experiment ought to be considered a fair comparison of the relative effects of the two rations.

HERD GAIN OR LOSS IN LIVE WEIGHT.

Ration.	Pounds.
Molasses Ration,	10 +
Corn Meal Ration,	67 +

While receiving the molasses ration, the six cows apparently made a slight gain in live weight. In case of the corn meal ration, the gain was more noticeable although not pronounced.

EFFECT OF MOLASSES ON GENERAL CONDITION.

It was not possible to observe any particularly favorable effect of the molasses on the general health and appearance of the animals, all of which were in uniformly good condition during the entire experiment. The faeces from those animals receiving the molasses ration had a noticeably dark color and were softer than from the animals to which the corn meal ration was fed. If too large an amount of molasses is given at first, purging is apt to result.[17]

[17] We began with a pound daily and added small amounts every other day.

HERD YIELD OF MILK AND MILK INGREDIENTS (Pounds).

Character of Ration.	Total Milk Yield.	Daily per Cow.	Total Milk Solids.	Total Milk Fat.	Butter Equivalent.[18]
Molasses Ration,	3788.9	18.04	543.0	185.4	224.8
Corn Meal Ration,	4126.2	19.65	604.6	209.7	254.1
Percent'ge increase corn meal over molasses ration,	8.9	—	11.3	13.1	—

It is evident that the corn meal ration produced substantially 9 per cent more milk and 11 and 13 per cent more total solids and milk fat than did the molasses ration.

AVERAGE COMPOSITION OF THE HERD MILK (Per Cent).

Character of Ration.	Total Solids.	Milk Fat.	Solids not Fat.
Molasses Ration, - - - - - - -	14.33	4.89	9.44
Corn Meal Ration, - - - - - -	14.65	5.08	9.57
Difference in favor of corn meal,	.32	.19	.13

The molasses appeared to have produced milk with slightly less fat and solids not fat. Whether this is to be attributed to the molasses is not clear but is worthy of further study[19].

FOOD COST OF MILK AND BUTTER.

Character of Ration.	Total Cost of Milk.	Cost of 100 Pounds Milk.	Cost of 100 Pounds Butter.
Molasses Ration, - - - - - - -	$48.34	$1.28	$21.50
Corn Meal Ration, - - - - - -	49.29	1.19	19.41

[18] 82.5 per cent fat equivalent.

[19] A year previous, an experiment of a similar nature was started with four cows. One cow became ill, and the experiment was completed with three. It did not seem wise to publish the results of that experiment since the four cow balance was destroyed. The yield of milk produced by both rations showed only slight variations. In the composition of the milk, substantially identical results were obtained as in the present experiment, the molasses ration producing .26 per cent less fat and .10 per cent less solids not fat than did the corn meal ration.

The figures show that the corn meal ration produced a definite amount of milk and butter fat for less money than did the molasses ration.

DRY AND DIGESTIBLE MATTER REQUIRED TO PRODUCE MILK AND BUTTER (Pounds).

Character of Ration.	Dry Matter.			Digestible Matter.		
	100 lbs. Milk.	1 lb Milk Solids.	1 lb. Milk Fat.	100 lbs. Milk.	1 lb. Milk Solids.	1 lb. Milk Fat.
Molasses Ration, - - - - -	125 5	8.76	25.64	75.61	5.28	15.45
Corn Meal Ration, - - - - -	117.9	8.04	23.20	73.68	5.03	14.53

It is evident that it required from 6 to 10 per cent more dry matter and from 3 to 6 more digestible matter to produce milk and butter with the molasses than with the corn meal ration[20].

FERTILIZER INGREDIENTS IN THE RATIONS.

It has already been shown[21] that a ton of corn meal contains fertilizer ingredients which are approximately 10 per cent more valuable than those in molasses. Inasmuch as both rations were alike, excepting that one contained molasses and the other corn meal, and that molasses constituted only 13 per cent of the dry matter of the ration, practically there would be no difference in the value of the resulting fertilizer ingredients.

EFFECT OF MOLASSES UPON THE CHARACTER OF MILK AND BUTTER.

A number of samples of milk from each cow was taken in thoroughly sterilized glass bottles, brought to the laboratory and tested when both cold and warm by two different parties. Only in case of one cow was a distinct molasses taste noted. Repeated tests of other samples from the same cow failed to reveal the characteristic taste.

It not being possible during this experiment to make butter, the effect of molasses upon the flavor, composition of the butter fat and

[20] The amount of dry matter required was determined ; the amount of digestible matter was estimated by applying average digestion coefficients to the dry matter consumed.

[21] See page 5.

consistency or body of the butter was not noted. This is worthy of further investigation.

SUMMARY.

1. Any particularly favorable effect of Porto Rico molasses upon the general health and appearance of the six milch cows employed in the above described experiment was not observed. The faeces from the molasses fed animals were darker in color and softer than from those receiving the corn meal ration.

2. A daily ration containing nearly four pounds of corn meal produced some 10 per cent more milk and 11 to 13 per cent more total solids and fat than a similar basal ration containing a like amount of Porto Rico molasses.

3. The molasses ration seemed to produce milk with slightly less fat and solids not fat than did the corn meal ration.

4. A like amount of milk and butter from the molasses ration cost 8 to 11 per cent more than from the corn meal ration.

5. Molasses did not produce any unfavorable effect upon the flavor of the milk.

Numerous foreign experiments are recorded relative to the value both of raw molasses and of molasses feeds for milch cows[22]. The results are often contradictory; in some cases it is indicated that molasses increased the fat percentage in the milk, and in other cases the body weight.

The general conclusions at the Copenhagen Experiment Station[23], when experiments were conducted according to the Fjord method were that corn, wheat, wheat bran and also molasses had substantially equal values for dairy stock but that for milk production these were inferior to concentrated feeds rich in protein and fat. A molasses ration did not cause any marked change either in the condition of the animal or in the quality of the milk. It had no effect on the composition of the butter fat other than to increase the melting point some two degrees and render the butter firmer.

Ramm's[23] investigations lead him to conclude that the amido bodies contained in the molasses act as a stimulant upon the mammary glands and check the normal diminution in the secretion of the milk. Both Ramm and Hagermann[23] further maintain that the

[22] Same reference as 2, Schmoeger, etc.

[23] Summary in Ann. Sci. Agron. 2e Serie, Tome II 1904, pages 182-186.

organic matter other than sugar in the molasses increases the fat percentage and the butter producing quality of the milk.

P. Hoppe[23 and 24] demonstrates that the addition of small quantities of molasses (2 pounds daily per 1000 pounds live weight) causes a small increase in the daily milk production, but that the yield is noticeably decreased when the amount supplied daily reaches four pounds per 1000 pounds live weight. Contrary to Ramm and Hagermann, Hoppe notes a decrease in the fat percentage of the milk. He further concludes that an intensive molasses diet is not suitable either for dairy animals or for any other farm stock.

All things considered, the writer does not see any advantage to be gained by Northern farmers from the use of molasses as a food for dairy stock in place of corn meal and similar carbohydrates. As an appetizer for cows out of condition and for facilitating the disposal of unpalatable and inferior roughage and grain, 2—3 pounds of molasses daily undoubtedly would prove helpful and economical.

For fattening beef cattle. Some 3 pounds daily of molasses may be fed advantageously, especially during the finishing process, when the appetite is likely to prove fickle. The object at such times should be to make the food especially palatable and thus induce a maximum consumption and also to secure a bright, sleek appearance.

MOLASSES FOR HORSES.

German investigators have studied the value of both cane and beet molasses as a component of the daily ration for horses.

Kellner[25] remarks that " in addition to the food value of molasses it possesses another very valuable characteristic in that it prevents colic or renders the attacks much less severe. Whoever has once fed molasses to his horses and observed its favorable effect is not inclined to discontinue its use. One must, however, feed it in moderate quantities, since an excessive amount will act as a purgative as well as a diuretic." This investigator considers 3 pounds daily a fair allowance for horses weighing 1000 pounds.

French investigators,[26] as a result of extensive experiments, call attention to the injurious effect on the kidneys and digestive organs of excessive quantities of molasses (12 to 20 lbs. daily). They emphasize the value of molasses as a condiment mixed with other-

---

24 Beiträge zur Frage des Werthes der Melasse als Futtermittel. Leipzig, 1900.

25 Die Ernährung der Landw. Nützthiere, page 351.

26 Les Ailments du Cheval. Dechambre et Curot, pages 278-292.

wise unpalatable foods, and its influence in improving the appetite and digestion of horses out of condition, and likewise its favorable therapeutic effects in case of colic and in respiratory troubles. Nicolas, Lavalard, Laurent, Hollard, Dickson, Malpeaux, Grandeau, Garola and Sidersky have made numerous experiments with horses concerning the value of molasses.[26] The molasses has been fed diluted with water and sprinkled over hay and straw, and also mixed with a variety of substances such as peat, oil cakes, bran, finely cut straw, brewer's grains, etc. These authorities consider 5 pounds daily the maximum quantity for horses weighing 1000 pounds. Laurent, as a result of his experiments, draws the following conclusions:

"1. The employment of molasses as a portion of the ration for draught horses is to be recommended on economic and hygienic grounds.

2. The molasses acts as a condiment which, mixed with coarse fodders, straws and the like, favors their resorption; it is likewise a food and perhaps serves in the ration in place of some other ingredient of nutrition.

3. The objections to the use of molasses in its natural state are not serious, and farmers ought to thus use it in place of the commercial molasses feeds. The latter are more easily handled but cost so much that their use is not considered economical."

M. Hollard reported to the French Society of Veterinary Medicine the satisfactory results which he had secured with molasses as a component of the daily ration for farm horses. He did not purchase molasses feeds, believing it preferable to mix the clear molasses with some of the less desirable roughages, thereby rendering them more palatable. In winter he fed some 2 pounds of molasses daily at night in place of 2 pounds of oats, and in the busy spring and summer months this amount was doubled, the extra quantity being fed at noon. By replacing one-half of the oat ration (12 pounds daily) with molasses and dried brewer's grains he was enabled to effect a saving of 8 cents per head. The animals kept in uniformly good condition and did fully as satisfactory work as upon the oat ration.

In the southern United States, especially on the sugar plantations of Louisiana, large quantities of cane molasses (blackstrap) are fed without any apparent ill effects. Dalrymple[27] states that "the consumption of molasses per day on forty-seven sugar estates during April, 1905, averaged just about 10 pounds, the extremes being from 2 to 3 pounds to a fraction over 21 pounds,—all seem to refer to the marked diminution in the number of cases of dietetic ailments such as colic, etc., and the health and therefore the capacity of the

[27] Bulletin No. 86, Louisiana Experiment Station, pages 45-75.

animals for work being very much improved." The molasses was sometimes fed clear from a trough and in other cases mixed with cut hay, or with crushed corn including cob and shuck, as well as with rice bran and cottonseed meal. Dalrymple failed to note any injurious effects from feeding such large quantities of cane molasses, his observations being contrary to those of German and French investigators with beet molasses.[28]

F. G. Helyar[29] notes an improved appearance and an increase in spirit from feeding about one pound daily of cane molasses to both draught and driving horses. Lack of energy and a rough coat followed a discontinuance of its use. Helyar does not consider it advisable to feed molasses to horses which are in normal condition.

Our Own Experiment with Molasses for Horses.

Our experience with molasses was confined to a single observation with four horses belonging to the agricultural department of this station and was carried out during the months of November, December and January, 1904-1905. The horses were doing light work at the time, and were receiving 15 to 18 pounds of hay and 7 pounds of a mixture of corn and oats daily, (110 pounds cracked corn and 45 pounds oats mixed). In the first period of four weeks, four pounds of molasses were substituted for four pounds of the grain mixture with two of the horses, and in the second period the conditions were reversed. The periods proper were preceded by a preliminary period of 12 days.

DATES OF EXPERIMENTS.

Period.	Character of Ration.	Horses No.	Dates.	No. Weeks.
I	Full Grain and Hay,	2 and 3	Nov. 6 to Dec. 4.	4
	Molasses, Grain and Hay,	1 and 4	Nov. 6 to Dec. 4.	4
II	Full Grain and Hay,	1 and 4	Dec. 16 to Jan. 12.	4
	Molasses, Grain and Hay,	2 and 3	Dec. 16 to Jan. 12.	4

Method of Feeding. The horses were fed three times daily, the molasses being given undiluted in two portions—morning and evening—mixed with the corn and oats.

[28] Beet molasses contains more mineral matter (potash and soda salts) and likewise noticeably more non-protein bodies (amids, betaine, choline, etc.) than does cane molasses, to which its injurious effect may be attributed.

[29] Superintendent of Mt. Hermon (Mass.) Farm. Verbal communication.

Character of Feed Stuffs. The cracked corn and oats were of good average quality. The molasses used was the same as previously described in this bulletin. The hay was of first quality, timothy predominating.

RATION CONSUMED BY EACH HORSE DAILY (Pounds).

First Period.

Horse No.	Corn and Oat Mixture.	Porto Rico Molasses.	Hay.
1	3	4	18
2	7	—	18
3	7	—	18
4	3	4	15

Second Period.

Horse No.	Corn and Oat Mixture.	Porto Rico Molasses.	Hay.
1	7	—	18
2	3	4	18
3	3	4	18
4	7	—	15

AVERAGE DIGESTIBLE NUTRIENTS CONSUMED BY EACH HORSE DAILY[30]

(Pounds)

Character of Ration.	Horses No.	Nutrients per 1,000 lbs. live weight.					Energy in Nutrients. (Calories).
		Protein.	Fat.	Carbohydrates.	Total Nutrients.	Nutritive Ratio.	
Full Grain and Hay, - - -	1-2-3	1.09	.20	8.09	9.38	1 : 7.8	17,920
Full Grain and Hay, - - -	4	1.04	.20	7.64	8.88	1 : 7.8	16,990
Molasses, Grain and Hay, -	1-2-3	.83	.12	8.20	9.15	1 : 10.2	17,303
Molasses, Grain and Hay, -	4	.76	.11	7.70	8.57	1 : 10.4	16,200

30 In making the calculations which follow, average figures were taken for the analysis of the corn, oats and hay, and digestion coefficients obtained for horses were applied. In case of molasses it was allowed that a ton contained 1200 pounds of digestible carbohydrates.

The results of numerous experiments made by various investigators as well as extensive compilations of the rations fed by cab and express companies are stated in the following table for comparison.* The figures represent the different amounts required by horses under a variety of conditions.

Kind of Work.	Nutrients per 1,000 lbs. live weight. Protein.	Fat.	Carbohydrates.	Total.	Nutritive Ratio.	Energy in Nutrients. (Calories).
European Experiments.						
Light. Wolff-German, - - -	1.5	.4	9.5	11.4	1 : 7.0	22,150
Medium. Wolff-German, - - -	2.0	.6	11.0	13.6	1 : 6.2	26,700
Heavy. Wolff-German, - - -	2.5	.8	13.3	16.6	1 : 6.0	32,750
Moderate. Grandeau-French, -	1.9	.4	10.0	12.3	1 : 5.7	23,950
Paris Bus Co.'s Horses, - - -	1.6	.4	12.1	14.1	1 : 8.1	27,200
Ordinary. Lavalard-French, -	1.1	—	11.0†	12.1	1 : 10.0	22,510
Severe. Lavalard-French, - -	1.3	—	11.0†	12.3	1 : 8.4	23,180
American Experiments.						
Light, driving horses, - - - -	1.6	.2	6.4	8.2	1 : 4.3	15,895
Light, general average, - - - -	1.0	.3	6.3	7.6	1 : 7.0	14,890
Moderate, express and cab, - -	1.1	.5	9.0	10.6	1 : 9.2	20,860
Moderate, farm, - - - - - -	1.6	.4	8.1	10.1	1 : 5.6	22,760
Moderate, general average, - -	1.5	.4	9.7	11.6	1 : 7.0	22,710

The calculated energy in total calories in the present experiment compares fairly well with the general average of all American experiments for light work as given in the above table. It is, however, noticeably below that required by French and German experimenters.

WEIGHTS AT BEGINNING AND END OF PERIODS (Pounds).

Full Grain and Hay.

Horses No.	1	2	3	4	Total Gain or Loss.
Beginning, - - - - -	1300	1295	1375	1255	—45
End, - - - - - - - -	1290	1300	1350	1240	

* Taken from Bulletin 125, Office of Experiment Stations, U. S. Department of Agriculture.

† Includes fat multiplied by 2.25.

Molasses, Grain and Hay.

Beginning, - - - - -	1270	1290	1370	1230	+20
End, - - - - - - - -	1285	1300	1345	1250	

The horses appeared to have lost slightly in live weight while on the full grain ration and to have made a slight gain while receiving the ration containing molasses. It is evident, however, that the total nutrients in each of the rations were sufficient to substantially maintain them in equilibrium. The work performed was very irregular; some days they would be engaged in drawing moderate loads from four to seven hours, and at other times they would remain in the stable the entire day. The drivers repeatedly noted and called attention to the fact that the horses receiving the molasses ration were logy and lacked the life of those receiving the full grain. This condition was attributed to the effect of the molasses.

By referring to the digestible nutrients in both rations it will be observed that the molasses ration contained less than one pound of digestible protein per 1000 pounds live weight; furthermore, by observing the feeding standards established by the several investigators (page 19) it will be seen that the minimum protein standard called for by Lavalard is 1.1 pounds daily, and that the general average for light work of all American experiments is one pound daily. It seems probable, therefore, that the logy condition noted was not due primarily to the molasses, nor to the insufficiency of the total nutrients, *but to the lack of digestible protein in the ration*, and this it is believed is the teaching of the experiment.

The several horses were in good condition at the beginning of the trial and no particular effect, favorable or otherwise, excepting the logy condition referred to, was noticed from the four pounds daily of Porto Rico molasses. The faeces maintained their normal condition in all cases. It is evident that the amount of molasses was out of proportion to the amount of grain fed.

In spite of the many reports favorable to the use of molasses for horses, the writer is not inclined to recommend to Northern farmers its indiscriminate use in place of the cereals and their by-products. As an appetizer and tonic for horses out of condition, as a colic preventative and for improving the palatability

of rations, 2 to 3 pounds daily of molasses undoubtedly would prove productive of satisfactory results.

RATIONS CONTAINIG MOLASSES.

1.

Garcola-French.

Crushed Oats,	6½ lbs.
Pail-mel[31],	13 lbs.
Hay,	6–7 lbs.

2.

Nicolas-French[32].

Grain Hulls,	13 lbs.
Bran and Shorts,	13 lbs.
Molasses,	3 lbs.
Water,	6 qts.

3.

Nicolas-French[33].

Grain Hulls,	13 lbs.
Bran and Shorts,	4½ lbs.
Crushed Oats,	6½ lbs.
Molasses,	3 lbs.
Water,	6 qts.

4.

Laurent-French[34].

Oats,	8 lbs.
Barley,	8 lbs.
Wheat Bran,	7 lbs.
Linseed Meal,	½ lbs.
Molasses,	4½ lbs.
Clover Hay,	16 lbs.

5[35].

Dried Brewers' Grains,	5 lbs.
Hominy Feed,	5 lbs.
Molasses[36],	2 lbs.
Hay,	15–18 lbs.

6[35].

Crushed Oats,	5 lbs.
Cracked Corn,	5 lbs.
Molasses,	2 lbs.
Hay,	15–18 lbs.

7[35].

Cracked Corn,	6 lbs.
Wheat Bran,	4 lbs.
Molasses,	2 lbs.
Hay,	15–18 lbs.

8[35].

Hominy Feed,	7 lbs.
Gluten Feed,	3 lbs.
Molasses,	2 lbs.
Hay,	15–18 lbs.

31 A mixture of finely ground straw and molasses.

32 The grain hulls are spread upon the floor, sprinkled and mixed with one-half of the molasses (each pound of molasses is diluted with 2 quarts of water). The bran and shorts are mixed in, after which the balance of the molasses dissolved in water is sprinkled over the mass, which is once more mixed and is then ready for use.

33 Mixed in the same way as in ration 2.

34 Heavy team horses averaging 1430 lbs. in weight. The oats were fed whole, the barley crushed, and the molasses added to the grains in the manger and mixed in.

35 Suggesled by Lindsey for horses weighing 1200 lbs. and doing moderate farm work. Grain can be increased if work is strenuous, and hay somewhat reduced.

36 A quart of molasses weighs about three pounds.

MOLASSES FOR PIGS.

It is generally stated that pigs can take and assimilate considerable quantities of molasses without suffering any ill effects and that the molasses does not exert any digestion depression upon the other feed stuffs.

In order to corroborate the former fact, two pigs each weighing some 50 pounds were fed a daily ration beginning Sept. 21. of 5 quarts of skim milk, 20 ounces of hominy meal and 2 ounces of Porto Rico molasses. The milk, meal and molasses were gradually increased until Nov. 4, when each pig was receiving daily 8 quarts of milk, 2 pounds of meal and about 14 ounces (425 grams) of molasses. At this date each animal was growing well (one weighing 110 pounds and the other 130 pounds) and showing no bad effects from the molasses diet. This method of feeding was continued until Jan. 10, the amount of molasses being increased every few days, at which time each pig received daily 8 quarts of milk, 40 ounces of meal and 67 ounces of molasses (2000 grams). It then appeared that an excess of molasses was being fed; the animals breathed short, their hair appeared rough and the skin quite dark in color as though the circulation was poor. On Jan. 22, they weighed 237 pounds and 266 pounds, but it was apparent that they were receiving a noticeable excess of the molasses and were not assimilating it. The amount was therefore reduced to 57 ounces daily (1600 grams) and the hominy meal increased. The animals immediately improved and their general condition remained satisfactory until they were slaughtered Feb. 12. It was not possible to detect any abnormal condition of their internal organs, nor of their dressed carcasses. No particular study was made relative to the quality or chemical composition of the fat. It was noted that neither of the animals was excessively fat.

The above trial simply confirms the claim that pigs can take comparatively large amounts of cane molasses without trouble. It is necessary however to begin with small amounts and increase slowly every few days. On the appearance of any bad effects such as disturbed circulation manifesting itself in a dark color of the skin and shortness of breath, the quantity should be reduced. The animals consumed daily without apparent trouble, nearly 1.5 pounds of cane molasses for each 100 pounds of live weight, but this quantity is believed to be excessive for long periods. Kellner[37] states that fattening swine can take daily without ill effects, 0.5 pound of beet molasses per 100 pounds live weight.

A number of German experiments are reported[38] in which molasses and blood or meat meal and molasses were used as substitutes or partial substitutes for corn, barley and rye meals. The gain in live weight, while in some cases not quite equal to that produced by the several cereals, was on the whole satisfactory. J. Klein[39] states that one kilo of a mixture of barley and corn meal (fed together with 105 grams of meat meal) produced on the average, as large an increase in live weight as 1.21 kilos of molasses (i. e. molasses had 85 per cent of the feeding value of these cereals). Klein recommends mixing the molasses with palm-nut meal rich in protein.

Danish experiments conducted by the Fjord method[39] show substantially equal results from the same amount of barley, rye, wheat and corn meals, and from molasses; also that one part by weight of these several feeds proved equal in feeding value to six parts by weight of skim milk and twelve parts by weight of whey. The fat produced by corn was of inferior quality (soft and oily) but was improved by the other grains and by molasses.

Maercker[38] states that in the case of pigs, molasses fed in combination with peat (Torfmelasse) gives the best results, the faeces excreted being in excellent mechanical condition and free from the odor of butyric acid. One pound of this feed stuff can be given daily per 100 pounds live weight. Lehmann[38] secured poor results when molasses was fed together with sour milk.

Forristall[40] reports quite satisfactory results from the following mixture for growing and fattening pigs: "Fifty pounds of low grade wheat flour were stirred into a barrel full of water and the mixture steamed for an hour or two until it was well thickened; a gallon of molasses was then added."

If molasses is used for the nutrition of pigs, it must be mixed with foods reasonably rich in protein. If skim milk is not available, a combination by weight of two parts bran, one part gluten feed, one part corn meal and one part molasses; or one part tankage, four parts corn meal and one part molasses, ought to prove satisfactory. The writer sees no particular advantage under ordinary conditions for the Northern farmer to employ molasses for pig feeding other than as an appetizer.

---

37 See Reference 1, Kellner etc. page 252.

38 See Reference 2, Schmoeger, etc. page 153.

39 Resume in Ann. Sci. Agron. 2e Serie Tome II, 1904, p. 128-130.

40 Superintendent of M. A. C. Farm—Verbal statement.

PART II. MOLASSES DAIRY FEEDS.

CONTENTS.

COMPOSITION.

The molasses or sugar feeds found in New England markets are composed of oat and barley residues, partially ground grain screenings and malt sprouts in many cases, one-fourth to one-third molasses, and sufficient gluten feed and cotton seed meal to supply the protein guaranteed.

Dried molasses-beet pulp[43] has been previously described. Mueller's molasses grains has been noted to consist of dried brewers' grains, malt sprouts, dried beet pulp and molasses. This material frequently has been found to be unduly sticky and of uneven chemical composition. The more common molasses feeds—Sucrene and Green Diamond brands—are yellowish brown in color, slightly sticky to the touch, but of a satisfactory mechanical condition. Molac and Holstein dairy feeds are coarser and darker in color than the former two.

CHEMICAL COMPOSITION.

Brands.	Sucrene Dairy.	Green Diamond.	Holstein.	Molac.	Hammond.	Wheat Bran for Comparison
No. Samples	3	3	2	2	1	—
Water, -	11.61	6.15	9.85	11.55	10.98	10.00
Ash, - -	6.87	6.30	6.18	5.02	8.66	6.20
Protein, -	16.44[44]	17.11[45]	12.01	17.38[46]	15.14[47]	16.30
Fiber, - -	9.98	10.48	10.05	12.79	11.88	10.00
Ext. Matter,	51.64	56.87	59.59	50.24	49.41	53.10
Fat, - - -	3.46	3.09	2.32	3.02	3.93	4.40
	100.00	100.00	100.00	100.00	100.00	100.00

43 Bulletin 99 of this Station.
44 Average percentage of protein in 3 samples collected in 1907, 18.25.
45 Average percentage of protein in 3 samples collected in 1907, 15.53.
46 Average percentage of protein in 5 samples collected in 1907, 16.53.
47 Average percentage of protein in 1 sample collected in 1907, 18.16.

In their percentage composition, the several brands closely resemble wheat bran and likewise each other. The Holstein feed contained rather less protein and more extract or starchy matter than the others. The protein in this class of feeds is derived principally from malt sprouts, cottonseed meal and gluten feed; the fibre particularly from the cereal residues, and the extract matter largely from the cereal residues and from the molasses. The carbohydrate matter consists of sugar, starch and pentosans.

DIGESTIBILITY.

Digestion experiments with sheep were made with the several molasses feeds and the resulting coefficients follow:

Figures equal percentages of the different ingredients digestible.

Brands.	Sucrene.	Green Diamond.	Holstein.	Macon.[48]	Average Four Brands.	For Comparison.		
						Wheat Bran.	Flour Middlings.	Gluten Feed.
Dry Matter,	69	66	71	71	69	62	83	85
Ash,	38	38	33	20	32	—	—	—
Protein,	61	70	66	59	64	77	85	85
Fiber,	72	44	44	44	51	21	36	76
Extract Matter,	73	74	80	82	77	69	88	89
Fat,	94	84	88	82	87	66	85	83

Applying the above coefficients to the percentages or pounds in 100 contained in the different brands and multiplying the results by 20, one secures the data in the next table.

[48] Macon was a brand furnished by Chapin & Co. of St. Louis. In chemical composition and appearance it resembled the Green Diamond.

DIGESTIBLE ORGANIC NUTRIENTS IN 2,000 POUNDS.

Brands.	Sucrene.	Green Diamond.	Holstein.	Macon.	Average Four Brands.	For Comparison.		
						Wheat Bran.	Wheat Middlings.	Gluten Feed.
Protein, - - - -	200	239	158	160	189	254	338	440
Fiber, - - - - -	144	92	88	80	101	58	24	110
Extract Matter, -	754	842	954	976	882	732	1048	964
Fat, - - - - -	65	52	40	25	45	60	82	50
Total, - - - -	1163	1225	1240	1241	1217	1104	1492	1564

The four different brands examined contained about equal amounts of digestible nutrients, none varying widely from the average. The amount of digestible fiber and fat in the Sucrene feed was in excess of that in the other three brands. Being manufactured feeds, one cannot say the above figures would remain constant for the reason that the nature and variety of the substances entering into their composition may at any time be changed. It is likely, however, that the averages presented will represent fairly well the amount of digestible matter contained in a definite amount of the several brands under consideration.

The total digestible organic nutrients contained in the molasses feeds are in excess of those in wheat bran, but noticeably below those in flour middlings or gluten feed. The amount of protein contained in bran, middlings and gluten feed is decidedly greater than that in the average of the several molasses feeds. The latter class of feeds may be said to be only moderately digestible.

MOLASSES FEEDS FOR MILK PRODUCTION.

Sucrene Dairy Feed vs. Wheat Bran and Gluten Feed.

Two experiments were conducted to compare the effect of a definite amount of Sucrene dairy feed[49] with a mixture of wheat bran and

49 The sucrene feed was furnished by the American Milling Co. from stock in the hands of their local agents.

gluten feed[50]; (a) on the health of the animals and (b) on the yield and cost of milk and milk ingredients.

Four cows were employed in each experiment which was made by the reversal method. The first experiment extended over a period of 5 and the second over a period of 11 weeks. Unfortunately both herds suffered an attack of scours and while the experiments were completed, the disturbance so seriously interfered with the accuracy of the results as to render a detailed statement unwarranted. It may be said that the Sucrene feed appeared to be in no way responsible for the trouble for the reason that different cows on both grain rations were affected[51]. A few general statements relative to the experiments may prove of interest.

EFFECT ON THE HEALTH OF THE ANIMAL.

It was not noted that the Sucrene feed had any particular effect favorable or otherwise, upon the general health and appearance of the animals, all of which were uniformly in good condition at the beginning of the experiment. The animals ate the molasses feed readily, appeared to relish it and maintained their weight during both experiments.

YIELD OF MILK AND MILK INGREDIENTS (Pounds).

Experiments 1 and 2.

Character of Ration.	Milk.	Total Solids.	Total Fat.
Sucrene, - - - - - - - - - -	7357.4	1022.8	362.9
Bran and Gluten, - - - - - -	7639.6	1092.4	384.5
Percentage increase Bran and Gluten over Sucrene, - - -	3.8	6.8	6.0

It is not claimed that the above figures represent the exact difference in the feeding effect of the two rations for the reason previously explained. In experiment 1, two of the cows scoured while on bran and gluten and in experiment 2, two were affected just as they were

50 Three pounds of bran to four of gluten.

51 Soy bean and corn silage constituted a part of the basal rations. In some portions of the mixture, the soy bean predominated and it is believed that an excess of this plant in a state of fermentation and slight decomposition was the cause of the trouble.

about to begin the Sucrene period proper. It may be safely assumed, judging from observations made at the time and from data secured, that the bran and gluten ration produced rather better results than the Sucrene ration; further deductions cannot be drawn. The above figures in no way reflect seriously upon the character of the sucrene feed. They show that combined with a good quality of hay and with corn and soy bean silage, this feed was capable of making a fairly satisfactory showing. To its deficiency in digestible protein and in total digestible matter and to the presence of weed seeds[52] is to be attributed its inferiority to a combination of bran and gluten.

MACON SUGAR FEED VS. WHEAT BRAN AND GLUTEN FEED.

Macon sugar feed had the same general type of composition as did other feeds of this class. It was lower in protein than the average (13.54 per cent.)

Four cows that had been used in second experiment just described, were employed in this experiment which extended over a period of four weeks, and was conducted by the reversal method. The method of caring for the cows and sampling of feeds and milk was the same as described under the experiment with molasses.

The Macon feed was unusually dry so that in order to make a fair comparison, an equal amount of dry matter of this feed was compared with an equal amount of dry matter of bran and gluten[53]. A nice quality of hay and rowen constituted the basal ration. The animals ate the daily rations clean and no disturbances were noted during the entire experiment.

YIELD OF MILK AND MILK INGREDIENTS (Pounds).

Character of Ration.	Total Milk.	Average Daily Yield.	Total Solids.	Total Fat.
Macon Sugar Feed,	1877.4	16.76	262.38	93.16
Bran and Gluten Feed,	2084.6	18.61	297.01	106.25
Percentage increase Bran and Gluten over Macon ration,	11.0	—	13.2	14.0

[52] Recent samples show that the weed seeds are mostly ground, which would enable them to be more or less digested, and would prevent their distribution in the manure.

[53] Equal parts by weight.

The four cows had been five to six months in milk at the beginning of this experiment. They gained in live weight some 118 pounds on the Macon and some 69 pounds on the bran and gluten ration. It is evident that the former ration with its less protein and wider nutritive ratio was better suited to the putting on of flesh than for milk production, especially with animals that had been milked for a considerable length of time. While it enabled the cows to produce a fair yield and to lay on a little flesh, it lacked the digestible protein necessary to stimulate the flow of milk. If a poor quality of hay had been employed in place of the extra quality of hay and rowen actually fed, the difference in favor of the bran and gluten, it is believed, would have been more marked. The food cost of milk and butter fat produced by the Macon ration was respectively 10 and 12.9 per cent above that produced by the bran and gluten ration.

MOLASSES FEEDS VS. HOME MIXED GRAIN RATIONS.

In Bulletin 112 issued by the Station, the writer stated that a ready ration for dairy stock whether proprietary or home mixed should be bulky, palatable, free from mould and rancidity, and should contain at least 16 lbs. of digestible protein and 70 pounds of digestible organic nutrients, in 100 lbs. and not over 9 per cent of total fibre.

The proprietary molasses feeds may be regarded as satisfactory in so far as bulk and palatability are concerned; they do not meet the other requirements however, in that they have been found to average but 9.4 lbs. of digestible protein and 61 lbs. of total digestible organic nutrients in 100 lbs.

The comparison may be carried still further by studying the composition and cost of the following grain mixtures:

1.

7 lbs. (7 qts.) Molasses Feeds contain:

.66 lbs. digestible protein,
4.26 lbs. digestible organic matter,
7 lbs. cost 9.8 cents,
1 lb. digestible protein costs 9.36 cents,
1 lb. digestible organic matter costs 2.30 cents.

2.

100 lbs. Bran,
100 lbs. Flour Middlings,
150 lbs. Gluten Feed,
Mix and feed 7 lbs. (8-9 qts.) daily.

7 lbs. contain:

1.25 lbs. digestible protein,
5.00 lbs. digestible organic matter.
7 lbs. cost 11.5 cents,
1 lb. digestible protein costs 6.1 cents,
1 lb. digestible organic matter costs 2.30 cents.

3.

100 lbs. Bran,
100 lbs. Gluten Feed,
35 lbs. Cottonseed Meal,
Mix and feed 7 lbs. (8-9 qts.) daily.
7 lbs. contain:
1.40 lbs. digestible protein,
4.70 lbs. digestible organic matter,
7 lbs. cost 10.85 cents,
1 lb. digestible protein costs 5. 6 cents,
1 lb. digestible organic matter costs 2.31 cents.

4.

125 lbs. Bran,
100 lbs. Cottonseed Meal,
125 lbs. Corn Meal,
Mix and feed 7 lbs. (8 qts.) daily.
7 lbs. contain:
1.24 lbs. digestible protein,
4.66 lbs. digestible organic matter,
7 lbs. cost 11.1 cents,
1 lb. digestible protein costs 6.1 cents,
1 lb. digestible organic matter costs 2.38 cents.

5.

150 lbs. Bran,
200 lbs. Gluten Feed,
Mix and feed 7 lbs. (9 qts.) daily.
7 lbs. contain:
1.25 lbs. digestible protein,
4.80 lbs. digestible organic matter,
7 lbs. cost 11.3 cents,
1 lb. digestible protein costs 6.1 cents,
1 lb. digestible organic matter costs 2.35 cents.

6.

200 lbs. Distillers' Dried Grains,
150 lbs. Flour Middlings,
Mix and feed 7 lbs. (8-9 qts.) daily.
7 lbs. contain:
1.40 lbs. digestible protein,
5.20 lbs. digestible organic matter,
7 lbs. cost 11.9 cents.
1 lb. digestible protein costs 5 4 cents.
1 lb. digestible organic matter costs 2.30 cents.

SUMMARY.

Character of Grain Ration.	Digestible (Pounds). Protein.	Digestible (Pounds). Org. Matter.	Cost (Cents). 7 lbs. Ration.	Cost (Cents). 1 lb. Digestible Protein.	Cost (Cents). 1 lb. Digestible Org. Matter.	Dollars. Average Cost of 1 ton.
Ration 1.						
7 lbs. Molasses Feed, - - -	.66	4.26	9.8	9.36	2.30	$28.00
Rations 2-6.						
7 lbs. Mixtures, - - - - -	1.31	4.83	11.33	5.86	2.33	32.40

The calculations summarized in the above table enable one to draw the following conclusions:

1. While 7 pounds of grain in the form of molasses feed cost rather less than a like amount in the form of the home mixed concentrates yet the former furnishes decidedly less digestible protein and noticeably less digestible organic matter than do the latter rations.

2. Digestible protein in molasses feed at present prices costs considerably more than in the home mixed concentrates.

3. Digestible organic matter in molasses feed at present prices costs about the same as in the home mixtures. A year ago digestible matter could be purchased cheaper in the form of standard concentrates than in molasses feeds.

Molasses has been shown to be an easily digested carbohydrate and dairy rations suitably compounded of which it is a component, ought to give satisfactory results. The chief objections to the present proprietary molasses dairy feeds in comparison with home mixtures, have been shown to consist in the marked amount of hulls and screenings which they contain, and in their protein deficiency and cost. Either of the following combinations containing molasses, if brought into merchantable condition, ought to prove desirable as a ready dairy ration:

1.	2.
500 lbs. Malt Sprouts,	500 lbs. Bran,
500 lbs. Cottonseed Meal,	600 lbs. Cottonseed Meal,
200 lbs. Gluten Feed,	200 lbs. Gluten Feed,
600 lbs. Molasses,	500 lbs. Molasses,
200 lbs. Oat Feed.	200 lbs. Oat Feed.

That it would be possible for the manufacturer to bring together these or similar feeds, mix, dry, bag and transport them, allow a satisfactory commission to local agents, and offer them in competition with home mixtures appears doubtful to the writer. In most cases staple by-products are freely offered at retail at a very reasonable advance over wholesale cost and are likely to prove more economical to the consumer than proprietary mixtures.

CONCERNING WEED SEEDS.

Some molasses feeds have been found to contain large quantities of unground weed seeds.

These seeds pass through the animal undigested and are distributed over the field with the manure.

The farmer not only pays at the rate of $26 to $28 a ton for material having no feeding value but he likewise is obliged to spend his money and energy in destroying the pests the following season.

Question !! Does it pay to buy weed seeds?

BULLETIN No. 119. DECEMBER, 1907.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

INSPECTION OF COMMERCIAL FERTILIZERS

BY

H. D. HASKINS, E. T. LADD and W. E. DICKINSON

This bulletin contains the chemical analyses of licensed commercial fertilizers sold in Massachusetts during the past season. The details of the inspection are explained and discussed, deductions are drawn and a summary shows the general condition of the fertilizer industry as regards composition of the various brands. The comparative standing of the several firms is shown as based on results of the inspection.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

Agricultural Experiment Station,
Amherst, Mass.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. Lindsey, Chemist.

Inspection of Commercial Fertilizers

FOR THE SEASON OF 1907

By H. D. Haskins, Chemist in Charge.

ASSISTED BY

E. T. Ladd and W. E. Dickinson.

New Fertilizer Legislation. According to a recent Act of the State Legislature, a portion of Section 7 of the Legislative Acts for 1896, Chapter 297, has been, in effect, repealed.

The earlier law relating to the publication of results of analyses of the officially collected samples of fertilizers reads as follows: "And shall publish the results from time to time, with such additional information as the circumstances render advisable, *provided such information relates only to the composition of the fertilizer or fertilizer material inspected.*

The aim of the new act is to give authority to publish in connection with the analysis of each brand, *the retail cash price per ton*, the *comparative commercial value per ton* of the ingredients found in each fertilizer and the *percentage of difference between the said price and the said value.*

The passage of this new Act will in effect repeal that portion of Section 7 of the earlier Act which forbids the publication of data relating to valuations.

ACTS AND RESOLVES OF MASSACHUSETTS FOR 1907 (CHAPTER 289.)

Section 1. Be it enacted etc. as follows:—The bulletins or other publications of the Massachusetts Agricultural Experiment Station containing information about fertilizers shall, in all cases, state the dealers' cash price per ton for such fertilizers, and the value per ton of the ingredients of the same, and the percentage of difference between the said price and the said value.

Section 2. This act shall take effect upon its passage.

The necessary data have been collected in accordance with the above Act and the method employed in obtaining said data is described on a subsequent page.

Summary of Inspection Data.

Seventy-seven manufacturers, importers and dealers, including the various branches of the American Agricultural Chemical Co., have secured licenses for the sale of fertilizers in Massachusetts during the season of 1907.

Three hundred and seventeen brands of fertilizer and agricultural chemicals have been licensed in the State during the year.

Five hundred and thirteen samples, representing three hundred and fifty-eight distinct fertilizers have been analyzed.

Forty-five more brands have been tested than during the previous season.

List of Manufacturers and Brands.

The following list gives the names of all the manufacturers or importers legally selling fertilizer in the State and the brands licensed by each.

The American Agricultural Chemical Co. 92 State St., Boston, Mass.

High Grade Fertilizer with 10% Potash,
Grass and Lawn Top Dressing,
Tobacco Starter and Grower,
High Grade Tobacco Manure,
Fine Ground Bone,
Dissolved Bone Black,
Muriate of Potash,
Double Manure Salts,
High Grade Sulphate of Potash,
Nitrate of Soda,
Dry Ground Fish,
Plain Superphosphate,
Sulphate of Ammonia,
Kainit,
Dried Blood,
Fine Ground Tankage,
Ground South Carolina Phosphate,
Baker's A. A. Ammoniated Super.,
Baker's Complete Potato Manure,
Bradley's Complete Manure Potatoes and Vegetables,
Bradley's Comp. Man. Corn and Grain,

American Agr. Chem. Co. (Continued).

Bradley's Comp. Man. with 10% Potash,
Bradley's Complete Manure Top Dress. Grass and Grain,
Bradley's X. L. Superphosphate,
Bradley's Potato Manure,
Bradley's Potato Fertilizer,
Bradley's Corn Phosphate,
Bradley's Seeding Down Manure,
Bradley's Eclipse Phosphate,
Bradley's Niagara Phosphate,
Bradley's English Lawn Fertilizer,
Bradley's Columbia Fish and Potash,
Bradley's Abattoir Bone Dust,
Church's Fish and Potash,
Bradley's Comp. Man. for Asparagus,
Clark's Cove Bay State Fertilizer,
Clark's Cove Bay State Fert. G. G.,
Clark's Cove Great Planet Manure,
Clark's Cove Potato Manure,
Clark's Cove Potato Fertilizer,
Clark's Cove King Philip Guano,
Crocker's Corn Phosphate,
Crocker's Potato, Hop and Tobacco,
Crocker's A. A. Complete Manure,
Cumberland Superphosphate,
Cumberland Potato Fertilizer,
Darling's Blood, Bone and Potash,
Darling's Complete 10% Manure,
Darling's Potato Manure,
Darling's Farm Favorite,
Darling's Potato and Root Crop Man.,
Darling's General Fertilizer,
Great Eastern Northern Corn Special,
Great Eastern Veg., Vine and Tobacco,
Great Eastern Garden Special,
Great Eastern General,
Great Eastern Grass and Oats Fert.,
Pacific High Grade Special,
Pacific Potato Special,
Soluble Pacific Guano,
Pacific Nobsque Guano,
Packers' Union Gardener's Comp. Man.,
Packers' Union Animal Corn Fertilizer,
Packers' Union Universal Fertilizer,
Packers' Union Wheat, Oats and Clover,
Quinnipiac Market Garden Manure,
Quinnipiac Phosphate,
Quinnipiac Potato Manure,
Quinnipiac Potato Phosphate,
Quinnipiac Corn Manure,
Quinnipiac Climax Phosphate,
Quinnipiac Onion Manure,
Read's Practical Potato Special,
Read's Farmers' Friend,
Read's Standard,
Read's High Grade Farmers' Friend,
Read's Vegetable and Vine,
Standard Complete Manure,
Standard Fertilizer,
Standard Special for Potatoes,
Standard Guano,
Tucker's Original Bay State Bone Superphosphate,
Tucker's Special Potato,
Wheeler's Corn Fertilizer,
Wheeler's Potato Manure,
Wheeler's Havana Tobacco Grower,
Wheeler's Bermuda Onion Grower,
Wheeler's Grass and Oats Fertilizer,
Williams & Clark's High Grade Special,
Williams & Clark's Americus Phos.,
Williams & Clark's Potato Manure,
Williams & Clark's Royal Bone Phos.,
Williams & Clark's Pro. Crop Produc.,
Williams & Clark's Potato Phosphate.

W. H. Abbott, Holyoke, Mass.

Abbott's Animal Fertilizer,
Abbott's Onion Fertilizer,
Abbott's Eagle Brand,
Abbott's Tobacco Fertilizer.

American Cotton Oil Co., 27 Beaver St., New York, N. Y.

Cottonseed Meal,
Cotton Hull Ashes.

American Linseed Co., 100 William St., New York, N. Y.

Linseed Meal.

Armour Fertilizer Works, 861 Calvert Building, Baltimore, Md.

Armour's Fruit and Root,
Armour's Blood, Bone and Potash,
Armour's High Grade Potato,
Armour's All Soluble,
Armour's Ammon. Bone with Potash,
Armour's Bone Meal,
Armour's Complete Potato,
Armour's Corn King,
Armour's Market Garden,
Armour's Grain Grower,
Armour's Amer. Farm. Fish and Potash.

H. J. Baker & Bro., 100 William St., New York, N. Y.

Castor Pomace.

Beach Soap Co., Lawrence, Mass.

Beach's Advance Brand,
Beach's Reliance Brand,
Beach's Fertilizer Bone.

Berkshire Fertilizer Co., Bridgeport, Conn.

Berkshire Grass Special,
Ammoniated Bone Phosphate,
Potato and Vegetable Phosphate,
Complete Fertilizer.

Bonora Chemical Co., 488 Broadway, New York, N. Y.

Nature's Plant Food "Bonora."

Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.

Bowker's Tobacco Ash Elements,
Bowker's Gloucester Fish and Potash,
Bowker's Potash Bone,
Bowker's Sure Crop Phosphate,
Bowker's Potash or Staple Phosphate,
Bowker's 10% Manure,
Bowker's Bone and Potash, Square Brand,
Bowker's Bone and Wood Ash Fert.,
Bowker's Bristol Fish and Potash,
Clover Brand, Bone and Wood Ash Fertilizer,
Bowker's Corn Phosphate,
Bowker's Farm and Garden Phosphate,
Bowker's Potato and Veg. Phosphate,
Bowker's Fresh Ground Bone,
Bowker's Hill and Drill Phosphate,
Bowker's Tobacco Starter,
Bowker's Fish and Potash, Square Brand,
Bowker's Fish and Potash, D. Brand,
Bowker's Corn, Grain and Grass Fert.,
Bowker's Cranberry Phosphate,
Bowker's High Grade Fertilizer,
Bowker's Soluble Animal Fertilizer,
Bowker's Potato and Vegetable Fert.,
Bowker's Market Garden Fertilizer,
Bowker's Lawn and Garden Dressing,
Bowker's Early Potato Manure,
Bowker's Complete Alkaline Tobacco Grower,
Bowker's Blood, Bone and Potash,
Bowker's Dissolved Bone,
Bowker's Plain Superphosphate,
Bowker's Nitrate of Soda,
Stockbridge Special Manures,
Bowker's Sulphate of Ammonia,
Bowker's Dried Blood,
Bowker's Tankage,
Bowker's Dry Ground Fish,
Bowker's Muriate of Potash,
Bowker's Double Sulphate of Potash and Magnesia,
Bowker's High Grade Sulphate of Potash,
Bowker's Kainit,
Bowker's Ammon. Food for Flowers,
Bowker's Seeding Down Fertilizer,
Bowker's Dissolved Bone Black,
Bowker's Canada Hard Wood Ashes,
Bowker's Tobacco Carbonates.

Joseph Breck & Sons, Corporation, 51-52 North Market St., Boston, Mass.

Breck's Lawn and Garden Dressing,
Breck's Flower Food,
Breck's Market Garden Manure,
Breck's Ram's Head Brand Pulverized Sheep Manure.

T. W. Brode & Co., 40 So. Front St., Memphis, Tenn.

Cottonseed Meal.

Buffalo Fertilizer Co., William St., Buffalo, N. Y.

Fish Guano,
Farmers' Choice,
Ideal Wheat and Corn,
Celery and Potato Special,
Vegetable and Potato,
Garden Truck,
Top Dresser,
Buffalo Tobacco Producer,
Buffalo Bone Meal.

T. H. Bunch Co., Little Rock, Ark.

Cottonseed Meal.

Charles M. Cox Co., 714 Chamber of Commerce, Boston, Mass.

Cottonseed Meal.

The Coe-Mortimer Co., 24-26 Stone St., New York, N. Y.

E. Frank Coe's Columbian Corn and Potato Fertilizer,
E. Frank Coe's Celebrated Special Potato Fertilizer,
E. Frank Coe's Excelsior Potato Fert.,
E. Frank Coe's Gold Brand Excelsior Guano,
E. Frank Coe's High Grade Ammoniated Bone Superphosphate,
E. Frank Coe's New Englander Corn and Potato Fertilizer,
E. Frank Coe's XXV Ammoniated Bone Phosphate,

The Coe-Mortimer Co. (Continued).

Nitrate of Soda,
Thomas Phosphate Powder (Basic Slag Phosphate),
Muriate of Potash,
Genuine Peruvian Guano, Chincha Grade,
Genuine Peruvian Guano, Lobos Grade,
High Grade Sulphate of Potash,
High Grade Dis. Bone and Potash.

John C. Dow Co., 13-14 Chatham St., Boston, Mass.

Dow's Pure Bone.

Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.

Imperial Plant Food.

Eureka Liquid Fertilizer Co., 35 Congress St., Boston, Mass.

Eureka Liquid Fertilizer.

R. & J. Farquhar & Co., 6-7 South Market St., Boston, Mass.

Farquhar's Vegetable and Potato Fert.,
Thompson's Imp. Vine, Plant and Veg.,
Farquhar's Farm and Garden Dressing,
Thompson's Special Crysanthemum Manure,
Farquhar's Pure Ground Bone,
Clay's London Fertilizer.

Fertilizer Products Co., 76 Hudson St., Jersey City, N. J.

Plant Blood.

C. W. Hastings, Ashmont, Mass.

Ferti Flora.

Thomas Hersom & Co., New Bedford, Mass.

Bone Meal,
Meat and Bone.

The Home Soap Co., 103 Webster St., Worcester, Mass.

Ground Bone.

Humphreys Godwin Co., Memphis, Tenn.

Cottonseed Meal.

Hunter Bros. Milling Co., St. Louis, Mo.

Prime Cottonseed Meal.

A. Klipstein & Co., 122 Pearl St., New York, N. Y.

Carbonate of Potash.

John Joynt, Lucknow, Ontario, Can.

Canada Hard Wood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.

Lister's High Grade Special,
Lister's Success,
Lister's Special Corn,
Lister's Potato Manure,
Lister's Special Tobacco Fertilizer,
Lister's 10% Potato Grower,
Lister's Bone and Potash,
Lister's Ground Bone.

George E. Marsh Co., Lynn, Mass.

Bone Meal.

George L. Monroe & Sons, Oswego, N. Y.

Pure Canada Unleached Wood Ashes.

D. M. Moulton, Monson, Mass.

Moulton's Ground Bone.

Mapes Formula and Peruvian Guano Co,, 143 Liberty St., New York.

Potato Manure,
Tobacco Starter, Improved,
Tobacco Manure, Wrapper Brand,
Economical Potato Manure,
Average Soil Complete Manure,
Vegetable Manure or Complete Manure for Light Soils,
Corn Manure,
Complete Manure "A" Brand,
Cereal Brand,
Cauliflower and Cabbage Manure,
Grass and Grain Spring Top Dressing,
Fruit and Vine Manure,
Complete Manure 10% Potash,
Top-dresser, Improved, Half Strength,
Tobacco Ash Constituents,
Mapes Complete Man. for General Use.

Mitchell Fertilizer Co., Tremley, N.J.

Mitchell's Special Vegetable Fertilizer.

National Fertilizer Co., Bridgeport, Conn.

Chittenden's Potato Phosphate,
Chittenden's Complete Fertilizer,
Chittenden's Fish and Potash,
Chittenden's Tobacco Starter,
Chittenden's Tobacco Grower,
Chittenden's Market Garden,
Chittenden's Tobacco Special with Carbonate of Potash,
Chittenden's Complete Tobacco,
Chittenden's High Grade Special Tob.,
Chittenden's Ammoniated Bone,
Chittenden's Formula "A",
Chittenden's Fish and Potash X,
Chittenden's Dry Ground Fish,
Chittenden's Fine Ground Bone,
Chittenden's Double Manure Salts,
Chittenden's High Grade Sulphate of Potash.

New England Fertilizer Co., 40 A North Market St., Boston, Mass.

New England Corn Phosphate,
New England Potato Fertilizer,
New England Superphosphate,
New England Complete Manure,
New England High Grade PotatoFert.,
New England High Grade Special,
New England Corn and Grain Fertilizer,

Olds & Whipple, Hartford, Conn.

O. & W. Complete Tobacco Fertilizer.
O. & W. Complete Onion Fertilizer,
O. & W. Corn and Potato Fertilizer,
O. & W. Vegetable Potash,
O. & W. Dry Ground Fish.

Parmenter & Polsey, Fertilizer Co., Peabody, Mass.

Plymouth Rock Brand,
Special Potato Fertilizer,
Pure Ground Bone.

R. T. Prentiss, Holyoke, Mass.

Complete Fertilizers.

Benjamin Randall, Chelsea St., Boston, Mass.

Boston Fertilizer Market Garden,
Boston Fertilizer Farm and Field.

W. W. Rawson & Co., Boston, Mass.

Rawson'sSpecial Lawn and Gard.Dress.,
Rawson's Lawn and Garden Dressing,
Rawson's Fine Ground Bone,
Rawson's Wizard Brand Pulverized Sheep Manure.

Ross Bros. Co., 88-92 Front St., Worcester, Mass.

Ross Bros'.Lawn and Garden Fertilizer,
Nitrate of Soda,
Phosphatic Slag.

N. Roy & Son, South Attleboro, Mass.

Complete Animal Fertilizer.

Rogers & Hubbard Co., Middletown, Conn.

Hubbard's Complete Phosphate,
Hubbard's Grass and Grain Fertilizer,
Hubbard's Market Garden Phosphate,
Hubbard's Oats and Top Dressing,
Hubbard's Potato Phosphate,
Hubbard's Sol. Corn and Gen. Crops,
Hubbard's Soluble Potato Manure,
Hubbard's Pure Raw Knuckle Bone Flour,
Hubbard's Soluble Tobacco Manure,
Hubbard's Strictly Pure Fine Bone.

The Rogers Manufacturing Co., Rockfall, Conn.

All Round Fertilizer,
High Grade Corn and Onion,
Complete Potato and Vegetable,
Fish and Potash,
High Grade Tobacco and Potato,
High Grade Oats and Top Dressing,
High Grade Grass and Grain,
High Grade Soluble Tobacco,
Pure Knuckle Bone.

Russia Cement Co., Gloucester, Mass.

Essex Dry Ground Fish,
Essex Complete Manure for Corn, Grain and Grass,
Essex Complete Manure for Potatoes, Roots and Vegetables,
Essex Market Garden and Potato,
Essex Corn Fertilizer,
Essex A. 1. Superphosphate,
Essex XXX Fish and Potash,
Essex Odorless Lawn Dressing,
Essex Tobacco Starter,
Essex Special Tobacco Manure,
Essex R. I. Special for Potatoes and Roots,
Essex Grass and Top Dressing,
Essex Nitrate of Soda.

The Salisbury Cutlery Handle Co., Salisbury, Conn.

Ground Bone.

Sanderson Fertilizer and Chemical Co., P. O. Box 172, New Haven, Conn.

Sanderson's Formula "A",
Sanderson's Formula "B",
Sanderson's Top Dressing,
Sanderson's Potato Manure,
Atlantic Coast Bone, Fish and Potash,
Fine Ground Fish,
Nitrate of Soda,
Sulphate of Potash,
Muriate of Potash,
Plain Superphosphate.

M. L. Shoemaker & Co., Limited, Philadelphia, Pa.

Swift Sure Superphosphate Gen. Use,
Swift Sure Bone Meal.

Smith Agricultural Chemical Co., Columbus, O.

Abbott's Tobacco and Potato Special,
Abbott's Ideal Grain Grower,
Abbott's Truck Guano,
Abbott's German Potash Mixture,
Abbott's Harvest King,
Hardy's Potato Grower,
Hardy's Potato and Tobacco Special,
Hardy's Tankage, Bone and Potash.

Springfield Rendering Co., Springfild, Mass.

Tankage,
Ground Bone.

Thomas L. Stetson, Randolph, Mass.

Stetson's Ground Bone.

Sterling Chemical Co., 6 Osborn St., Cambridgeport, Mass.

Sterlingworth Plant Food Tablets.

Swift's Lowell Fertilizer Co., 40 No. Market St., Boston, Mass.

Swift's Lowell Bone Fertilizer,
Swift's Lowell Potato Phosphate,
Swift's Lowell Animal Brand,
Swift's Lowell Market Garden Manure,
Swift's Lowell Potato Manure,
Swift's Superior Fertilizer,
Swift's Lowell Lawn Dressing,
Swift's Lowell Perfect Tobacco Grower,
Swift's Lowell Ground Bone,
Swift's Special Vegetable Manure,
Acid Phosphate,
Nitrate of Soda,
Muriate of Potash,
Tankage,
Dissolved Bone,
Blood, Bone and Potash,
Dried Blood,
High Grade Sulphate of Potash,
Dissolved Bone Black,
Special Grass Fertilizer,
Dissolved Bone and Potash,
Potato Grower,
Empress Brand for Corn and Potatoes.

Tavender Process Co., Boston, Mass.

Am. Pho. Nite.

S. D. Viets Co., 61 Cypress St., Springfeld, Mass.

Cottonseed Meal.

A. L. Warren, Northboro, Mass.

Warren's Ground Bone.

Whitman & Pratt Rendering Co., Lowell, Mass.

Potash Special,
Potato Plowman,
Corn Success,
Vegetable Grower,
All Crop,
Ground Bone.

Sanford Winter, Brockton, Mass.

Winter's Ground Bone.

Wilcox Fertilizer Works, Mystic, Conn.

Wilcox Potato, Onion and Veg. Man.,
Wilcox Potato Fertilizer,
Wilcox Complete Bone Superphosphate,
Wilcox Fish and Potash,
Wilcox High Grade Tobacco Special,
Wilcox Dry Ground Fish,
Wilcox Nitrate of Soda,
Wilcox Muriate of Potash,
Wilcox Grass Fertilizer.

A. H. Wood & Co., Framingham, Mass.

B. B. Brand General Fertilizer.

J. M. Woodard & Bro., Greenfield, Mass.

Woodard's Tankage.

Method of Collecting Samples.

The samples in the following tables, unless otherwise specified, were drawn by an authorized agent who is an assistant and chemist at the Experiment Station and were taken according to the requirements of the Massachusetts fertilizer laws. It is the usual custom, in case of large shipments of fertilizer, to sample at least ten per cent of the bags present. Where only a few bags of any one brand are in stock, a portion is taken from at least three packages.

The sample is secured by means of a metal sampling tube which takes a portion of the fertilizer the entire length of the bag. The portions drawn from the several bags are placed on a piece of clean, smooth oil cloth or paper, and after being thoroughly mixed are transferred to two glass jars. A guarantee slip is filled out from the data given on the bags sampled; this slip is folded and placed inside of the jar containing the sample which is to be forwarded to the Station laboratory. Both jars are then sealed and a label is attached to the one that is to be left with the agent, said label giving brand, name and address of manufacturer as well as agent, also date and place of sampling. Samples are drawn in the presence of the agent or his representative and the guarantee slips and identification labels are signed by the collector and the fertilizer agent or one witness.

Samples of the same brand are taken in various parts of the state whenever possible, and an analysis is made of a composite composed of equal weights of the several lots belonging to that brand.

Samples were taken this year in about eighty towns and cities representing every county in the state. The list of towns visited is varied more or less from year to year and an effort is made to inspect every brand which is licensed. In case our collectors fail to find certain brands, the manufacturer is asked to furnish a list of agents having them in stock; these agents are visited and samples are procured so far as possible. In case we are unable to locate a brand, the manufacturer is given the privilege of sending a representative certified sample for analysis; these samples are designated in the tables as manufacturers' samples.

Classification of Fertilizers Published.

The fertilizers are classified or grouped in the subsequent tables as follows:

COMPLETE FERTILIZERS,

DISSOLVED PHOSPHATES AND POTASH,

WOOD ASHES,

GROUND BONES, DISSOLVED BONES, TANKAGE AND DRY GROUND FISH,

NITRATE OF SODA, DRIED BLOOD, COTTONSEED MEAL, LINSEED MEAL AND CASTOR POMACE,

POTASH SALTS,

PHOSPHORIC ACID COMPOUNDS.

Complete Fertilizers. Under this head are grouped those fertilizers which furnish the three essential elements of plant food: nitrogen, phosphoric acid and potash. They include the special crop manures, so called, the nitrogenous superphosphates and other miscellaneous fertilizers. The fertilizers in all of the several groups are arranged according to the alphabetical order of manufacturers. The various brands of the American Agricultural Chemical Company will be identified by the prefixion of the name of the branch firm responsible for the trade name.

Dissolved Phosphates and Potash. These samples will be found following the list of complete fertilizers. The names of these brands might indicate them to be complete fertilizers but a glance at the analysis shows the absence of nitrogen. They are composed mainly of acid phosphate (superphosphate) or possibly dissolved bone black with a little potash, the remaining bulk being made up, when necessary, by some filler.

Wood Ashes. Only two brands of wood ashes were officially collected; the analyses of these will be found in the same table with the "dissolved phosphates and potash" as they furnish mainly potash and phosphoric acid. Many other so-called farmers' samples have been analyzed at this laboratory during the season; the results of these analyses have been reserved for a future publication.

The "other brands" in the same table and immediately following the wood ashes, are two mixtures containing potash and phosphoric acid and were designed for use in connection with cottonseed meal or other like material for growing tobacco.

Ground Bones. Ground bones used as fertilizer may be divided into two classes, raw and steamed. The former contain more grease and nitrogen than does the steamed or cooked bone which has had the greater part of the grease and some of the nitrogen removed by cooking under pressure. Experiments in the field, however, show but little difference in the agricultural value of equal amounts of plant food in these two materials. The average standard for ground bones, as shown by the analyses made at this laboratory of 253 samples, (see compilation of analyses in 18th annual report of this station) is nitrogen 3.06 per cent, total phosphoric acid 24.34 per cent.

Dissolved Bones. This class of material consists of fine ground bone to which has been added sulphuric acid (oil of vitriol) for the purpose of rendering the phosphoric acid more available. The phosphoric acid in the untreated bone is present in the form of tri-calcium phosphate. In the treatment with sulphuric acid the tri-calcium (three-line) phosphate is largely changed to mono-calcium (one-line) and di-calcium (two-line) phosphate; the phosphoric acid in these forms is much more available as plant food than it is in the untreated bone. The average of nine analyses of dissolved bone furnishes the following standard: nitrogen 2.14 per cent, total phosphoric acid 16.42 per cent, available phosphoric acid 12.40 per cent.

Tankage. This material, like the ground bone, is a refuse product from slaughtering establishments. It furnishes a very important source of nitrogen as well as phosphoric acid and large quantities of the various grades of tankage are used in compounding mixed fertilizers. There are several grades known to the trade which may be classed as high, medium and low grade tankages, according to the per cent of nitrogen which they contain. The nitrogen is the most valuable of the essential elements; for this reason the higher the percentage present the greater the commercial and agricultural value. The different grades are often designated as 11 and 15 tankage, 9 and 20 tankage, 7 and 30 tankage, 6 and 35 tankage etc. meaning 11 per cent of ammonia and 15 per cent bone phosphate; 9 per cent ammonia and 20 per cent bone phosphate etc. These various grades figured on the basis of nitrogen and phosphoric acid, would give standards about as follows.

Grade of tankage.	Nitrogen equivalent.	Phosphoric acid equivalent.
11 and 15	9.06	6.87
9 and 20	7.41	9.16
7 and 30	5.77	13.74
6 and 35	4.94	16.03

Ammonia quotations may be changed to a nitrogen basis by multiplying by the factor .82. Quotations of bone phosphate may be changed to phosphoric acid by multiplying by the factor .46.

Dry Ground Fish. This product is a refuse from the fish oil factories and is valued particularly for its high percentage of easily decomposed organic nitrogen. Fish also contains an appreciable amount of phosphoric acid. The average composition of fifty-nine samples of this material shows a nitrogen content of 8.36 per cent and phosphoric acid 8.87 per cent.

Nitrogen Compounds.

Nitrate of Soda. This soluble quick acting material is found in the crude form in large quantities, in the rainless regions of South America, more particularly in Chili and Peru. The crude material as mined. contains varying quantities of nitrogen, ranging from two to four per cent and over. This material is refined and comes on to the market in light colored crystalline form containing about ninety-five per cent nitrate of soda or about 15.5 per cent nitrogen. Nitrate of soda is soluble in water and its nitrogen is in a form to be readily assimilated by the growing plant. If used by itself care should be taken that it does not come in direct contact with the plant. If applied as a top dressing to grass and lawns, to promote more even application it is well to mix with at least twice its bulk of earth or other material.

Blood is a refuse from slaughter houses and is considered one of the most valuable sources of animal organic nitrogen. A good quality of blood contains from 10. to 10.5 per cent of easily decomposed nitrogen.

Cottonseed Meal, Linseed Meal, Castor Pomace. These substances which are the finely ground oil extracted residues of the cottonseed, flaxseed and castor bean are particularly valuable on account of the relatively high percentage of vegetable organic nitrogen which they contain. Cottonseed meal as found in our markets is mixed with more or less cotton hulls which of course, reduces the content of nitrogen. All of these products contain an appreciable quantity of potash and phosphoric acid. The average of many analyses made at this laboratory furnishes the following standards of composition.

	Nitrogen.	Potash.	Phosphoric acid.
Cottonseed Meal,	6.74%	1.41%	1.71%
Linseed Meal,	5.78	1.52	1.47
Castor Pomace,	5.18	1.20	2.12

Potash Compounds.

The Potash Compounds used for agricultural purposes are derived largely from the Stassfurt saline deposits in Germany. The refined products are found in the market in various forms. *High grade sulphate of potash* has an actual potash content of about 50 per cent. *Potash-magnesia sulphate* has an actual potash content of about 25 per cent and a magnesia content of about 14 per cent. Potash in the form of sulphate is particularly adapted for the growth of a superior quality of tobacco as well as crops producing sugar and starchy products such as fruits, sugar beets, potatoes, etc. *Muriate of potash,* chemically known as chloride of potash, is a high grade product showing about 50 per cent actual potash. It is particularly valuable as a source of potash for grass crops; also for general farm forage crops with the exception of legumes for which one of the sulphates is to be preferred.

Carbonate of Potash has been a popular source of potash for tobacco for a number of years. In composition it varies from 63 to 65 per cent actual potash, and is quite strongly alkaline.

Phosphoric Acid Compounds.

Acid Phosphate, commonly called superphosphate, is a mineral phosphate which has been treated with sulphuric acid in order to render the phosphoric acid more available. It is the common source of phosphoric acid in factory mixed goods. This material is usually brought on the unit of available phosphoric acid.

The composition of acid phosphate varies according to the grade: the low grade superphosphate runs from 12 to 15 per cent total phosphoric acid; the better grades run from 15 to 19 per cent total phosphoric acid, mostly in available form if properly manufactured.

Dissolved Bone Black. The bone black from which this material is made, is a by-product from sugar refining establishments where the charred bone has been used for decolorizing sugar solutions. After it has thus served its usefulness, it is treated with sulphuric acid and furnishes a superior source of available phosphoric acid. The average of 38 analyses made at this laboratory shows 17.56 per cent of total phosphoric acid, of which 16.38 per cent was available. The expression "available phosphoric acid" means the sum of the water soluble and citrate soluble phosphoric acid.

Thomas Phosphatic Slag. This material is obtained as a by-product in the manufacture of phosphorous free metallic iron from phosphorous containing iron ores; it is a valuable source of phosphoric acid and has been used for many years in Germany and other European countries. Its use in this country dates back to 1888. Dr. C. A. Goessmann was one of the first in the United States to study this material and recognized its worth as a source of phosphoric acid for general farm crops. The average of 15 analyses made at this laboratory gives a total phosphoric acid content of 18.63 per cent; the slag also contains an average lime content of 45.50 per cent of which 6 to 7 is in the form of free calcium oxide. The phosphoric acid in slag meal is present probably in combination with the lime as tetra-calcium phosphate.

Trade Values. The trade values in the following table show the average cost per pound, at retail, of the various forms of nitrogen, phosphoric acid and potash as they were found and quoted in raw materials and chemicals in the markets in New England, New York and New Jersey during the six months preceding March 1. 1907.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1907.

Nitrogen.

	Cents per pound.
Nitrogen in ammonia salts,	17½
" " nitrates,	18½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	20½
" " " fine bone and tankage,	20½
" " " coarse bone and tankage,	15

Phosphoric Acid.

Phosphoric acid soluble in water,	5
" " soluble in ammonium citrate, (reverted phosphoric acid),	4½
" " in fine ground bone and tankage,	4
" " in coarse bone and tankage,	3
" " in cottonseed meal, linseed meal, castor pomace and ashes,	4
" " insoluble (in neutral citrate of ammonia solution) in mixed fertilizers,	2

Potash.

Potash as sulphate, free from chlorides,	5
" " muriate (chloride),	4¼
" " carbonate,	8

Retail Cash Prices. The method of obtaining the retail cash prices published in the following tables is as follows: The collector ascertains the price of each brand of fertilizer by inquiry of the agent or his representative, at the time the samples are taken; these prices are verified later by communicating with each agent. The results of analysis of each brand, together with prices and other data, are reported to the agent as well as to the manufacturer, to give opportunity for corrections and explanations.

In a few instances we have been unable to get retail cash prices from the agent. With very few exceptions, however, they have gladly aided us in procuring the necessary data. In most instances, in case of composite samples, the average of the several prices has been used as the basis in computing the percentage of difference between the retail cash price and valuation.

The retail cash price of each sample has been published opposite the name of the town where said sample was collected. The increased cost of freight and cartage to the outlying country districts necessarily increases the retail cash price charged by the agent. It may not be out of place here to say a few words regarding the variation in the retail cash prices given on samples of the same brand collected in different parts of the state. There are a number of influences which are responsible for the frequent wide variations noted.

The price of a given fertilizer depends first upon the location of the agent. The person selling fertilizer near the factory where it is made, or near the port where it is received, often gets his fertilizer at a lower initial cost than does the agent living in the back country districts, and for this reason can retail his goods at a correspondingly lower figure. Secondly, the price of a fertilizer will necessarily depend somewhat upon the size of the order as well as upon the date when said order is placed. The consumer who orders a carload of fertilizer to be delivered before the rush of the season will, as a rule, get a better quotation than the one who waits until he wishes to use the goods and then only buys a few bags at a time when the supply may be low.

It should be borne in mind that the cost of handling and cartage will naturally come out of the consumer as the fertilizer agent is not in the business for love or philanthropic purposes and will cease to handle fertilizer when it fails to net him a fair return.

The consumer should obtain quotations for an early delivery and in carload lots if possible; this may often be done by co-operation among neighbors; in this way and by a cash payment the consumer may reasonably expect lowest prices. Many farmers no doubt, accept a fertilizer agency for the reason that it gives them an opportunity to get their own fertilizer supply at wholesale prices. Such agents often sell goods at a much lower price than can the agent who is situated in town and who must sell his goods at an increased cost in order to secure a fair profit. It is hoped that the above stated facts will explain many of the wide variations in prices given in the following tables.

Valuations. The comparative commercial values published are obtained by computing, by means of the trade values to be found on a previous page, the value of each of the three essential elements of plant food, (nitrogen, phosphoric acid and potash, including the different forms of each wherever different forms are recognized in the analysis) in 100 lbs. of the fertilizer and by multiplying each product by twenty to change it to a ton basis. The sum of these values gives the total approximate commercial value of the fertilizer per ton at centers of distribution. Taking each element up in the order in which it appears in the tables of analyses, the water soluble nitrogen is valued at 18½ cents per pound as most of the soluble nitrogen in mixed fertilizers is derived from nitrate of soda. The organic nitrogen in the mixed goods is valued as coming from the best grade of raw materials and is counted at 20½ cents per pound. This method of valuing the organic nitrogen in mixed fertilizers will, of course, give a too high value on those goods in which the organic nitrogen has been derived from low grade materials which possess slowly available nitrogen. This seems to be the only course however at present, as the ordinary methods of analysis will not discriminate between the available and inert forms of organic nitrogen.

Soluble phosphoric acid is valued at 5 cents per pound, citrate soluble or reverted phosphoric acid at 4½ cents, and the phosphoric acid which is insoluble in ammonium citrate (usually termed insoluble phosphoric acid) at 2 cents per pound. Potash is valued according to the form in which it is found present in the fertilizer. Whenever a potash test is reported in the tables without comment or foot note, it will be understood that sufficient chlorine was present to unite with all of the potash. Every brand of complete fertilizer is tested for chlorides and if sufficient chlorine is found to unite with all of the potash, it is taken for granted that the potash exists in the form of muriate and is counted as worth 4½ cents per pound. The presence of chlorine does not necessarily prove that it is in combination with the potash, but its presence in a fertilizer supposed and advertised to be free from chlorides or where the potash is said to be present as sulphate or carbonate, is just as objectionable as though it was actually in combination with the potash. Whenever the potash is guaranteed to be present as sulphate and the analysis shows the presence of chlorine, a foot note has been used to indicate how much is present in each form. Wherever only very small quantities of chlorides are present the potash has been reported as sulphate. Potash in form of sulphate has been valued at 5 cents per pound.

Whenever the potash is guaranteed as carbonate a test has been made for chlorides and sulphates and a foot note indicates how much potash is present in each form. Potash in form of carbonate has been valued at 8 cents per pound.

Whenever it was known that potash had been derived wholly or in part from organic sources, in mixed fertilizers, a total potash test has been made and will be found reported in a foot note. No attempt has been made to place a valuation on that portion of the potash which is insoluble in water. It no doubt has a commercial value, but as we have no basis for establishing its worth, the results have simply been reported without comment. It should not be understood that all of the potash in vegetable organic compounds is insoluble in water. As a matter of fact about 80 per cent of the potash in cottonseed meal is recovered in a water soluble potash test.

That the valuations in the tables of complete fertilizers fall below the retail cash prices is not surprising. To these valuations should be added the expense of extra handling, grinding and mixing, bagging, transportation, agents commissions, long credits, bad debts, etc., which amount to a considerable sum. In the commercial valuation of ground bones and tankages the calculations are based on a mechanical analysis which states the percentage of fine and coarse bone in each brand. The portion designated as fine bone will pass through a sieve having circular perforations 1-50 of an inch in diameter. That portion designated as coarse bone includes only particles larger than 1-50 of an inch in diameter.

In computing the valuation, the nitrogen and phosphoric acid value for each grade of mechanical fineness is calculated separately by multiplying the pounds of nitrogen and phosphoric acid per ton by the per cent of each grade and multiplying these products by the trade values per pound for nitrogen and phosphoric acid. The sum of the values of both ingredients in each grade gives the comparative commercial value per ton.

Percentage of Difference.

The column headed "percentage of difference between selling price and valuation" shows the percentage excess of the average retail cash price over the average valuation as figuredby our trade values for 1907. The average comparative commercial value of the 275 brands of complete fertilizers analyzed during the season is $24.19, the average retail cash price is $35.40 and the percentage of difference 44.85. The above mentioned column shows which fertilizers will furnish the largest amount of plant food for a given outlay. They will be found to be those fertilizers where the percentage of difference is relatively small. Before selecting a fertilizer on this basis however, care should be exercised in choosing goods that are adapted to the crop and soil for which they are to be used. It is well to bear in mind that in many cases it is through accident that the percentage of difference is relatively small on some of the fertilizers; imperfect or careless mixing may be responsible for this. It is best therefore to get the general standing of any particular brand for a number of years before making a selection on this basis.

Agricultural Values.

The agricultural value of a fertilizer represents its crop-producing power which is far from constant on all soils.

The beneficial effect of any fertilizer on a particular soil depends on whether the fertilizer in question contains those elements of plant food in suitable quantity and quality in which the soil is deficient. In other words the supply of plant food in soils varies widely and every user of commercial fertilizers must select his fertilizer according to, the conditions of his soil and the requirements of the crop which he wishes to raise. We are often asked which is the best mixed fertilizer to use. The consumer can better answer this question for himself by a study of his soil conditions and crop requirements. A general statement may be made however, to the effect that all conditions being equal, the consumer should select those fertilizers which give the greatest amount of plant food in suitable and available forms for the least money. A study of the tables of analyses should furnish reliable data in making fertilizer selections. The tables show the quality and quantity of the various essential elements of plant good with the possible exception of organic nitrogen. Prescribed methods of analysis do not include a wholly reliable means of determining the availability of organic nitrogen and in all valuations, in case of the mixed goods, it is assumed that the organic nitrogen is present in the best forms.

The high grade fertilizers will, as a general rule, be the most economical ones to buy and the low grade fertilizers will, ordinarily, be the most expensive ones. In the manufacture of the best goods only high grade raw materials and chemicals can be used as the formula has to be made up of compounds whose united composition will furnish the desired qnantity and quality of plant food and whose combined weight must not exceed 2000 pounds. On the other hand, in the manufacture of very low grade fertilizers the necessary compounds to supply the percentage of nitrogen, phosphoric acid and potash which is guaranteed might be supplied in 1200 to 1500 pounds of material of good quality and the remainder, to make up the ton weight, will be a filler of some sort which often times has no fertilizing value whatever. Besides this, the consumer is obliged to pay freight and cartage on low valued or worthless material. Many low grade goods contain a high percentage of phosphoric acid. It should be borne in mind that phosphoric acid is the cheapest of the essential elements of plant food and that some of the low grade mixed goods contain an excess of this material. Cheap or low grade fertilizers are sometimes made up of crude stock having a comparatively low commercial and agricultural value.

Guarantees. The State laws provide that guarantees shall be made as follows: "percentage of nitrogen of potash soluble in distilled water and of phosphoric acid in available form, soluble in distilled water and reverted as well as total phosphoric acid." Most manufacturers give a nitrogen guarantee on their nitrogenous goods. Occasionally a sample is found guaranteed in the ammonia equivalent; this is not legal according to Massachusetts laws. Ammonia may be guaranteed in conjunction with, but never in place of, the nitrogen. The consumer should always insist upon a nitrogen guarantee and any case where ammonia is stated in place of nitrogen, should be called to the attention of the experiment station authorities.

Some manufacturers have adopted the unfortunate practice of so wording their potash guarantee as to lead the unwary to assume that the potash is present in form of sulphate when, in reality, it is present in the cheaper form of chloride or muriate. A common practice among manufacturers is to guarantee the percentage of actual potash, and on the line below, to print the words "equivalent to sulphate of potash," giving in computed figures the equivalent of this compound. The close observer will find that when a fertilizer manufacturer wishes to advertise the fact that he is using high grade sulphate of potash in any particular brand of fertilizer he will say "*In form of sulphate of potash.*" and not "Equivalent to sulphate of potash."

The usual practice is to guarantee a minimum and maximum amount of the various essential elements of plant food. These guarantees often vary widely, as potash from 2 to 4 per cent and phosphoric acid from 8 to 12 per cent. It should be borne in mind that only the lower figure is binding, and that the manufacturer has fulfilled his contract in furnishing the minimum amount of plant food guaranteed.

The following tables show the comparative quality of the brands of complete fertilizers and crude stock materials such as bones, tankage and dry ground fish.

COMPLETE FERTILIZERS.

SUMMARY OF RESULTS OF INSPECTION.

MANUFACTURER.	No. Brands Analyzed.	No. with all three elements equal to lower guarantee.	No. equal to guarantee in commercial value.	Per cent. of brands not showing a commercial shortage.	No. with one element below lower guarantee.	No. with two elements below lower guarantee.	No. with three elements below lower guarantee.
W. H. Abbott	3	1	3	100.	2	—	—
American Agricultural Chemical Co.	61	45	58	95.08	14	2	—
Armour Fertilizer Works	10	8	10	100.	1	1	—
Beach Soap Company	3	1	2	66.66	2	—	—
Berkshire Fertilizer Company	4	2	4	100.	2	—	—
Bonora Chemical Company	1	—	1	100.	1	—	—
Bowker Fertilizer Company	33	19	29	90.	8	6	—
J. Breck & Sons, Corporation	4	1	1	25.	3	—	—
Buffalo Fertilizer Company	4	—	1	25.	3	1	—
Coe-Mortimer Company	7	2	3	42.85	4	1	—
Eastern Chemical Company	1	—	1	100.	1	—	—
Eureka Liquid Fertilizer Company	1	—	—	0.	—	—	1
R. & J. Farquhar & Co.	5	4	4	80.	—	1	—
Fertilizer Products Company	1	1	1	100.	—	—	—
C. W. Hastings	1	—	—	0.	1	—	—
Lister's Agricultural Chemical Works	7	5	6	85.71	2	—	—
Mapes' Formula & Peruvian Guano Co.	16	12	16	100.	4	—	—
Mitchell Fertilizer Company	1	—	1	100.	1	—	—
National Fertilizer Company	15	8	13	86.66	5	2	—
New England Fertilizer Company	7	4	6	85.71	2	1	—
Olds & Whipple	4	3	4	100.	—	1	—
Parmenter & Polsey Fertilizer Company	2	2	2	100.	—	—	—
R. T. Prentiss*	3	—	—	0.	—	1	2
Benjamin Randall	2	1	2	100.	—	1	—
W. W. Rawson & Co.	3	3	3	100.	—	—	—
Rogers & Hubbard Co.	8	4	8	100.	4	—	—
Rogers Manufacturing Company	8	5	7	87.50	3	—	—
Ross Brothers Co.	1	—	1	100.	1	—	—
N. Roy & Son	1	—	—	0.	1	—	—
Russia Cement Company	11	7	11	100.	4	—	—
Sanderson Fertilizer & Chemical Co.	4	1	1	25.	2	1	—
M. L. Shoemaker & Co., Limited	1	1	1	100.	—	—	—
Smith Agricultural Chemical Company	8	1	4	50.	4	2	1
Sterling Chemical Company	1	—	1	100.	—	1	—
Swift's Lowell Fertilizer Company	14	3	12	85.71	10	1	—
Tavender Process Co.	1	1	1	100.	—	—	—
Whitman & Pratt Rendering Co.	4	3	4	100.	1	—	—
Wilcox Fertilizer Works	6	6	6	100.	—	—	—
A. H. Wood & Co.	1	1	1	100.	—	—	—

* The brands sold by Mr. Prentiss were manufactured by the Buffalo Fertilizer Co.

GROUND BONE, DISSOLVED BONE, TANKAGE AND DRY GROUND FISH.

SUMMARY OF RESULTS OF INSPECTION.

MANUFACTURER.	No. Brands Analyzed.	No. with two elements above guarantee.	No. equal to guarantee in commercial value.	No. with one element below guarantee.	No. with two elements below guarantee.
W. H. Abbott	1	1	1	1	—
American Agricultural Chemical Co.	1	—	—	1	—
Armour Fertilizer Works	1	1	1	—	—
Beach Soap Company	1	—	1	1	—
Bowker Fertilizer Company	4	2	4	2	—
Buffalo Fertilizer Company	1	—	—	—	1
John C. Dow & Co.	1	1	1	—	—
R. & J. Farquhar & Co.	1	—	1	1	—
Thomas Hersom & Co.	2	2	2	—	—
Home Soap Company	1	1	1	—	—
George E. Marsh Co.	1	—	1	1	—
D. M. Moulton	1	—	—	—	1
National Fertilizer Company	2	—	1	2	—
Olds & Whipple	1	1	1	—	—
Parmenter & Polsey Fertilizer Company.	1	—	1	1	—
W. W. Rawson & Co	1	1	1	—	—
Rogers & Hubbard Co.	2	1	2	1	—
Rogers Manufacturing Company	1	1	1	—	—
Russia Cement Company	1	1	1	—	—
Sanderson Fertilizer and Chemical Co.	1	—	—	1	—
Springfield Rendering Company	2	1	2	1	—
Swift's Lowell Fertilizer Company	4	2	3	2	—
T. L. Stetson	1	—	1	1	—
A. L. Warren	1	1	1	—	—
Whitman & Pratt Rendering Company	1	—	1	1	—
Wilcox Fertilizer Works	1	1	1	—	—
Sanford Winter & Son.	1	1	1	—	—
J. M. Woodard & Brother	1	1	1	—	—

Summaries. The summary in the first table gives the following information concerning each manufacturer:—the number of brands of complete fertilizer collected and analyzed; the number of brands in which all three of the essential ingredients of plant food are equal to the lower guarantee; the number which do not show a commercial shortage, and includes those fertilizers where a deficiency of any one element is offset commercially by an excess of another. Another column shows the per cent of the whole number of each company's complete fertilizers not having a commercial shortage. The other three columns indicate the number of brands deficient in one, two or in all three of the essential elements of plant food.

The summary in the table of ground bone, tankage and dry ground fish gives nearly the same information but the column giving the percentage number which do not show a commercial shortage is not included. This was omitted on account of the small number of brands of these raw materials licensed by each manufacturer.

Of the 275 analyses of complete fertilizers published, 113 or about 41 per cent of the whole number failed to meet the manufacturers' guarantee in some one or more particulars. In many of these brands the deficiency is made up by an excess of some one or more of the other ingredients. Some of the brands, however, show a commercial shortage ranging from a few cents to $13.50 per ton. A liquid fertilizer manufactured by the Eureka Liquid Fertilizer Company, Boston, Mass., showed the greatest shortage. Eighty-six brands were deficient in one, 23 in two and 4 in all three elements.

The largest number of brands were deficient in nitrogen, the number being 70; 43 were deficient in potash and 28 were deficient in phosphoric acid.

Among the ground bones, tankages and fish, out of the 38 samples analyzed, 16 failed to meet the guarantee in nitrogen and 4 in phosphoric acid. Only a few of these brands, however, showed a commercial shortage.

The average retail cash prices, valuations and percentages of difference of the ground bone, dissolved bone, tankage and dry ground fish are as follows:

	Average retail cash price.	Valuation.	Percentage difference.
Ground bone,	29.46	27.45	7.32
Dissolved bone,	25.50	25.03	1.88
Tankage,	21.67	29.93	27.60*
Dry ground fish,	39.00	39.89	2.23*

In case of the chemicals, two samples of sodium nitrate, one sample of dried blood and five samples of cottonseed meal failed to meet the nitrogen requirement. Two samples of muriate of potash and one sample of carbonate of potash failed to meet the potash guarantee. One sample of superphosphate, one sample of dissolved bone black and two samples of dissolved phosphate and potash failed to meet the phosphoric acid guarantee.

From the data furnished in the tables of analyses of the various agricultural chemicals and raw materials we find the pound of nitrogen, potash and phosphoric acid have cost the consumer as follows:

	Cents per pound.
Nitrogen.	
From nitrate of soda,	$19\frac{1}{4}$
From blood,	$22\frac{1}{2}$
From cottonseed meal,	$23\frac{3}{5}$
From linseed meal,	$24\frac{2}{5}$
From castor pomace,	$23\frac{1}{4}$
Potash.	
From carbonate of potash,	8
From sulphate of potash,	$5\frac{2}{5}$
From muriate of potash,	$4\frac{1}{2}$
Available Phosphoric Acid.	
Dissolved bone black,	$7\frac{1}{2}$
Acid phosphate (superphosphate),	$5\frac{4}{5}$

NOTE.—The pound of total phosphoric acid in "Thomas Slag Phosphate" cost the consumer on the average about 5 cents.

*In excess of selling price.

Free Analyses for Farmers.

Aside from the analyses which appear in this bulletin, nearly 300 miscellaneous fertilizers, raw materials, chemicals, refuse by-products, soils, etc., have been analyzed during the season for farmers. With very few exceptions these samples have been taken according to printed instructions furnished the applicant; the analyses of these materials, therefore, may be said to be fairly representative. In so far as possible, this class of substances have been taken up for analysis in the order of their arrival at the station; the work, however, is not allowed to interfere with the duties of the official inspection. Lack of space has prevented the publication of the analyses of farmers' samples, which have been reserved for a future bulletin.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chem. Co., 92 State St., Boston, Mass.				
Grass and Lawn Top Dressing	Seekonk	38.00	22.44	60.42
" " " " "	Brockton			
" " " " "	Boston	34.00		
High Grade Fertilizer, 10% Potash	Southwick	35.00	25.00	40.00
Tobacco Starter and Grower	Southwick	36.00	28.65	25.65
Baker's A. A. Ammoniated Superphosphate	New Bedford	35.00	22.42	56.11
Bradley's X. L. Superphosphate	New Bedford	33.00	22.88	44.23
" " "	Brockton	34.00		
" " "	Worcester	34.00		
" " "	Lawrence	31.00		
Bradley's Potato Fertilizer	Brockton	34.00	20.33	62.32
" " "	Worcester	33.00		
" " "	Fitchburg	32.00		
Church's Fish and Potash	New Bedford	30.00	18.94	50.47
" " " "	Southwick	27.00		
Bradley's Potato Manure	Middleboro	32.00	23.50	37.33
" " "	Boston	32.00		
" " "	Worcester	34.00		
" " "	Lawrence	31.00		
Bradley's Eclipse Phosphate	Brockton	32.00	16.70	85.63
" " "	Webster	30.00		
Bradley's Complete for Potatoes and Vegetables	Boston	36.00	28.48	32.13
" " " " " "	Worcester	40.00		
" " " " " "	Fitchburg	38.50		
" " " " " "	Lexington	36.00		
Bradley's Complete Manure for Asparagus	Concord	36.00	28.64	25.70
Bradley's Comp. Manure for Topdress. Grass and Grain	Worcester	40.00	25.60	48.44
" " " " " " " "	Lexington	36.00		
Bradley's Complete Manure, 10% Potash	Worcester	40.00	28.07	26.30
" " " " "	Danvers	*38.00		
Bradley's Niagara Phosphate	Webster	26.00	14.63	74.30
" " "	Westfield	25.00		
Bradley's Complete Manure for Corn and Grain	Fitchburg	38.50	28.67	34.29
Church's Fish and Potash	Chicopee	30.00	18.15	65.29
Bradley's Corn Phosphate	Chicopee Falls	32.00	19.64	61.66
" " "	Fitchburg	31.50		
Bradley's English Lawn Fertilizer	Lexington	56.00	27.00	107.41
Bradley's Columbian Fish and Potash	Westfield	30.00	16.81	78.47
Clark's Cove Potato Fertilizer	Spencer	30.00	20.68	45.07

* This price was furnished by the American Agricultural Chemical Co. as being about the average retail cash price to the consumer. The sample was not taken from an agent, but of stock in possession of consumer.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid Reverted.	Phosphoric Acid Insoluble.	Phosphoric Acid Total. Found.	Phosphoric Acid Total. Guaranteed.	Phosphoric Acid Available. Found.	Phosphoric Acid Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
133, 202, 215	8.37	4.11	—	4.11	3.91	1.30	3.10	1.82	6.22	6.00	4.40	5.00	2.84	2.00
445	10.71	1.35	1.17	2.52	2.40	4.38	2.34	1.86	8.58	7.00	6.72	6.00	9.33	10.00
454	10.60	1.77	1.03	3.70	3.30	5.80	2.32	2.48	10.60	10.00	8.12	8.00	5.32	7.40*
138	14.75	1.65	1.20	2.85	2.50	5.23	4.05	1.72	11.00	11.00	9.28	9.00	2.14	2.00
111, 224, 350, 378	14.68	1.68	1.23	2.91	2.50	6.20	2.68	2.56	11.44	11.00	8.88	9.00	2.34	2.00
201, 249, 270	13.40	.62	1.50	2.12	2.00	6.45	2.11	2.26	10.82	10.00	8.56	8.00	3.10	3.00
124, 464	13.50	.79	1.55	2.34	1.70	2.60	3.10	5.40	11.10	7.50	5.70	4.50	2.48	2.00
156, 197, 241, 243, 389	12.68	1.41	1.28	2.69	2.50	4.90	2.50	1.92	9.32	8.00	7.40	6.00	5.88	5.00
109, 275	14.33	.62	.56	1.18	1.03	6.23	0.05	1.00	11.18	10.00	10.18	8.00	2.26	2.00
212, 239, 280, 351	11.52	1.10	2.33	3.43	3.30	5.40	2.58	1.90	9.88	9.00	7.98	8.00	7.50	7.00
226	12.01	1.95	1.60	3.55	2.72	4.23	3.75	1.84	9.82	9.00	7.98	8.00	7.66	7.00
235, 344	9.86	3.18	1.27	4.46	4.83	2.38	3.40	1.38	7.16	6.00	5.78	5.00	3.06	2.50
242, 356	12.23	1.80	1.61	3.41	3.30	2.83	3.95	1.38	8.16	7.00	6.78	6.00	10.32	10.00
254, 448	16.76	.64	.72	1.36	.82	3.35	3.87	2.50	9.72	8.00	7.22	7.00	1.74	1.00
285	12.55	3.17	.57	3.74	3.30	7.60	4.18	.94	12.72	12.00	11.78	8.00	3.36	3.00
316	10.78	.40	1.86	2.26	2.09	4.43	2.31	1.22	7.96	7.00	6.74	6.00	2.40	2.00
320, 432	13.85	.98	1.53	2.51	2.06	6.30	2.20	1.74	10.24	9.00	8.50	8.00	1.86	1.50
361	9.07	4.94	.10	5.04	4.95	1.95	4.03	.92	6.90	6.00	5.98	5.00	2.78	2.50
[illegible]	11.52	.87	1.25	2.12	1.65	3.08	2.22	3.22	8.52	6.00	5.30	5.00	2.46	2.00
[illegible]	13.45	.84	1.58	2.42	2.06	3.68	4.74	1.48	9.90	10.00	8.42	8.00	3.00	3.00

* Potash in form of sulphate, only traces of chlorides present.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co. (Continued)				
Clark's Cove King Philip Alkaline Guano	Spencer	27.50	16.72	64.47
Clark's Cove Great Planet Manure	E. Longmeadow	38.00	27.31	39.14
Clark's Cove Bay State Fertilizer	Great Barrington	32.00	21.54	48.56
Clark's Cove Bay State Fertilizer G. G.	West Granville	38.00	19.72	72.41
" " " " " "	Great Barrington	30.00		
Clark's Cove Potato Manure	Great Barrington	32.00	24.32	50.08
" " " "	West Granville	41.00		
Crocker's Potato, Hop and Tobacco Phosphate	Worcester	31.00	20.76	49.33
Crocker's Ammoniated Corn Phosphate	Worcester	31.00	19.28	60.78
Cumberland Superphosphate	N. Leominster	32.00	20.89	53.18
" "	N. Wilbraham	32.00		
Cumberland Potato Fertilizer	N. Leominster	32.00	20.57	55.57
Darling's Blood, Bone and Potash	Worcester	39.00	30.14	29.40
Darling's Animal Fertilizer	Worcester	36.00	24.04	49.75
Darling's Complete 10% Manure	Worcester	39.00	29.29	33.15
Great Eastern Garden Special	Sunderland	30.50	29.09	28.05
" " " "	E. Longmeadow	38.00		
Great Eastern Vegetable, Vine and Tobacco	Sunderland	32.00	23.39	38.95
" " " " " "	N. Wilbraham	33.00		
Great Eastern General Fertilizer	Sunderland	27.50	16.34	85.13
" " " "	Hinsdale	33.00		
Great Eastern Northern Corn Special	N. Wilbraham	33.00	21.39	54.28
Pacific Potato Special	Newburyport	32.00	20.22	58.26
Pacific Nobsque Guano for All Crops	Newburyport	28.00	16.82	66.47
Soluble Pacific Guano	Newburyport	32.00	19.33	65.55
Packers' Union Animal Corn Fertilizer	Greenfield	33.00	27.53	19.87
Packers' Union Potato Manure	Greenfield	—	28.24	—
Packers' Union Gardener's Complete Manure	Greenfield	35.00	28.14	24.37
Packers' Union Universal Fertilizer	Great Barrington	27.00	13.00	60.13
Quinnipiac Market Garden Fertilizer	Fall River	37.50	28.11	34.29
" " " "	Pittsfield	38.00		
Quinnipiac Potato Phosphate	Southwick	30.00	19.86	61.13
" " "	Pittsfield	34.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
296	14.49	1.20	.20	1.40	1.06	6.43	2.17	2.56	11.16	10.00	8.60	8.00	2.42	2.00
321	13.90	1.85	1.47	3.32	3.30	5.73	2.27	1.36	9.36	9.00	8.00	8.00	7.20	7.00
473	15.11	1.57	1.11	2.68	2.50	6.73	1.41	2.84	10.98	11.00	8.14	9.00	2.40	2.00
485 / 490	15.45	1.09	1.15	2.24	2.06	7.65	.73	2.04	10.42	10.00	8.38	8.00	2.16	1.50
489 / 508	13.39	1.23	1.62	2.85	2.50	5.08	2.02	2.64	9.74	8.00	7.10	6.00	6.08	5.00
260	13.29	.81	1.57	2.38	2.06	4.23	3.71	2.76	10.70	10.00	7.94	8.00	3.12	3.00
273	14.37	.66	1.62	2.28	2.06	5.38	2.46	2.48	10.32	10.00	7.84	8.00	1.90	1.50
415 / 444	15.37	1.61	.97	2.58	2.06	5.60	3.73	.81	10.14	10.00	9.33	8.00	1.96	1.50
430	14.64	1.23	1.11	2.34	2.06	5.58	2.20	2.60	10.38	10.00	7.78	8.00	3.38	3.00
262	11.66	2.39	1.61	4.00	4.10	3.20	5.48	2.14	10.82	9.00	8.68	7.00	6.72	7.00
266	13.85	1.90	.99	2.89	3.30	6.45	1.97	1.82	10.24	10.00	8.42	8.00	4.70	4.00
300	10.01	2.56	1.15	3.71	3.30	1.68	4.00	2.92	8.60	7.00	5.68	6.00	10.18	10.00
15 / 310	10.94	2.27	1.45	3.72	3.30	5.58	2.76	1.58	9.92	9.00	8.34	8.00	7.12	7.00
18 / 440	12.08	1.30	1.27	2.57	2.06	5.73	2.17	2.38	10.28	10.00	7.90	8.00	5.58	6.00
37 / 502	13.50	.50	.64	1.14	.82	4.95	2.65	2.46	10.06	10.00	7.60	8.00	4.18	4.00
450	13.37	2.05	.40	2.45	2.47	7.13	2.25	2.04	11.42	11.00	9.38	9.00	2.56	2.00
326	14.10	1.03	1.21	2.24	2.06	5.25	2.75	2.56	10.56	10.00	8.00	8.00	3.18	3.00
337	16.28	.93	.78	1.71	1.25	4.48	2.66	2.96	10.10	10.00	7.14	8.00	2.50	2.00
340	16.84	1.28	.87	2.15	2.06	6.68	1.84	2.10	10.62	10.00	8.52	8.00	2.16	1.50
409	10.65	.98	2.56	3.54	2.50	5.60	2.18	2.74	10.52	11.00	7.78	9.00	5.58	2.00
471	10.63	1.18	2.19	3.37	2.06	5.23	1.65	3.02	9.90	10.00	6.88	8.00	7.24*	6.00
475	10.05	1.30	2.05	3.35	2.40	4.83	1.87	2.34	9.54	7.00	6.70	6.00	7.50*	10.00
495	12.92	.53	.40	.93	.82	6.43	1.83	1.56	9.82	9.00	8.26	8.00	4.30	4.00
107 / 330	11.63	1.49	1.90	3.39	3.30	5.15	3.03	2.38	10.56	9.00	8.18	8.00	7.34	7.00
455 / 501	14.62	1.08	1.14	2.22	2.06	5.23	2.25	2.84	10.32	10.00	7.48	8.00	3.28	3.00

* 471 Enough chlorine present to unite with 1.80% potash, remainder as sulphate.
475 " " " " " 1.53% " " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co. (Continued).				
Quinnipiac Corn Manure	Southwick	30.00	18.91	58.65
Quinnipiac Climax Phosphate, All Crops	Williamstown	—	14.96	100.53
" " " "	Pittsfield	30.00		
Quinnipiac Phosphate	Pittsfield	34.00	21.81	55.89
Read's Practical Potato Special Fertilizer	Webster	30.00	20.22	48.37
Read's Standard Superphosphate	Framingham	30.00	17.05	75.95
Read's High Grade Farmers' Friend Fertilizer	East Longmeadow	38.00	28.63	32.73
Read's Potato Manure	S. Williamstown	32.00	26.39	21.26
Standard Special for Potatoes	Holyoke	32.00	19.14	67.19
Wheeler's Corn Fertilizer	Pittsfield	31.00	17.43	77.86
Wheeler's Potato Manure	Pittsfield	31.00	19.80	56.56
Williams & Clark's Royal Bone Phosphate	Middleboro	—	17.82	—
Williams & Clark's Americus Potato Manure	Middleboro	—	20.64	45.35
" " " " " "	Southboro	30.00		
Williams & Clark's Prolific Crop Producer	Worcester	28.00	14.08	91.70
" " " " " "	Chicopee Falls	26.00		
Williams & Clark's Americus H. G. Special Potato, etc.	Southboro	35.00	27.98	25.09
Williams & Clark's Ammoniated Bone Phosphate	Southboro	32.00	20.79	53.92
Williams & Clark's Americus Corn Phosphate	Southboro	30.00	18.87	58.98
W. H. Abbott, Holyoke, Mass.				
Abbott's Eagle Brand Fertilizer	South Deerfield	37.00	31.56	18.82
" " " "	Holyoke	38.00		
Abbott's Tobacco Fertilizer	Holyoke	41.00	36.53	12.23
Abbott's Onion Fertilizer	Manuf't'rs Sample	37.00	35.03	5.62
Armour Fertilizer Works, Baltimore, Md.				
Armour's High Grade Potato	North Hadley	—	25.45	33.60
" " " "	Taunton	34.00		
" " " "	Concord	33.00		
" " " "	Haverhill	35.00		
Armour's All Soluble	Amherst	33.00	24.00	37.50
" " "	Taunton	33.00		
" " "	Concord	32.00		
" " "	Haverhill	34.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
462	16.30	1.46	.66	2.12	2.06	6.10	2.60	1.36	10.06	10.00	8.70	8.00	2.14	1.50
481 507	13.17	.55	.63	1.18	1.03	5.38	2.78	2.26	10.42	10.00	8.16	8.00	1.84	2.00
505	15.03	1.47	1.12	2.59	2.50	4.50	4.44	3.04	11.98	11.00	8.94	9.00	2.42	2.00
274	11.53	.60	.88	1.48	.82	3.10	3.40	2.90	9.40	5.00	6.50	4.00	8.32	8.00
410	12.48	.78	.59	1.37	.82	2.05	4.75	3.76	10.56	10.00	6.80	8.00	4.60	4.00
441	12.00	1.93	1.42	3.35	3.30	3.98	2.18	1.08	7.24	7.00	6.16	6.00	10.94	10.00
504	12.19	1.25	1.50	2.75	2.40	3.68	1.84	2.84	8.36	7.00	5.52	6.00	10.74	10.00
323	11.10	.98	1.14	2.12	2.06	5.15	1.99	3.12	10.26	9.00	7.14	8.00	3.12	3.00
496	12.10	.78	.83	1.61	1.65	6.50	1.90	2.30	10.70	8.00	8.40	7.00	2.36	2.00
494	11.46	1.10	1.04	2.14	2.06	5.98	2.04	2.40	10.42	9.00	8.02	8.00	3.16	3.00
130	14.05	1.14	.74	1.88	1.03	6.05	2.01	2.36	10.42	10.00	8.06	8.00	2.08	2.00
135 398	13.13	.97	1.31	2.28	2.06	5.17	2.73	2.64	10.54	10.00	7.90	8.00	3.52	3.00
240 314	13.42	.58	.58	1.16	.82	5.38	2.34	1.68	9.40	8.00	7.72	7.00	1.64	1.00
412	11.90	1.90	1.44	3.34	3.30	6.03	1.97	1.98	9.98	9.00	8.00	8.00	7.60	7.00
422	16.58	1.66	.64	2.30	2.50	6.53	2.67	1.76	10.96	11.00	9.20	9.00	2.82	2.00
424	16.51	1.28	.76	2.04	2.06	6.18	2.38	1.68	10.24	10.00	8.56	8.00	2.38	1.50
91 307	6.83	1.27	1.68	2.95	2.50	1.98	7.02	6.20	15.20	13.00	9.00	11.00	9.38*	10.00
309	5.31	2.22	1.89	4.11	4.00	1.18	9.72	3.02	13.92	11.00	10.90	8.00	9.56*	10.00
522	5.76	3.43	1.30	4.73	3.50	.70	6.56	4.64	11.90	10.00	7.26	8.00	8.66*	7.00
65 131 198 329	8.69	.60	1.34	1.94	1.65	6.43	1.91	1.82	10.16	10.00	8.34	8.00	10.42	10.00
70 151 172 343	9.79	1.53	1.38	2.91	2.89	6.68	2.28	1.30	10.26	10.00	8.96	8.00	4.04	4.00

* 91-307 Enough chlorine present to unite with 1.28% potash, remainder as sulphate.
309 " " " " " .90% " " " "
522 " " " " " .71% " " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works (Continued).				
Armour's Bone, Blood and Potash	Amherst	38.00	31.18	23.48
" " " " "	Haverhill	39.00		
American Farmer's Fert., Fish and Potash Mixture	Taunton	25.00	19.74	26.65
American Farmer's Fert., Market Garden	Concord	34.00	29.73	14.36
Armour's Complete Potato	Concord	33.00	20.93	57.66
Armour's Grain Grower	Webster	27.00	18.08	52.10
" " "	Haverhill	28.00		
Armour's Ammoniated Bone with Potash	Danvers	30.00	19.23	56.01
" " " " "	Haverhill	30.00		
Armour's Fruit and Root Crop Special	Westminster	28.00	20.28	38.07
American Farmer's Fert., Corn King	Westfield	—	22.65	—
Beach Soap Company, Lawrence, Mass.				
Special R. H. Grass	Lawrence	45.00	40.98	9.81
Beach's Special Market Gardening	Lawrence	39.00	35.32	10.42
Beach's Advance Brand Fertilizer	Lawrence	32.00	28.71	11.46
Berkshire Fertilizer Co., Bridgeport, Conn.				
Berkshire Potato and Vegetable Phosphate	North Amherst	28.00	18.11	54.61
Berkshire Complete Fertilizer (Tobacco)	North Amherst	30.00	26.53	13.08
" " " (Root)	North Hadley	32.00	25.54	29.60
" " " "	Oxford	34.20		
Berkshire Ammoniated Bone Phosphate	Fall River	27.00	16.13	67.39
" " " "	Oxford	—		
Berkshire Grass Special	Oxford	36.10	26.98	33.80
Bonora Chemical Co., 492 Broadway, New York City.				
Nature's Plant Food	Boston	1000.*	67.94	1371.8
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Bowker's Bone and Potash, Square Brand	Northampton	30.00	17.11	66.57
" " " " " "	Great Barrington	27.00		

* Sold only in from one to five pound packages at 50 cents per pound.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
86 331	11.66	2.14	1.95	4.09	4.11	7.83	.63	.44	8.90	10.00	8.46	8.00	7.86	7.00
136	8.59	.69	1.88	2.57	2.06	4.60	2.26	2.50	9.36	7.00	6.86	6.00	2.18	2.00
179	10.50	3.47	.34	3.81	3.29	7.45	.95	.74	9.14	9.00	8.40	8.00	7.48*	7.00
197	9.45	.75	1.07	1.82	1.65	5.38	2.60	.84	8.82	8.00	7.98	7.00	6.70	6.00
281 330	12.00	.48	1.19	1.67	1.65	7.00	2.48	1.16	10.64	10.00	9.48	8.00	2.04	2.00
333 342	10.54	1.43	1.22	2.65	2.47	4.20	2.12	1.56	7.88	7.00	6.32	5.00	2.60	2.00
540	8.58	.75	.94	1.69	1.65	5.85	2.79	.82	9.46	10.00	8.64	8.00	5.84	5.00
542	8.46	1.37	1.19	2.56	2.47	6.05	2.71	.70	9.46	9.00	8.76	8.00	4.62	4.00
372	4.25	5.22	.72	5.94	5.77	.48	4.10	3.10	7.68	7.50	4.58	—	15.66	17.00
376	6.71	3.89	.96	4.85	4.94	2.68	5.00	1.02	8.70	8.00	7.68	—	10.04*	10.00
379	6.69	1.54	1.22	2.76	2.47	4.73	6.07	1.50	12.30	10.00	10.80	8.00	7.30‡	6.00
12	8.80	.43	1.54	1.97	1.70	3.80	1.26	3.30	8.36	8.00	5.06	6.00	4.66	4.00
31 75 293	9.14	1.47	1.28	2.75	2.50	6.10	2.54	2.18	10.82	10.00	8.64	8.00	6.58†	6.00
144 288	11.82	.61	.87	1.48	.80	5.83	2.05	1.64	9.52	10.00	7.88	8.00	2.30	2.00
241	13.10	3.93	1.04	4.97	5.00	3.48	1.58	.98	6.04	5.00	5.06	4.00	3.40	2.00
159	2.22	16.18	—	16.18	15.00	3.65	.35	—	4.00	5.00	4.00	5.00	4.82	3.00
1 509	10.22	.76	1.18	1.94	1.65	4.13	2.21	4.04	10.38	7.00	6.34	6.00	2.02	2.00

* 179 Enough chlorine present to unite with 3.95% potash, remainder as sulphate.
376 " " " " " 4.27% " " " " "
† 31 Branded "Tobacco" contains potash as sulphate.
75-293 Branded "Root" contains potash as chloride.
‡ Practically all of the potash is in form of sulphate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Co. (Continued).				
Bowker's Market Garden Fertilizer	Northampton	37.00	25.40	45.67
" " " "	Lawrence	37.00		
Bowker's Tobacco Starter	South Deerfield	35.00	24.14	40.85
" " "	Southwick	33.00		
Bowker's Fish and Potash	Northampton	32.00	17.78	79.98
Bowker's Early Potato Manure	South Deerfield	36.50	27.08	33.86
" " " "	North Adams	36.00		
Bowker's Soluble Animal Fertilizer	Fall River	34.00	24.70	37.65
Bowker's Ammoniated Food for Flowers	Boston	†	25.20	—
Bowker's Potato and Vegetable Phosphate	Boston	32.00	22.10	44.80
Bowker's Lawn and Garden Dressing	Lexington	‡56.00	22.77	117.39
" " " " "	North Adams	43.00		
Bowker's Bone and Wood Ash Fertilizer	Boston	30.00	17.70	63.84
" " " " " "	Springfield	28.00		
Bowker's Hill and Drill Phosphate	Boston	32.00	21.37	49.74
" " " " "	Lexington	32.00		
" " " " "	Lawrence	32.00		
Bowker's High Grade Fertilizer	Oxford	31.50	23.63	33.31
Bowker's 10% Manure	Danvers	31.00	24.01	29.11
Bowker's Corn and Grain Fertilizer	Danvers	—	21.26	—
Bowker's Special Potato and Vegetable Fertilizer	Danvers	32.00	21.91	46.05
Bowker's Corn Phosphate	Danvers	28.00	17.91	61.92
" " "	North Adams	30.00		
Bowker's Blood, Bone and Potash	Lowell	41.00	28.29	44.93
Bowker's Farm and Garden Phosphate	Lawrence	31.00	17.77	74.45
Bowker's Complete Alkaline Tobacco Grower	Southwick	34.00	26.88	26.49
Bowker's Potash or Staple Phosphate	Great Barrington	25.00	16.86	48.28
Bowker's Special Seeding Down Fertilizer	Great Barrington	32.00	23.20	37.93
Bowker's Potash Bone	Pittsfield	21.50	13.39	60.57
Bowker's Sure Crop Phosphate	Palmer	28.50	16.07	77.35
Bristol Fish and Potash	Indian Orchard	—	18.28	—

† Sold only in small packages at 15 and 25 cents per package.
‡ Retailed in 10 to 50 lb. lots; never sold by the ton.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
7, 377	9.41	1.38	1.26	2.64	2.47	3.33	2.11	1.98	7.42	7.00	5.44	6.00	10.70	10.00
41, 460	9.33	1.81	1.40	3.21	2.47	6.73	1.53	1.44	9.70	10.00	8.26	8.00	3.54‡	3.00
42	10.08	1.19	1.42	2.61	2.47	2.73	1.15	.98	4.86	5.00	3.88	4.00	4.00	4.00
93, 470	11.17	1.77	1.61	3.38	3.29	5.58	1.70	1.26	8.54	8.00	7.28	7.00	7.44	7.00
154	14.05	1.87	1.22	3.09	2.50	7.18	.80	2.90	10.88	10.00	7.98	8.00	4.38	4.00
161	6.25	3.17	.21	3.38	2.00	1.73	7.81	.90	10.44	6.00	9.54	4.00	3.64*	2.00
168	16.19	1.98	.83	2.81	1.65	6.75	2.15	1.98	10.88	10.00	8.90	9.00	2.22	2.00
208, 480	8.41	1.84	1.45	3.29	3.00	1.63	2.91	2.08	6.62	8.00	4.54	5.00	5.80	5.00
211, 400	10.29	.57	1.22	1.79	1.65	.23	8.23	2.32	10.78	8.00	8.46	6.00	2.38	2.00
213, 339, 391	15.18	1.53	1.02	2.55	2.47	6.65	1.93	2.50	11.08	10.00	8.58	9.00	2.52	2.00
295	15.83	1.90	.88	2.78	2.47	7.65	1.85	1.66	11.16	10.00	9.50	6.00	3.54	4.00
328	13.60	1.34	.75	2.09	.82	2.63	3.27	2.50	8.40	6.00	5.90	5.00	11.06	10.00
334	17.35	1.62	.65	2.27	2.47	6.33	2.67	1.90	10.90	10.00	9.00	8.00	3.66	4.00
341	16.41	1.55	.62	2.17	2.47	6.54	2.02	1.82	10.38	9.00	8.56	7.00	5.34	4.00
349, 484	16.23	1.09	.85	1.94	1.36	4.90	2.70	2.56	10.16	9.00	7.60	8.00	2.40	2.00
359	13.46	3.07	.82	3.89	4.11	4.25	1.75	2.00	8.00	9.00	6.00	7.00	8.16	7.00
384	16.12	1.03	.76	1.79	1.65	6.30	1.78	2.44	10.52	9.00	8.08	8.00	2.30	2.00
465	12.86	1.13	2.77	3.90	4.00	.43	4.27	6.78	11.48	5.00	4.70	4.00	4.56*	5.00
488	14.87	.71	.65	1.36	.82	4.38	2.82	3.30	10.50	9.00	7.20	8.00	3.90	3.00
492	15.07	1.39	1.36	2.75	2.47	5.08	2.72	2.26	10.06	9.00	7.80	8.00	4.76	4.00
510	12.99	.41	.68	1.09	.82	4.03	2.43	1.20	7.66	7.00	6.46	6.00	2.80	2.00
538	13.73	.62	.85	1.47	.82	5.30	2.24	3.00	10.54	9.00	7.54	8.00	2.08	2.00
543	7.90	.56	1.30	1.86	1.65	4.15	2.93	4.82	11.90	6.00	7.08	5.00	2.28*	2.00

* 161 Enough chlorine present to unite with .97% potash, remainder as sulphate.
465 " " " " " 1.33% " " " "
543 " " " " " .79% " " " "
‡ Practically all of the potash present as sulphate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Co. (Continued).				
Bowker's Clover Brand Bone and Wood Ash Fertilizer	West Newton	40.00‡	17.17	132.96
Bowker's Fish and Potash, Square Brand	Northampton	32.00	18.12	76.60
Bowker's Cranberry Phosphate	South Carver	35.00	23.37	49.77
Stockbridge Complete Manure for Grass Topdressing	Northampton	40.00	29.22	36.89
" " " " " "	Lawrence	40.00		
Stockbridge Manures, Potatoes and Vegetables	Northampton	40.00	28.71	36.71
" " " " "	Fall River	38.00		
" " " " "	Lexington	39.00		
" " " " "	Lawrence	40.00		
Bowker's Stockbridge Manure, Tobacco	South Deerfield	47.00	36.86	27.56
Stockbridge Manures for Corn and All Grain Crops	South Deerfield	38.00	28.73	35.75
" " " " " "	Lawrence	40.00		
" " " " " "	Great Barrington	—		
Stockbridge Manures, Perm. Dress., Seeding Down, etc.	Dighton	36.50	25.36	47.87
" " " " " " "	Oxford	38.50		
Stockbridge Special Manures, Complete Corn and Grain	Lexington	39.00	27.45	42.08
J. Breck & Son, 51-52 N. Market St., Boston, Mass.				
Breck's Lawn and Garden Dressing	Boston	45.00	27.13	65.87
Breck's Flower Food	Boston	298.40*	33.87	781.02
Breck's Market Garden Manure	Boston	32.00	22.54	41.97
Ram's Head Brand, Sheep Manure, Pulverized	Brockton	40.00	13.85	188.81
Buffalo Fertilizer Co., William St., Buffalo, N. Y.				
Farmers' Choice	Holyoke	27.00	15.51	74.08
Celery, Potato Special	Townsend	32.50	22.52	44.32
Buffalo Top Dresser	North Carver	42.00	28.61	46.80
High Grade Manure	North Carver	36.00	26.65	35.08
Coe-Mortimer Company, 24-26 Stone St., N. Y. City.				
E. Frank Coe's H. G. Ammon. Bone Superphosphate	Taunton	27.00	18.11	65.65
" " " " " "	Westfield	33.00		

‡ Retailed in 10 to 50 lb. lots; never sold by the ton.

* Sold only in small packages at $1.00 and $2.00 per dozen.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
536	17.36	1.05	.84	1.89	1.75	—	6.78	3.78	10.56	9.00	6.78	7.00	2.62	2.25
544	11.20	.69	1.91	2.60	2.47	2.53	1.63	1.46	5.62	5.00	4.16	4.00	3.72	4.00
531	17.16	1.74	1.15	2.89	2.47	7.33	1.89	3.02	12.24	10.00	9.22	9.00	2.32	2.00
25, 352	12.08	2.75	1.92	4.67	4.93	2.68	2.38	2.36	7.42	6.00	5.06	4.00	6.36	6.00
58, 103, 348, 383	12.26	2.03	1.46	3.49	3.29	3.45	2.71	2.00	8.16	7.00	6.16	6.00	10.02	10.00
80	10.60	3.15	2.95	6.10	5.75	2.88	1.84	.84	5.56	6.00	4.72	4.00	8.64*	10.00
85, 393, 491	12.76	1.90	1.36	3.26	3.29	6.03	3.55	1.94	11.52	11.00	9.58	10.00	7.19	7.00
104, 276	12.35	1.52	1.16	2.68	2.47	3.45	2.47	2.08	8.00	9.00	5.92	6.00	9.98	10.00
182	14.07	1.76	1.45	3.21	3.29	5.98	3.32	1.98	11.28	11.00	9.30	10.00	6.15	7.00
164	8.09	4.61	—	4.61	5.00	1.48	3.42	1.50	6.40	—	4.90	5.00	5.78	5.00
158	5.86	5.81	.75	6.56	6.50	2.05	.87	.46	3.38	3.38	2.92	2.92	6.60*	6.50
219	15.31	1.73	1.10	2.83	3.50	6.43	2.45	2.12	11.00	11.00	8.88	9.00	2.52	2.00
355	9.80	.67	1.64	2.31	2.68	.60	.93	none	1.53	1.50	1.53	—	3.21†	1.75
311	13.64	.58	.22	.80	.82	3.23	5.01	1.56	9.80	9.00	8.24	8.00	4.82	5.00
534	14.94	.82	.36	1.18	1.64	5.70	3.56	.84	10.10	9.00	9.26	8.00	10.32	10.00
535	8.73	3.80	.42	4.22	5.74	2.68	4.66	.56	7.90	7.00	7.34	6.00	5.74‡	5.00
537	14.41	2.50	.76	3.26	3.26	3.93	4.43	.26	8.62	8.00	8.36	7.00	7.36	10.00
96, 453	12.97	.99	.87	1.86	1.85	3.53	4.33	2.50	10.36	11.00	7.86	9.00	2.88	2.25

* 80 Enough chlorine present to unite with 2.78% potash, remainder as sulphate.
158 " " " " " 2.15% " " " "

† In computing valuation on this sample, potash was valued at 5 cents per pound.

‡ Sulphate of potash the source of potash.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Coe-Mortimer Co. (Continued).				
E. Frank Coe's Excelsior Potato Fertilizer	East Taunton	33.00	25.31	33.03
" " " " "	East Longmeadow	34.00		
" " " " "	Greenfield	34.00		
High Grade Peruvian Guano, Chincha Grade	North Hadley	44.00	40.60	8.37
Columbian Corn and Potato Fertilizer	Concord	—	15.68	82.59
" " " " "	East Longmeadow	25.50		
" " " " "	Westfield	32.00		
" " " " "	Westfield	32.00		
" " " " "	Greenfield	25.00		
E. Frank Coe's X X V Ammoniated Bone Phosphate	East Longmeadow	24.00	11.09	116.41
Celebrated Special Potato Fertilizer	East Longmeadow	28.25	15.38	102.04
" " " "	Westfield	34.00		
Peruvian Guano, Lobos Grade	Manuf't'rs Sample	—	28.26	—
Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.				
IMP. Plant Food	Boston	140.00	99.43	40.80
Eureka Liquid Fertilizer Co., 35 Congress St., Boston,				
Eureka Liquid Fertilizer	Manuf't'rs Sample	—	5.64†	—
R. & J. Farquhar & Co. (Licensee), Boston, Mass.				
Farquhar's Vegetable and Potato Fertilizer	Boston	45.00	27.12	65.93
Thompson's Imp. Vine, Plant and Vegetable Manure	Boston	124.95	29.98	316.81
Farquhar's Lawn and Garden Dressing	Boston	50.00	24.89	100.88
Thompson's Special Chrysanthemum Manure	Boston	249.90	31.60	690.82
Clay's London Fertilizer	Boston	124.95	22.55	454.10
" " "	Pittsfield	—		
Fertilizer Products Co., 76 Hudson St., Jersey City, N.J.				
Plant Blood	Manuf't'rs Sample	80.00	30.80	159.74
C. W. Hastings, Jamaica Plain, Mass.				
Ferti-Flora	Boston	1000.*	18.80	5219.15

* Sold only in 8 oz. bottles at twenty-five cents apiece.

† This brand is seriously deficient in all of the essential elements of plant food. The shortage amounts to $13.50 per ton.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Guaranteed.
120, 315, 468	10.62	1.63	.73	2.36	2.47	4.68	3.00	1.40	9.08	9.00	7.68	7.00	8.50‡	8.00
79	15.06	5.14	2.75	7.89	6.59	2.40	5.94	1.86	10.20	9.00	8.34	—	2.12	2.00
206, 318, 434, 446, 487	11.42	.78	.47	1.25	1.23	4.10	3.84	1.48	9.42	10.50	7.94	8.50	3.02*	2.50
304	10.60	.70	.22	.92	.80	1.63	3.49	2.10	7.22	10.00	5.12	8.50	2.34	1.50
317, 461	13.67	.95	.40	1.35	1.65	2.08	4.62	1.46	8.16	10.00	6.70	8.00	4.00	4.00
549	9.93	1.70	1.28	2.98	2.90	1.60	8.66	6.62	16.88	15.00	10.26	9.00	4.82*	4.75
162	2.50	13.33	—	13.33	13.00	23.54	—	—	23.54	25.30	23.54	—	26.57§	24.60
545	90.89	.70	—	.70	1.37	.16	—	—	.16	7.81	.16	—	2.89§	6.23
163	13.38	1.68	1.54	3.22	3.00	5.65	2.53	1.34	9.52	7.00	8.18	—	7.20	7.00
188	8.59	2.06	1.56	3.62	3.50	5.48	3.04	4.40	12.92	12.00	8.52	8.00	7.04	7.00
189	7.80	2.60	.44	3.04	3.30	.88	4.52	5.62	11.02	14.00	5.40	4.00	7.38	7.00
190	7.10	4.30	.61	4.91	4.00	3.88	3.52	5.16	12.56	12.00	7.40	6.50	4.80	4.50
217, 498	11.53	2.22	2.50	4.72	4.50	—	.86	7.60	8.46	8.00	.86	.75	.28‡	.25
546	12.01	2.99	1.40	4.39	4.00	2.03	7.37	1.26	10.66	6.50	9.40	6.00	4.84‡	4.00
176	82.36	3.22	—	3.22	3.25	3.59	—	—	3.59	3.66	3.59	—	3.30†	3.30

* 206-318-434-446-487 Enough chlorine present to unite with 2.09% potash, remainder as sulphate.
549 " " " " " .94% potash.

§ Only traces of chlorine present.

‡ Sulphate of potash the source of potash.

† No chlorine or sulphuric acid present.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Lister's Agricultural Chemical Works, Newark, N. J.				
Lister's Special Potato Fertilizer	Hadley	31.50	18.19	75.92
" " " "	Concord	32.50		
Lister's Special Tobacco Fertilizer	Hadley	31.50	21.65	45.50
Lister's Success Fertilizer	Hadley	30.00	17.76	71.73
" " "	Leicester	31.00		
Lister's 10% Potato Grower	Concord	40.00	29.01	37.88
High Grade Special for Spring Crops	Concord	38.00	24.95	52.30
Lister's Potato Manure	Concord	39.50	26.81	47.33
Lister's Special Corn Fertilizer	Williamstown	26.12	19.63	33.06
Mapes Formula and Peruvian Guano Co., N. Y. City.				
Mapes' Lawn Top Dressing	Taunton	33.00	16.09	105.10
Mapes' Potato Manure	Taunton	41.00	27.46	48.40
" " "	Worcester	41.00		
" " "	Fitchburg	41.00		
" " "	Southwick	40.00		
Mapes' Grass and Grain Spring Topdressing	Taunton	43.00	29.79	44.34
" " " " " "	Fitchburg	43.00		
" " " " " "	Worcester	43.00		
Mapes' Complete Manure for General Use	Taunton	39.00	24.72	57.77
" " " " " "	Worcester	39.00		
Mapes' Economical Potato Manure	Taunton	—	26.75	40.82
" " " "	Worcester	38.00		
" " " "	Fitchburg	38.00		
" " " "	Southwick	37.00		
Mapes' Fruit and Vine Manure	Taunton	42.00	23.96	76.67
" " " " "	Worcester	43.00		
" " " " "	Fitchburg	42.00		
Mapes' Corn Manure	Taunton	37.00	23.37	58.32
" " "	Fitchburg	37.00		
Mapes' Cereal Brand	Taunton	31.00	16.56	87.20
" " "	Fitchburg	31.00		
Mapes' Vegetable Manure or Complete for Light Soils	Taunton	44.00	34.71	26.76
" " " " " " "	Worcester	44.00		
Mapes' Average Soil Complete Manure	Worcester	38.00	30.29	25.45
" " " " "	Fitchburg	38.00		
" " " " "	Pittsfield	—		
Mapes' Tobacco Starter, Improved	Westfield	35.00	26.41	32.53

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
45, 225	13.02	.75	1.03	1.78	1.65	4.80	2.32	3.40	10.52	9.00	7.12	8.00	3.46	3.00
53	11.51	1.16	1.39	2.55	2.06	5.23	2.55	2.50	10.28	10.00	7.78	8.00	3.68	3.00
55, 272	14.58	.73	.81	1.54	1.24	5.38	3.52	2.38	11.28	11.00	8.90	9.00	2.64	2.00
199	10.95	1.78	1.49	3.27	3.29	3.98	2.32	2.30	8.60	—	6.30	6.00	10.96	10.00
204	13.58	.77	1.11	1.88	1.05	5.60	2.44	2.48	10.52	9.00	8.04	8.00	10.31	10.00
205	15.59	2.11	.93	3.04	3.30	6.65	2.21	.84	9.70	9.00	8.86	8.00	7.30	7.00
477	11.85	1.01	.94	1.95	1.65	4.55	3.31	4.12	11.98	9.00	7.86	8.00	3.36	3.00
97	13.77	2.50	.18	2.68	2.41	.90	2.24	1.26	4.40	3.50	3.14	—	3.15	2.50
115, 253, 267, 447	7.41	3.17	.54	3.71	3.71	1.05	5.31	2.74	9.10	8.00	6.36	8.00	6.74†	6.00
116, 292, 301	8.01	3.98	.64	4.62	4.94	.48	4.86	2.26	7.60	6.00	5.34	5.00	7.88	7.00
121, 244	10.71	3.02	.50	3.52	3.29	.60	6.36	3.78	10.74	10.00	6.96	8.00	4.32	4.00
139, 259, 299, 466	9.78	3.08	.50	3.58	3.29	.80	3.60	2.58	6.98	6.00	4.40	4.00	8.52*	8.00
141, 231, 429	9.92	1.51	.52	2.03	1.65	.43	4.59	3.04	8.06	7.00	5.02	5.00	10.82*	10.00
145, 261	8.46	1.98	.62	2.60	2.47	1.00	5.44	4.48	10.92	10.00	6.44	8.00	6.84	6.00
146, 298	10.33	1.30	.71	2.01	1.65	.48	4.72	4.02	9.22	8.00	5.20	6.00	2.94	3.00
148, 278	8.64	4.87	.74	5.61	4.94	.45	5.75	2.38	8.58	8.00	6.20	6.00	7.34*	6.00
245, 246, 497	8.95	.54	3.81	4.35	4.12	1.40	5.00	2.02	8.42	8.00	6.40	7.00	6.06†	5.00
413	8.21	3.94	.88	4.82	4.12	—	5.54	3.18	8.72	8.00	5.54	6.00	2.08*	1.00

* 139-259-299-466. Enough chlorine present to unite with 1.94% potash, remainder as sulphate.
141-231-429. " " " " " 2.38% " " " "
148-278. " " " " " 1.71% " " " "
413 " " " " " .77% " " " "
† Sulphate of potash, the source of potash.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Mapes Formula and Peruvian Guano Co. (Continued).				
Mapes' Cauliflower and Cabbage Manure	Fitchburg	40.00	26.46	51.17
Mapes' Tobacco Manure, Wrapper Brand	Southwick	49.00	41.60	17.79
Mapes' Complete Manure, "A" Brand	Southwick	36.00	21.48	67.60
Mapes' Tobacco Ash Constituents	Southwick	34.00	26.20	29.77
Mapes' Top Dressing Improved, Half Strength	Southwick	34.00	23.61	44.01
Mitchell Fertilizer Co., Tremley, N. J.				
Mitchell's Special Vegetable Manure	Seekonk	39.00	33.50	16.42
National Fertilizer Co., Bridgeport, Conn.				
Chittenden's Complete Fertilizer	Bradstreet	—	28.12	28.02
" " "	North Hadley	36.00		
Chittenden's Market Garden Fertilizer	North Hadley	33.00	24.58	34.26
Chittenden's Connecticut Valley Tobacco Grower	Sunderland	48.00	33.84	41.84
" " " " "	North Hadley	48.00		
Chittenden's Connecticut Valley Tobacco Starter	Sunderland	48.00	36.81	30.40
" " " " "	North Hadley	48.00		
" " " " "	North Hadley	48.00		
Chittenden's Complete Fertilizer (Root)	Sunderland	36.00	27.11	36.48
" " " "	Leominster	38.00		
Chittenden's Formula A	Bradstreet	30.40	26.98	12.68
Fish and Potash	North Hadley	28.50	21.85	30.43
" " "	West Springfield	—		
Chittenden's Complete Fertilizer (Grain)	Sunderland	35.00	27.51	27.22
Complete Tobacco Manure	South Deerfield	34.00	29.57	14.98
Chittenden's Complete Fertilizer (Grass)	South Deerfield	36.00	27.34	31.68
Chittenden's Complete Fertilizer (Tobacco)	North Hadley	36.00	28.10	28.11
" " " "	Sunderland	36.00		
Chittenden's Complete Fertilizer (Tobacco)	West Springfield	36.00	28.56	26.05
Chittenden's Ammoniated Bone Phosphate	Leominster	30.00	18.60	61.29
Chittenden's Potato Phosphate	Great Barrington	34.00	22.41	51.72
Tobacco Formula	Hatfield	38.00	26.65	42.59

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid Reverted.	Phosphoric Acid Insoluble.	Phosphoric Acid Total. Found.	Phosphoric Acid Total. Guaranteed.	Phosphoric Acid Available. Found.	Phosphoric Acid Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
423	7.42	3.17	.72	3.89	4.12	.95	4.89	2.40	8.24	6.00	5.84	6.00	6.44	6.00
439	10.36	1.22	5.02	6.24	6.18	.25	2.35	3.10	5.70	4.50	2.60	—	10.95*	10.50
445	10.72	1.73	.77	2.50	2.47	1.45	6.53	4.84	12.82	12.00	7.98	10.00	3.12	2.50
456	13.70	.42	.25	.67	.50	.10	2.14	3.68	5.92	5.70	2.24	—	15.00‡	15.00
459	9.06	4.72	.14	4.86	4.94	1.05	1.57	1.66	4.28	4.00	2.62	—	2.51†	2.00
102	8.11	2.66	1.79	4.45	4.50	6.07	2.39	1.80	10.26	9.00	8.46	8.00	8.08	8.00
2 / 35	11.20	1.80	1.80	3.60	3.30	6.20	1.90	2.18	10.28	10.00	8.10	8.00	6.24	5.00
3	13.68	1.33	1.18	2.51	2.50	5.70	2.54	2.28	10.52	10.00	8.24	8.00	6.96	6.00
8 / 87	8.41	1.80	2.98	4.78	4.90	—	3.30	2.00	5.30	4.00	3.30	—	7.46*	9.00
9 / 35 / 39	5.94	4.05	4.13	8.18	8.25	.15	1.23	2.10	3.48	3.00	1.38	—	3.16*	2.50
54 / 251	13.16	1.99	1.35	3.34	3.30	4.78	3.22	1.92	9.92	10.00	8.00	8.00	6.78	6.00
40	12.02	2.14	1.38	3.52	3.33	4.93	2.45	2.18	9.56	9.00	7.38	6.00	6.34	6.00
46 / 73	11.01	1.61	1.48	3.09	3.00	2.10	2.94	4.18	9.22	6.00	5.04	—	4.00	4.00
64	13.41	1.75	1.85	3.60	4.50	7.13	1.91	1.34	10.38	—	9.04	8.00	4.76	5.00
71	9.24	1.36	3.78	5.14	4.55	—	3.92	2.38	6.30	4.00	3.92	3.00	4.73*	5.50
72	9.32	4.16	.44	4.60	4.10	1.63	3.95	1.20	6.78	8.00	5.58	6.00	5.27	5.00
5 / 59	9.74	1.33	2.20	3.53	3.50	5.95	2.23	1.90	10.08	10.00	8.18	8.00	5.48†	5.40
74	10.51	1.71	2.00	3.71	3.30	5.73	2.35	2.46	10.54	10.00	8.08	8.00	5.35†	5.00
418	16.35	1.38	.68	2.06	1.65	6.28	2.02	1.90	10.20	10.00	8.30	8.00	2.16	2.00
499	11.32	.70	1.66	2.36	2.06	6.50	2.30	1.76	10.62	10.00	8.80	8.00	4.34	6.00
515	8.26	.04	4.33	4.97	4.94	1.95	1.35	.74	4.04	3.00	3.30	—	3.10*	3.00

* 439. Enough chlorine present to unite with 1.76% potash, enough sulphuric acid present to unite with 5.50% potash, remainder as carbonate.
8-87. " " " " " .99% " remainder as carbonate. Total potash 7.86.
9-35-39. " " " " " 2.45% " " " sulphate. Total potash 3.16.
71. " " " " " 1.13% " " " " Total potash 5.42.
515. " " " " " .25% " " " " Total potash 3.20.

† Sulphate of potash, the source of potash.

‡ 456. Enough chlorine present to unite with 2.15% potash, enough sulphuric acid present to unite with 5.39% potash, remainder as carbonate. Total potash 16.02.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
New England Fert. Co., 40A N. Market St., Boston.				
New England High Grade Potato Fertilizer	South Lowell	34.00	24.50	38.78
New England Superphosphate	South Lowell	32.00	23.82	28.04
" " "	Orange	29.00		
New England Corn Phosphate	South Lowell	30.00	18.54	61.81
" " " "	Orange	30.00		
New England Corn and Grain Fertilizer	South Lowell	27.00	14.89	81.33
New England Complete Manure	South Lowell	38.00	28.25	34.51
New England Potato Fertilizer	South Lowell	30.00	17.81	65.64
" " " "	Orange	29.00		
New England High Grade Special, 10% Potash	South Lowell	40.00	27.65	44.67
Olds & Whipple, 164-168 State St., Hartford, Conn.				
Complete Tobacco Fertilizer	North Hadley	36.00	28.43	26.63
Tobacco Special	South Deerfield	35.00	30.44	14.98
Special Onion Mixture	North Hadley	29.00	25.26	14.81
O. & W. Corn and Potato Fertilizer	Manuf't'rs Sample	32.00	27.09	18.12
Parmenter & Polsey Fertilizer Co., Peabody, Mass.				
Plymouth Rock Brand Fertilizer	South Lowell	32.00	22.20	46.40
" " " "	East Longmeadow	33.00		
Special Potato Fertilizer	East Longmeadow	38.00	27.23	39.55
R. T. Prentiss, Holyoke, Mass.				
Complete for Potatoes	Holyoke	37.00	22.65	61.15
" " "	Manuf't'rs Sample	36.00		
Complete for Corn and Grain	Manuf't'rs Sample	34.00	25.25	34.65
Complete for Corn and Grain	Ludlow*	35.00	22.55	55.21
Complete for Top Dressing	Manuf't'rs Sample	41.00	29.39	39.50
Complete for Top Dressing	Granby*	42.00	30.17	39.21
Benjamin Randall, East Boston, Mass.				
Randall's Boston Fertilizer, Market Garden	Westport	32.00	23.99	33.39
Randall's Boston Fertilizer, Farm and Field	Westport	25.00	19.36	29.13

* New samples taken at the request of Mr. Prentiss after the analyses of the other samples had been reported. All of these brands were manufactured by the Buffalo Fertilizer Co., who are willing to make a satisfactory rebate on all of their goods having a shortage.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
350	10.16	1.50	1.21	2.71	2.46	5.60	2.88	2.48	10.96	9.00	8.48	8.00	5.66	5.00
356 / 478	8.60	1.20	1.42	2.62	2.45	5.28	2.44	3.00	10.72	10.00	7.72	8.00	5.74	4.00
357 / 474	9.85	1.16	.78	1.94	1.64	5.60	1.74	2.72	10.06	9.00	7.34	8.00	3.28	3.00
366	8.95	.74	.63	1.37	1.25	4.55	2.55	2.60	9.70	8.00	7.10	7.00	1.98	2.00
369	7.26	1.81	1.44	3.25	3.29	3.33	2.97	1.66	7.96	7.00	6.30	6.00	10.58	10.00
370 / 482	7.47	.90	.85	1.75	1.64	3.78	3.08	2.54	9.40	8.00	6.86	7.00	4.02	4.00
375	8.97	1.93	1.44	3.37	3.50	4.55	2.85	2.02	9.42	.00	7.40	7.00	7.86	10.00
11	7.72	1.56	3.41	4.97	4.53	—	2.56	2.18	4.74	—	2.56	3.00	5.64*	5.50
88	9.43	1.31	3.72	5.03	—	.60	4.70	3.48	8.78	—	5.30	—	4.12†	—
89	10.40	1.73	1.17	2.90	3.00	1.15	7.31	2.00	10.46	—	8.46	8.00	5.82	6.00
530	6.78	.81	2.77	3.58	3.30	4.58	1.64	—	6.22	—	6.22	6.00	6.72‡	6.00
374 / 437	7.85	1.17	1.34	2.51	2.47	4.85	3.11	2.48	10.44	9.00	7.96	8.00	4.40	4.00
435	9.53	1.82	1.47	3.29	3.29	5.98	2.02	1.54	9.54	9.00	8.00	8.00	7.12	7.00
305 / 529	12.37	2.13	.39	2.52	2.87	1.73	3.91	1.40	7.04	9.00	5.64	8.00	7.70*	10.00
528	15.05	1.90	.76	2.66	2.88	2.95	3.69	.98	7.62	10.00	6.64	8.00	9.33	8.00
550	19.63	2.15	.61	2.76	2.87	3.12	2.10	1.44	6.66	9.00	5.22	—	7.56	8.00
527	15.31	4.02	.80	4.82	5.77	2.33	3.97	.40	6.70	9.00	6.30	7.00	6.09	8.00
551	10.05	4.27	.55	4.82	5.76	2.32	2.98	1.12	6.42	9.00	5.30	—	7.84	8.00
112	22.38	1.16	1.86	3.02	3.30	3.65	4.95	2.18	10.78	—	8.60	8.00	3.64	4.00
125	17.59	1.04	1.30	2.34	1.65	1.80	5.08	3.40	10.28	—	6.88	6.00	2.88	2.00

* 11. Enough chlorine present to unite with .90% potash, remainder as sulphate. Total potash 6.12.
305-529. " " " " " 2.25% " " " "

† 88. Sulphate of potash the source of potash. Total potash 4.76.

‡ Sulphate of potash, the source of potash.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
W. W. Rawson & Co., 5 Union St., Boston, Mass.				
Rawson's Special Lawn and Garden Dressing	Boston	35.00	18.96	84.60
Rawson's Lawn and Garden Dressing	Boston	50.00	22.78	119.49
Wizard Brand Pulverized Sheep Manure	Boston	35.00	11.22	211.94
Ross Brothers, 88-92 Front St., Worcester, Mass.				
Ross Lawn and Garden Fertilizer	Worcester	35.00	19.82	76.59
N. Roy & Son, South Attleboro, Mass.				
Roy's Animal Fertilizer	Manuf't'rs Sample	32.00	33.78	5.27*
Rogers & Hubbard Co., Middletown, Conn.				
Hubbard's Oats and Top Dressing	Seekonk	54.00	46.05	15.37
" " " " "	Oxford	52.25		
" " " " "	Danvers	—		
Hubbard's Special Tobacco Manure	Seekonk	47.25	39.87	18.51
Hubbard's Soluble Potato Manure	Seekonk	42.00	32.21	28.62
" " " "	Oxford	40.85		
Market Garden Phosphate	Oxford	39.42	30.09	31.01
" " "	Danvers	—		
Potato Phosphate	Oxford	32.30	22.26	45.10
" "	Danvers	—		
Soluble Corn and General Crops	Oxford	36.10	24.53	49.00
" " " " "	Hinsdale	37.00		
Complete Phosphate	Oxford	27.55	16.57	66.26
Hubbard's Grass and Grain Fertilizer	Manuf't'rs Sample	43.00	29.83	44.15
Rogers Manufacturing Co., Rockfall, Conn.				
Complete Potato and Vegetable Fertilizer	North Amherst	34.00	21.96	57.10
" " " " "	Sunderland	35.50		
" " " " "	Worcester	34.00		
High Grade Soluble Tobacco Manure	Sunderland	43.50	37.54	16.54
" " " " "	North Amherst	44.00		
Fish and Potash	Sunderland	30.50	21.69	44.08
" " "	Worcester	32.00		
High Grade Complete Corn and Onion	Sunderland	—	29.83	—
High Grade Fertilizer for Oats and Topdressing	Sunderland	44.50	37.55	18.51
All Round Fertilizer	Worcester	30.00	22.31	34.47
Corn and Onion Fertilizer	Manuf't'rs Sample	37.00	26.91	37.50
Tobacco and Potato Fertilizer	Manuf't'rs Sample	40.00	33.08	20.92

* Valuation in excess of selling price.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Guaranteed.
101	9.05	2.22	.10	2.32	1.65	1.38	6.22	1.66	9.26	9.00	7.60	3.00	3.00	2.00
220	7.37	3.32	.10	3.42	3.29	1.23	4.27	1.62	7.12	5.00	5.50	4.00	5.12	5.00
210	7.53	—	—	2.17	—	—	—	—	1.44	—	1.44	—	1.02†	—
258	9.94	1.54	.40	1.94	2.50	.15	6.41	.52	7.08	6.00	6.56	—	7.04*	5.50
524	6.13	1.61	2.97	4.58	5.42	.58	6.18	9.98	16.74	16.20	6.76	8.14	5.96*	4.16
109, 264, 552	4.39	7.41	1.14	8.55	8.50	—	6.02	3.14	9.16	8.00	6.02	3.90	8.56	8.00
152	7.77	3.77	1.27	5.04	5.00	.70	8.72	4.94	14.36	10.00	9.42	7.00	10.18‡	10.00
153, 234	12.54	3.09	1.36	4.45	5.00	.80	6.20	5.58	12.58	10.00	7.00	7.00	6.86*	5.00
252, 345	8.14	2.59	.72	3.31	3.50	4.15	3.61	1.98	9.74	8.50	7.76	7.00	11.02	10.00
263, 335	9.33	1.34	.60	1.94	2.00	6.03	3.13	1.76	10.92	10.00	9.16	9.00	6.22	5.00
282, 496	5.86	1.54	1.04	2.58	2.50	1.53	3.93	3.42	8.88	8.00	5.46	6.00	9.56	8.00
287	11.59	.34	.74	1.08	1.00	5.18	3.30	1.40	9.88	9.00	8.48	8.00	4.20	3.50
547	8.51	.77	2.29	3.06	2.20	.48	6.46	9.70	16.64	16.00	6.94	6.60	8.73§	12.00
4, 36, 239	11.01	1.47	.78	2.25	2.25	5.08	2.80	2.96	10.84	10.00	7.88	8.00	5.34	5.00
20, 66	6.58	2.83	2.05	4.88	5.00	1.28	4.88	2.02	8.18	8.00	6.16	6.00	12.36*	11.00
30, 255	7.98	1.05	2.33	3.38	3.25	1.73	2.75	2.10	6.58	6.00	4.48	4.00	3.76	3.75
52	7.99	2.52	1.66	4.18	3.60	3.58	2.58	3.36	9.52	8.00	6.16	6.00	7.60	7.50
32	6.90	4.38	1.62	6.00	6.60	1.50	4.42	4.40	10.32	8.00	5.92	7.00	8.78	7.50
285	10.65	1.75	.88	2.63	1.65	5.50	2.94	2.18	10.62	10.00	8.44	8.00	3.70	2.00
517	9.02	1.85	1.64	3.49	3.60	1.08	4.92	3.24	9.24	8.00	6.00	6.00	7.68	7.00
516	7.05	2.28	1.51	3.79	3.50	2.03	5.83	4.14	12.00	9.00	7.86	7.00	9.60‡	8.75

* 258 Enough chlorine present to unite with 4.60% potash, remainder as sulphate.
524 " " " " " 3.02% " " " "
153-234 " " " " " 1.82% " " " "
20-66 " " " " " 1.18% " " " "
‡ Practically all of the potash present as sulphate.
† In computing valuation on this sample, potash was valued at 5 cents per pound.
§ Another sample of this brand sent on by the company tested 11.86% potash.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Russia Cement Co., Gloucester, Mass.				
Essex Complete Manure for Potatoes, Roots, Vegetables	North Hadley	38.00	33.81	16.33
" " " " " "	Taunton	40.00		
" " " " " "	Dighton	—		
" " " " " "	Leominster	40.00		
Essex Market Garden and Potato Manure	Hadley	34.00	23.87	44.33
" " " " " "	Dighton	—		
" " " " " "	Worcester	35.00		
Essex Grass and Top Dressing Fertilizer	Hadley	44.00	36.65	20.05
Essex XXX Fish and Potash, General Farm Crops	Taunton	30.00	22.32	36.63
" " " " " " " "	Somerset	—		
" " " " " " " "	Leominster	31.00		
Essex Complete Manure, Corn, Grain and Grass	Middleboro	39.00	31.13	22.07
" " " " " " "	Sterling	37.00		
Essex Odorless Lawn Dressing	Taunton	52.00	31.44	54.26
" " " "	Leominster	45.00		
Essex R. I. Special Fertilizer for Potatoes and Roots	Dighton	—	27.79	—
Essex A1 Superphosphate	Sterling	27.00	15.88	72.10
" " "	S. Framingham	26.00		
" " "	Southwick	29.00		
Essex Corn Fertilizer	S. Framingham	32.00	22.59	41.65
Essex Tobacco Starter	Southwick	36.00	23.47	53.39
Essex Special Tobacco Manure	Hadley	44.00	38.87	13.20
Sanderson Fertilizer and Chem. Co., New Haven, Conn.				
Sanderson's Tobacco Formula B	Bradstreet	32.30	25.15	28.43
Sanderson's Top Dressing Fertilizer	Bradstreet	34.20	26.20	30.53
Sanderson's Formula A	Bradstreet	32.30	23.21	39.16
Sanderson's Formula A	N. Wilbraham	35.00	23.98	45.95
Sanderson's Potato Manure	N. Wilbraham	30.00	19.79	51.59
M. L. Shoemaker & Co. (Limited), Philadelphia, Pa.				
Shoemaker's Swift Sure Superphosphate for General Use	Sunderland	34.00	28.60	20.25
" " " " " " "	Springfield	35.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
44 / 122 / 143 / 240	4.66	1.23	2.61	3.84	3.70	4.25	4.11	5.12	13.48	9.00	8.36	7.00	8.56‡	8.50
48 / 105 / 209	9.94	.81	1.38	2.19	2.00	.83	9.03	4.82	14.68	10.00	9.86	8.00	5.08	5.00
67	8.55	3.41	2.01	5.42	5.00	2.05	5.57	4.32	11.94	10.00	7.62	8.00	8.24	8.00
98 / 150 / 421	8.18	.63	1.87	2.50	2.10	1.95	6.17	6.06	14.18	12.00	8.12	9.00	2.82	2.25
101 / 427	9.73	.24	3.08	3.32	3.30	6.73	2.49	2.60	11.82	9.50	9.22	7.00	8.94	9.50
114 / 396	4.75	.23	3.85	4.08	3.70	.88	5.02	5.12	11.02	8.00	5.90	6.00	7.98*	7.00
119	11.20	1.37	2.06	3.43	3.00	2.40	5.32	4.02	11.74	9.00	7.72	8.00	6.44	6.50
263 / 426 / 458	6.70	.18	1.03	1.21	1.00	.68	5.88	7.62	14.18	9.00	6.56	7.00	2.28	2.00
405	5.91	.82	1.63	2.45	2.00	1.80	6.40	5.94	14.14	11.00	8.20	9.00	3.46	3.00
452	8.19	1.18	1.28	3.02	2.50	3.80	6.08	5.30	15.18	12.00	9.88	9.00	2.46‡	2.50
533	3.31	1.80	2.58	4.38	4.50	3.53	2.07	4.56	11.06	8.50	6.50	7.00	13.66‡	12.00
22	10.34	1.64	1.64	3.28	3.33	2.43	3.15	3.02	8.60	10.00	5.58	6.00	6.92	6.00
27	10.78	2.03	1.25	3.28	4.12	2.85	4.07	1.68	8.60	—	6.92	7.00	7.50	7.00
28	12.03	1.42	1.35	2.77	3.33	3.18	2.40	2.36	7.94	9.00	5.58	6.00	7.22	6.00
433	11.30	1.39	1.37	2.76	3.33	4.25	2.69	2.86	9.80	9.00	6.94	6.00	6.36	6.00
440	10.15	.75	1.19	1.94	1.67	4.43	2.07	1.68	8.18	8.00	6.50	7.00	6.08	6.00
61 / 411	9.38	1.93	1.28	3.21	2.88	6.73	3.91	3.32	13.96	—	10.64	9.00	4.72‡	4.50

* 114-396 Enough chlorine present to unite with 4.21% potash, remainder as sulphate.

‡ Practically all of the potash is in form of sulphate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Smith Agricultural Chemical Co., Columbus, Ohio.				
Abbott's Special Tobacco and Potato	Bridgewater	33.00	19.60	68.37
Abbott's Ideal Grain Grower	Bridgewater	29.00	11.60	150.00
Abbott's Truck Guano	Holyoke	40.00	25.76	55.28
Abbott's German Potash Mixture	Bridgewater	40.00	20.05	99.50
Abbott & Martin's Harvest King	N. Oxford	28.00	15.60	70.49
Hardy's Potato Grower	Leominster	35.00	17.54	90.99
" " "	Holyoke	32.00		
Hardy's Potato and Tobacco Special	Leominster	31.00	16.86	66.07
" " " " "	Danvers	25.00		
Hardy's Tankage, Bone and Potash	Holyoke	28.00	16.27	72.10
Sterling Chemical Co., Cambridgeport, Mass.				
Sterlingworth Plant Food Tablets	Boston	250.00	47.81	422.90
Swift Lowell Fertilizer Co., 40 N. Market St., Boston.				
Swift's Superior Fertilizer, with 10% Potash	Seekonk	39.00	30.76	26.79
Swift's Lowell Animal Brand for all Crops	New Bedford	35.00	22.83	47.48
" " " " " "	Concord	32.00		
" " " " " "	Arlington	34.00		
Swift's Special Vegetable Manure	Seekonk	35.00	26.79	30.65
Swift's Lowell Market Garden Fertilizer	Taunton	—	28.57	33.00
" " " " "	Lexington	38.00		
Swift's Lowell Potato Phosphate	Taunton	—	24.72	41.58
" " "	Springfield	35.00		
Swift's Lowell Lawn Dressing	Lexington	44.00	25.57	74.66
" " " "	Concord	45.00		
" " " "	Boston	45.00		
Swift's Lowell Blood, Bone and Potash	Concord	36.00	29.99	20.04
Swift's Lowell Special Grass	Lexington	39.00	28.72	35.79
Swift's Lowell Dissolved Bone and Potash	Lowell	30.00	17.99	66.76
Swift's Lowell Potato Manure	South Lowell	30.00	19.48	61.70
" " " "	Southwick	33.00		
Swift's Lowell Potato Grower	South Lowell	38.00	27.88	36.30

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash K_2O in 100 lbs. Found.	Potash K_2O in 100 lbs. Guaranteed.
194	11.81	.66	1.21	1.87	1.65	2.28	6.52	1.44	10.24	10.00	8.80	8.00	4.08	4.00
228	12.64	.44	.34	.78	.82	2.95	4.05	2.04	9.04	9.00	7.00	7.00	1.36	1.00
324	9.03	.76	2.62	3.38	3.30	3.68	4.02	1.34	9.04	10.00	7.70	8.00	4.50*	7.00
229	11.22	.50	.27	.77	1.24	5.05	2.93	2.18	10.16	10.00	7.98	8.00	10.04	10.00
265	12.33	.50	.86	1.36	1.20	1.40	7.06	3.20	11.66	10.00	8.46	8.00	1.40	2.00
255, 308	10.56	.36	.25	.61	1.24	2.95	4.51	1.46	8.92	10.00	7.46	8.00	8.72	10.00
268, 340	10.41	.38	1.05	1.43	1.64	2.10	5.64	2.26	10.00	10.00	7.74	9.00	3.60	4.00
312	12.03	.88	.80	1.68	1.23	1.98	6.10	2.46	10.54	10.00	8.08	8.00	1.50	2.00
160	13.62	5.16	—	5.16	6.00	23.12	—	—	23.12	12.00	23.12	—	5.60‡	6.00
110	8.13	1.97	1.64	3.61	3.71	3.70	4.20	1.44	9.34	8.00	7.90	7.00	10.22	10.00
123, 207, 216	8.37	1.14	1.28	2.42	2.46	4.60	4.00	3.00	11.60	10.00	8.60	8.00	4.66	4.00
120	9.49	1.86	1.28	3.14	3.29	6.28	1.58	1.68	9.54	9.00	7.86	8.00	7.40	7.00
140, 225	9.31	2.01	1.80	3.81	4.10	3.58	3.94	3.00	10.52	8.00	7.52	7.00	6.38	6.00
147, 397	10.46	1.30	1.25	2.55	2.45	4.68	3.76	4.00	12.44	9.00	8.44	8.00	6.02	6.00
169, 180, 222	6.71	3.44	.19	3.63	4.10	4.95	2.15	1.44	8.54	8.00	7.10	7.00	5.40	5.00
175	8.06	2.20	1.87	4.07	4.12	4.33	2.63	1.66	8.62	8.00	6.96	7.00	8.02	7.00
347	8.81	2.07	1.82	3.89	4.10	3.55	4.17	2.92	10.64	8.00	7.72	7.00	6.04	6.00
331	9.92	.87	.89	1.76	1.65	6.43	2.27	1.92	10.62	10.00	8.70	9.00	2.21	2.00
328, 407	7.60	1.09	.96	2.05	1.65	4.10	3.56	2.22	9.88	8.00	7.66	7.00	3.91	4.00
362	7.52	1.78	1.41	3.19	3.28	3.45	3.01	1.66	8.12	7.00	6.46	6.00	10.22	10.00

* 324 Enough chlorine present to unite with .87% potash, remainder as sulphate.
‡ Only traces of chlorine present.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Swift's Lowell Fertilizer Co. (Continued).				
Swift's Lowell Empress Brand for Corn and Potatoes	South Lowell	27.00	14.12	98.30
" " " " " " " "	Southwick	29.00		
Swift's Lowell Perfect Tobacco Grower	South Lowell		20.34	—
Swift's Lowell Bone Fertilizer for Corn and Grain	Arlington	31.00	18.10	68.51
" " " " " " " "	Manuf't'rs Sample	30.00		
Tavender Process Co., Boston, Mass.				
Am-pho-nite	Manuf't'rs Sample	—	19.09	—
Whitman & Pratt Rendering Co., Lowell, Mass.				
Corn Success	N. Chelmsford	30.50	19.85	53.65
Whitman & Pratt Vegetable Grower	N. Chelmsford	37.50	30.15	24.37
Potash Special	N. Chelmsford	37.50	27.03	38.73
Potato Plowman	N. Chelmsford	35.00	28.22	24.02
Wilcox Fertilizer Works, Mystic, Conn.				
Wilcox Fish and Potash	Amherst	28.00	19.71	34.45
" " " "	Monson	25.00		
Wilcox Potato, Onion and Vegetable Manure	Amherst	35.00	28.31	21.86
" " " " " "	Monson	34.00		
Wilcox High Grade Tobacco Special	Amherst	36.00	31.87	12.96
Wilcox Potato Fertilizer	Amherst	30.00	21.35	40.52
Wilcox Grass Fertilizer	Seekonk	34.00	29.39	15.68
Wilcox Complete Bone Superphosphate	Monson	28.00	21.81	28.38
A. H. Wood & Co., Framingham, Mass.				
B. B. Brand General Fertilizer	Manuf't'rs Sample	—	27.21	10.26
" " " "	Framingham	30.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
	Moisture.	Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
373 } 463 }	8.20	.76	.49	1.25	1.23	4.45	2.65	1.98	9.08	8.00	7.10	7.00	1.96	2.00
386	11.04	3.79	.23	4.02	4.12	1.30	4.58	3.74	9.62	8.00	5.38	7.00	4.72*	6.00
185 } 525 }	9.77	1.09	.72	1.81	1.64	5.58	2.06	2.08	9.72	9.00	7.64	8.00	3.37	3.00
394	18.03	1.59	1.94	3.53	1.25	—	5.10	.64	5.74	2.00	5.10	1.25	.41	—
256	11.33	.98	.94	1.92	1.64	5.43	3.55	2.08	11.06	10.00	8.98	8.00	3.42	3.00
257	9.97	2.42	1.45	3.87	3.20	4.23	4.59	1.80	10.62	10.00	8.82	8.00	7.26	7.00
277	9.55	1.66	1.35	3.01	2.88	3.08	2.58	3.32	8.98	8.00	5.66	6.00	10.14	10.00
284	8.83	2.77	1.52	4.29	3.30	3.54	3.36	3.30	10.20	9.00	6.90	7.00	4.54	6.00
49 } 532 }	18.05	.85	1.63	2.48	2.46	2.03	3.77	2.60	8.40	6.00	5.80	5.00	4.02	3.00
51 } 541 }	12.82	1.87	1.62	3.49	3.30	6.08	1.76	2.04	9.88	8.00	7.84	7.00	6.96	6.00
82	5.98	1.59	2.00	3.59	3.30	—	9.64	3.54	13.18	7.00	9.64	5.00	7.78*	7.00
85	10.80	.48	1.82	2.30	2.05	2.38	3.76	2.96	9.10	7.00	6.14	6.00	6.08	4.50
134	8.66	2.66	1.64	4.30	4.11	3.65	2.69	2.72	9.06	6.00	6.34	5.00	6.28*	5.00
530	15.77	.77	1.66	2.43	2.05	6.23	2.23	2.10	10.56	9.00	8.46	8.00	3.61	3.00
502 } 417 }	8.00	1.44	1.62	3.06	2.47	3.08	4.90	5.66	13.64	11.00	7.98	7.00	6.46	5.00

* 386 Enough chlorine present to unite with 1.76% potash, remainder as sulphate. Total potash 4.96%.
82 " " " " " " 3.59% " " " "
134 " " " " " " 4.06% " " " "

Fertilizers Furnishing Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
DISSOLVED PHOSPHATES AND POTASH.				
Coe-Mortimer Co., 24-26 Stone St., New York City.				
E. Frank Coe's H. G. Dissolved Bone and Potash	S. Williamstown	25.00	10.02	149.50
American Agric. Chem. Co., 92 State St., Boston, Mass.				
Packers' Union Wheat, Oats and Clover	Great Barrington	21.00	11.50	82.61
Lister's Agricultural Chemical Works, Newark, N. J.				
Lister's Animal Bone and Potash	Concord	24.50	12.54	95.37
WOOD ASHES.				
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Pure Wood Ashes	Boston	18.00*	8.81	104.31
John Joynt, Lucknow, Ontario, Canada.				
Canada Hard Wood Ashes	Lexington	19.00	8.62	114.62
" " " "	Pittsfield	18.00		
OTHER BRANDS.				
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Bowker's Tobacco Ash Elements	North Hadley	31.00	21.03	45.6[illegible]
" " " "	Southwick	32.00		
Bowker's Tobacco Carbonate	South Deerfield	38.00	30.17	25.95

* Cash price in car load lots, in bulk, $10.50-$11.00 delivered.

Fertilizers Furnishing Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash K_2O in 100 lbs. Found.	Potash K_2O in 100 lbs. Guaranteed.
470	10.39	2.10	5.88	1.34	9.32	12.50	7.98	10.50	2.36	2.00
472	12.39	6.78	2.64	1.22	10.64	11.00	9.42	10.00	2.18	2.00
171	14.09	1.48	9.00	2.38	12.86	12.00	10.48	11.00	2.36	2.00
*167	15.84	—	—	—	1.34	1.00	—	—	4.75	4.00
*203 / 506	14.47	—	—	—	1.25	1.50	—	—	4.76	5.00
76 / 406	8.82	1.38	6.78	5.84	14.00	—	8.16	8.00	12.13‡	12.00
50	9.15	—	6.04	6.72	12.76	—	6.04	6.00	15.32†	15.00

* 167. Calcium oxide found 24.20%.
203-506 " " " 26.19%.

‡ Potash present in form of sulphate. Total potash 14.22%.

† 50 Enough chlorine present to unite with 1.05% potash, enough sulphuric acid present to unite with 2.81% potash, remainder as carbonate. Total potash 17.50%.

Ground Bones, Dissolved Bones, Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chem. Co., 92 State St., Boston, Mass.				
Fine Ground Bone	New Bedford	30.00	24.75	21.21
Armour Fertilizer Works, Baltimore, Md.				
Armour's Bone Meal	North Adams	34.00	25.84	31.58
Beach Soap Company, Lawrence, Mass.				
Beach's Fertilizer Bone	Lawrence	26.00	28.00	7.14*
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Bowker's Fine Ground Bone	Northampton	30.00	24.72	21.36
Bowker's Fresh Ground Bone	Boston	30.00	26.55	12.99
Bowker's Fresh Ground Bone	Lawrence	29.00	24.62	17.79
Buffalo Fertilizer Company, Buffalo, N. Y.				
Bone Meal	Holyoke	--	19.51	—
John C. Dow Co., 13-14 Chatham St., Boston, Mass.				
Dow's Pure Ground Bone	Boston	28.00	25.48	9.89
R. & J. Farquhar & Co, (Licensee), Boston, Mass.				
Farquhar's Pure Ground Bone	Boston	30.00	28.22	6.31
Thomas Hersom & Co., New Bedford, Mass.				
Pure Bone Meal	New Bedford	25.00	28.97	13.70*
Home Soap Co., Worcester, Mass.				
Pure Ground Bone	Worcester	28.00	27.77	.83
T. L. Stetson, Randolph, Mass.				
Stetson's Ground Bone	Manuf't'rs Sample	—	28.05	—
Geo. E. Marsh Co., Lynn, Mass.				
Ground Bone	Manuf't'rs Sample	30.00	27.77	8.03
D. M. Moulton, Monson, Mass.				
Ground Bone	Manuf't'rs Sample	26.00	24.71	5.22
National Fertilizer Co., Bridgeport, Conn.				
Chittenden's Fine Ground Bone	North Hadley	30.00	26.80	11.94
Parmenter & Polsey Fertilizer Co., Peabody, Mass.				
Pure Ground Bone	East Longmeadow	28.00	27.74	.94
W. W. Rawson & Co., 5 Union St., Boston, Mass.				
Rawson's Fine Ground Bone	Boston	30.00	29.33	2.28
Rogers & Hubbard Co., Middletown, Conn.				
Hubbard's Pure Knuckle Bone Flour	Pittsfield	—	31.54	—
Hubbard's Strictly Pure Fine Bone	Manuf't'rs Sample	34.00	27.34	24.36
Rogers Manufacturing Co., Rockfall, Conn.				
Knuckle Bone Flour	Sunderland	33.50	31.02	7.99
Springfield Rendering Co., Springfield, Mass.				
Ground Steamed Bone	Manuf't'rs Sample	27.50	28.80	4.71*

* Valuation in excess of selling price.

Ground Bones, Dissolved Bones, Tankage and Dry Ground Fish.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Mechanical Analysis. Coarse.	Mechanical Analysis. Fine.
100	12.64	—	—	1.72	2.67	—	—	—	27.08	22.80	—	—	54.11	45.89
479	5.05	—	—	2.49	2.47	—	7.02	17.68	24.70	24.00	7.02	10.00	53.96	46.04
380	10.05	—	—	3.80	4.12	—	—	—	22.13	18.00	—	—	61.51	38.49
14	11.11	—	—	2.09	2.47	—	—	—	25.30	22.80	—	—	55.53	44.47
166	4.67	—	—	2.52	2.47	—	—	—	25.14	18.00	—	—	49.99	50.01
387	15.36	—	—	1.64	2.47	—	10.78	16.22	27.00	11.00	10.78	3.00	51.48	48.52
526	3.42	—	—	2.35	2.88	—	—	—	14.66	22.00	—	—	33.55	66.45
218	8.85	—	—	2.14	2.00	—	—	—	25.62	24.00	—	—	50.73	49.27
214	7.96	—	—	2.41	2.47	—	—	—	28.77	22.80	—	—	55.72	44.28
149	3.59	—	—	2.34	2.29	—	9.43	18.63	28.06	23.54	9.43	10.40	37.53	62.47
271	7.90	—	—	2.39	2.00	—	—	—	28.06	28.00	—	—	54.34	45.66
303	7.33	—	—	4.09	4.20	—	—	—	21.66	20.66	—	—	68.43	31.57
518	3.18	—	—	2.21	2.48	—	8.42	19.86	28.28	23.00	8.42	6.00	48.48	51.52
519	10.50	—	—	4.33	4.50	—	—	—	18.03	21.00	—	—	89.24	10.76
57	15.50	—	—	2.43	3.47	—	—	—	26.36	22.80	—	—	53.53	46.47
450	3.72	—	—	2.37	2.47	—	8.97	18.90	27.87	23.00	8.97	5.00	52.24	47.76
221	8.27	—	—	3.00	2.47	—	—	—	27.02	22.00	—	—	52.53	47.47
311	10.17	—	—	3.84	3.50	—	—	—	25.76	24.00	—	—	51.42	48.58
348	7.60	—	—	4.01	2.95	—	—	—	21.46	22.00	—		72.04	27.96
15	11.65	—	—	3.87	3.80	—	—	—	25.02	24.00	—	—	52.42	47.58
521	2.57	—	—	2.46	2.47	—	—	—	25.53	23.00	—	—	21.02	78.98

Ground Bones, Dissolved Bones, Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.				
Swift's Lowell Ground Bone	Fall River	28.00	28.40	1.41*
Hinckley's Ground Bone	Arlington	32.00	29.61	5.37
Swift's Lowell " "	Lexington	29.00		
" " " "	Worcester	28.00		
Hinckley's " "	Framingham	32.00		
Swift's Lowell " "	Westfield	33.00		
A. L. Warren, Northboro, Mass.				
Warren's Ground Bone	Manuf'trs Sample	25.00	30.75	18.69*
Whitman & Pratt Rendering Co., Lowell, Mass.				
Pure Ground Bone	N. Chelmsford	28.00	29.14	3.91*
Sanford Winter & Son, Brockton, Mass.				
Ground Bone	Manuf'trs Sample	—	28.27	—
DISSOLVED BONES.				
W. H. Abbott, Holyoke, Mass.				
Abbott's Animal Fertilizer	Holyoke	27.00	27.96	3.43*
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.				
Dissolved Bone	Taunton	—	22.10	—
TANKAGE.				
Thomas Hersom & Co., New Bedford, Mass.				
Meat and Bone	New Bedford	22.50	30.09	25.22*
Springfield Rendering Co., Springfield, Mass.				
Ground Tankage	Manuf'trs Sample	27.50	34.80	20.98*
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.				
Ground Tankage	South Lowell	—	25.99	—
J. M. Woodard & Bro., Greenfield, Mass.				
Tankage	Manuf'trs Sample	15.00	28.82	47.95*
DRY GROUND FISH.				
Bowker Fertilizer Co., 40 Chatham St., Boston, Mass.				
Bowker's Fine Ground Fish	Northampton	40.00	39.37	1.60
National Fertilizer Co., Bridgeport, Conn.				
Chittenden's Dry Ground Fish	Bradstreet	37.00	38.76	4.54*
Olds & Whipple, Hartford, Conn.				
Olds & Whipple Dry Ground Fish	North Hadley	38.00	39.96	4.90*
Russia Cement Co., Gloucester, Mass.				
Essex Dry Ground Fish	Hadley	40.00	45.27	11.64*
Sanderson Fertilizer and Chem. Co., New Haven, Conn.				
Sanderson's Dry Ground Fish	Bradstreet	38.00	36.33	4.60
Wilcox Fertilizer Works, Mystic, Conn.				
Dry Ground Fish Guano	Amherst	40.00	39.67	.83
" " " "	Fall River	40.00		

* Valuation in excess of selling price.

Ground Bones, Dissolved Bones, Tankage and Dry Ground Fish.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.		Total.		Phosphoric Acid in 100 lbs.			Total.		Available.		Mechanical Analysis.	
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Coarse.	Fine.
127	3.55	—	—	2.00	2.47	—	—	—	25.62	25.00	—	—	34.59	65.41
193, 190, 157, 414, 457	4.89	—	—	2.33	2.47	—	9.55	10.58	29.13	23.00	9.55	5.00	38.83	61.17
395	0.94	—	—	3.83	3.00	—	—	—	24.24	22.00	—	—	47.92	52.08
294	0.87	—	—	1.80	2.47	—	—	—	30.39	25.00	—	—	34.23	65.77
327	1.27	—	—	3.21	3.00	—	6.53	19.06	25.59	25.00	6.53	—	62.05	37.95
306	10.07	1.55	1.93	3.48	3.00	1.50	10.72	6.50	18.72	15.00	12.22	10.00	—	—
142	9.04	—	—	2.45	1.65	—	10.51	6.48	16.99	14.00	10.51	10.00	—	
157	5.09	—	—	5.42	4.66	—	8.05	9.81	17.86	16.34	8.05	9.00	67.42	32.58
320	6.74	—	—	6.19	4.12	—	—	—	15.58	14.00	—	—	30.63	69.37
367	4.79	—	—	4.21	4.94	—	—	—	16.00	14.00	—	—	52.60	47.40
323	5.90	—	—	4.38	4.00	—	—	—	21.60	19.00	—	—	70.28	29.72
3	8.58	—	—	8.47	8.24	—	4.02	2.54	6.56	6.00	4.02	—	—	—
24	7.86	—	—	8.47	8.24	—	3.30	2.64	5.94	6.00	3.30	—	—	—
78	13.59	—	—	7.05	6.59	—	8.93	7.52	16.45	14.00	8.93	—	—	—
47	8.96	—	—	9.30	8.00	—	4.72	0.30	11.02	11.00	4.72	—	—	—
25	11.57	—	—	7 74	8.24	—	4.04	2.40	6.44	6.00	4.04	—	—	—
52, 128	7.49	—	—	8.65	8.50	—	3.30	3.08	6.38	6.00	3.30	4.00	—	—

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble	Organic.	Guaranteed.
Nitrate of Soda.									
American Agr. Chem. Co., 92 State St., Boston " " " " " "	Sunderland . . Brockton . . .	55.00 65.00	57.61	4.15	60 183	1.64	15.57	—	15.00
Bowker Fertilizer Co., 43 Chatham St., Boston " " " " " " " " " "	Northampton . Boston . . . . Leominster . .	60.00 60.00 59.00	59.42	.42	29 192 416	1.34	16.06	—	15.65
Coe-Mortimer Co., 24-26 Stone St., N. Y. City " " " "	Chicopee . . . Webster . . .	57.00 60.00	56.46	6.27	68 286	1.64	15.26	—	15.00
Ross Brothers Co., 88-92 Front St., Worcester	Worcester . .	†58.00	57.05	1.67	297	1.87	15.42	—	15.66
Russia Cement Co., Gloucester, Mass	Dighton . . .	—	55.61	—	106	3.08	15.03	—	15.60
Swift's Lowell Fertilizer Co., Boston, Mass.	South Lowell .	—	58.09	—	385	1.70	15.70	—	14.00
Wilcox Fertilizer Works, Mystic, Conn.	S. Deerfield .	61.00	56.65	7.67	69	1.80	15.31	—	15.00
Dried Blood.									
American Agr. Chem. Co., 92 State St., Boston	E. Longmead'w	55.50	48.34	14.81	438	12.80	—	‡11.47	12.36
Swift's Lowell Fertilizer Co., Boston, Mass . " " " " " " .	Taunton . . . Concord . . .	— 42.00	46.25	*9.19	94 170	11.53	—	‡10.20	9.89
Cottonseed Meal.									
Amer. Cotton Oil Co., 27 Beaver St., N.Y. City	Bradstreet . .	28.75	26.90	6.88	16	7.27	—	6.56	6.50
" " " " "	N. Hadley . .	—	27.39	—	19	7.50	—	6.68	6.50
" " " " "	Bradstreet . .	28.75	26.49	8.53	21	6.89	—	6.46	6.50
" " " " "	N. Hadley . .	28.75	27.92	2.97	34	8.24	—	6.81	6.50
T. H. Bunch Co., Little Rock, Ark.	Southwick . .	30.50	26.40	15.53	404	8.67	—	6.44	6.50
Chas. M. Cox Co., Chamb. Com. Bldg, Boston	S. Framingh'm	32.00	24.60	30.08	425	7.50	—	6.00	6.50
Humphreys, Godwin & Co., Memphis, Tenn.	Lawrence . .	33.00	24.44	35.02	382	7.66	—	5.96	6.50
Hunter Bros. Milling Co., St. Louis, Mo. . .	Springfield . .	31.00	26.49	17.03	403	8.01	—	6.46	7.00
S. D. Viets Co., Springfield, Mass.	Springfield . .	29.00	26.90	7.80	402	8.47	—	6.56	6.50
Linseed Meal.									
American Linseed Co., Chicago, Ill.	N. Hadley . .	29.25	24.56	19.10	77	9.85	—	5.99	5.60
Castor Pomace.									
H. J. Baker & Bro., 100 William St., N.Y. City	Hatfield . . .	24.00	21.16	13.42	513	8.40	—	5.16	4.50

†Ton price f. o. b. Boston, $56.00.
*Valuation in excess of selling price.
‡438 Total phosphoric acid, 1.45 per cent.
94-170 " " " 4.92 "

NOTE. Cottonseed meal contains from 2 to 3 per cent of phosphoric acid and from 1.5 to 2.5 per cent of potash, of which about 1.25 per cent is water soluble.

Linseed meal contains on the average 1.47 per cent phosphoric acid and 1.52 per cent potash.

Castor pomace contains on the average 2.12 per cent phosphoric acid and 1.20 per cent potash.

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
Carbonate of Potash.								
A. Klipstein & Co., 122 Pearl St., N. Y. City.	Hatfield	100.00	100.86	*.85	514	.36	65.04	65.00
Olds & Whipple, Hartford, Conn.	North Hadley	41.00	34.39	19.26	‡84	5.66	26.32†	25.00
High Grade Sulphate of Potash.								
American Agr. Chem. Co., 92 State St., Boston " " " " " "	Fall River Worcester	55.00 52.00	50.16	6.66	103 232	.59	50.16	48.00
Bowker Fertilizer Co., 43 Chatham St., Boston " " " " "	Northampton Fall River	52.00 55.00	50.52	5.90	26 132	1.37	50.52	48.00
Coe-Mortimer Co., 24-26 Stone St., N. Y. City	East Longmeadow	59.00	50.36	17.16	322	.47	50.36	50.00
National Fertilizer Co., Bridgeport, Conn.	Hatfield	52.00	50.84	2.28	512	.74	50.84	48.00
Swift's Lowell Fertilizer Co., Boston, Mass.	Concord	52.00	49.74	4.55	181	.19	49.74	48.00
Low Grade Sulphate of Potash.								
Bowker Fertilizer Co., 43 Chatham St., Boston	Northampton	32.00	24.40	31.15	63	5.11	24.40	24.00
National Fertilizer Co., Bridgeport, Conn.	North Hadley	30.00	34.84	*13.89	‡62	1.24	34.84	25.00
Muriate of Potash.								
American Agr. Chem. Co., 92 State St., Boston " " " " " "	New Bedford Worcester	48.00 45.00	42.40	9.65	115 247	.87	49.88	50.00
Bowker Fertilizer Co., 43 Chatham St., Boston " " " " "	Boston Leominster	50.00 47.00	41.38	17.21	186 279	1.70	48.68	50.00
Coe-Mortimer Co., 24-26 Stone St., N. Y. City	Concord	—	43.13	—	173	1.20	50.74	49.00
Swift's Lowell Fertilizer Co., Boston, Mass " " " " " "	Taunton Fitchburg	— 44.00	44.20	*.45	95 290	1.61	52.00	50.00
Wilcox Fertilizer Works, Mystic, Conn.	South Deerfield	45.75	43.21	5.88	81	.75	50.34	50.50

† Enough chlorine present to unite with 4.69% potash, enough sulphuric acid present to unite with 7.03% potash, remainder as carbonate. Total potash 26.68.

* Valuation in excess of selling price.

‡ 84 Vegetable Potash.

62 Double Manure Salts.

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Phosphoric Acid in 100 lbs. Moisture.	Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.
Dissolved Bone Black													
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Boston	25.00	15.88	57.43	165	11.56	12.40	3.76	.24	16.40	—	16.16	15.00
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.	Concord	22.00	14.19	55.04	177	13.07	—	15.46	.70	16.16	14.00	15.46	12.00
" " " " " "	Concord	22.00	14.22	54.71	227	14.18	9.63	4.37	1.66	15.66	17.00	14.00	15.00
Superphosphates. (Acid phosphate)													
American Agric. Chem. Co., 92 State St., Boston, Mass. " " " " " " "	Framingham East Longmeadow	— 17.00	16.81	1.13	428 442	12.05	13.18	3.95	.18	17.31	15.50	17.13	14.00
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Northampton	18.00	13.24	35.95	43	9.94	10.05	3.19	.80	14.04	14.00	13.24	12.00
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.	Concord	—	12.44	—	196	12.95	7.20	4.42	3.14	14.76	15.00	11.62	14.00
" " " " " "	Springfield	16.00	12.56	27.39	401	12.36	7.48	4.64	2.26	14.38	14.00	12.12	12.00
Basic Slag Phosphate.													
Coe-Mortimer Co., 24-26 Stone St., New York City " " " "	North Hadley East Longmeadow	17.50 15.00	†13.67	18.87	90 319	.22	none	11.16	7.16	18.32	17.00	11.16	*15.00
Ross Bros., 88-92 Front St., Worcester, Mass. " " " " " "	Boston Worcester	22.00 ‡18.00	†13.45	18.70	184 230	.05	none	10.22	7.86	18.08	15.00	10.22	

† 90-319 Valuation based on mechanical analysis. Portion passing through 100 mesh sieve 73.09% "fine" (valued at four cents per pound). Portion retained by 100 mesh sieve 26.91% "coarse" (valued at three cents per pound).

184-220 Valuation based on mechanical analysis. Portion passing through 100 mesh sieve 72.14% "fine" (valued at four cents per pound). Portion retained by 100 mesh sieve 27.86% "coarse" (valued at three cents per pound).

* Guarantee based on the method of analysis used in the California Agricultural Experiment Station.

‡ F. o. b. Boston $15.50.

BULLETIN No. 120. FEBRUARY, 1908.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

Inspection of Commercial Feed Stuffs

BY

P. H. SMITH AND L. S. WALKER.

This bulletin contains the analyses of commercial feed stuffs found in the Massachusetts market during the season of 1907 together with such comments as are called for by the results of the inspection. In addition will be found a discussion of home grown versus purchased cattle feeds, complete rations for dairy stock and a tabulated list of the wholesale cost of feeding stuffs for the year.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

Agricultural Experiment Station,
Amherst, Mass.

* Resigned.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. LINDSEY, *Chemist.*

INSPECTION OF COMMERCIAL FEED STUFFS.

BY P. H. SMITH, AND L. S. WALKER.

CONTENTS.

INTRODUCTION.

This bulletin contains the results of the analyses of commercial cattle and poultry feeds found in the Massachusetts market during the late summer and fall of 1907. These feeds were collected and the results are published in accordance with the Acts and Resolves of Massachusetts for 1903, Chapter 122.

During the year 841 samples of feed have been collected by the official agent of the experiment station of which 715 were selected for analyses. It not being possible to issue more than one feed bulletin annually, the results of those feeds collected early in the year were reported to manufacturers only, with such comments and suggestions as the conditions warranted.

In the present bulletin attention has been called to any unusual condition found to exist in the above mentioned feeds, when it appeared that the facts would prove of general interest.

High Prices and Small Stocks. Never since concentrated cattle feeds have been sold extensively in the East, have prices ruled so high as at present. The inspector found dealers generally to be carrying only enough goods to supply the curtailed demand and to be waiting for lower prices before buying for the winter trade. While the high prices have led dealers to look about for cheaper feeds, prevailing conditions have not succeeded in bringing out and developing the sale of any number of new by-products. There has evidently been slightly more activity in the sale of low grade material, but judging from the stock on hand in the various store houses, the sales of such goods have not increased largely—a fact which speaks well for the intelligence of both retailer and consumer.

Observance of the Feed Law. There has been a noticeable improvement in the observance of the feed law, it being necessary to serve fewer notices for infringement than ever before. Practically all of the jobbers and manufacturers either ship their goods with guarantee attached to packages, or in the case of bulk shipments, furnish tags and statements covering the law. At present, the trouble is largely with the retailers who neglect to attach tags furnished, or who are ignorant of the legal requirements. Both reasons are inexcusable as this statute has been in effect since 1903—an amply suffiicient time for all interested parties to become acquainted with its contents. Copies of the law will be furnished upon application to the experiment station.

Concerning Bulk Sales. A number of notices have been served where dealers have purchased in bulk and put the feed up in their own sacks. The Station rules "that for sales in bulk the retailer must have plainly printed cards stating brand, name and address of manufacturer and guarantee of protein and fat tacked up in a conspicuous place on or near the bin in which feed is stored. **If the retailer bags the feed in his own sacks and so offers the same for sale, tags must be attached as in the case of other feeds.**"

Consumers can be Helpful. Consumers can do much to aid in enforcing the feed law by refusing to buy unguaranteed feeds and by notifying the Experiment Station of any suspected case of misbranding or failure to tag feeds in accordance with the statute.

STANDARDS FOR CATTLE AND POULTRY FOODS.

A standard for comparison is always necessary in passing judgment on the composition of concentrated feeds. The percentages of protein, fat and fiber **serve as an index** of their character in the majority of cases. To be of **standard quality,** the various concentrates should be free from mould and rancidity, in good mechanical condition, and maintain the following percentages of protein, fat and fiber:*

	Feed Stuff.	Protein.	Fat.	Fiber.
Protein Feeds.	*Blood meal*	*85*	*0.2*	—
	Cottonseed meal (high grade)	*41–46*	*8–10*	*7*
	Cottonseed meal (medium grade)	*36–41*	*7–9*	*8*
	Cottonseed meal (low grade)	*24*	*5–6*	*18*
	N. P. linseed meal	*38*	*2*	*9*
	O. P. linseed meal	*32*	*6*	*9*
	Gluten meal	*35*	*1*	*2*
	Gluten feed	*25*	*3*	*7.5*
	Germ oil meal	*22*	*10*	*9.5*
	Distillers' dried grains	*32*	*10*	*12*
	Malt sprouts	*25*	*1*	*12.5*
	Brewers' dried grains	*22*	*5*	*12*
	Wheat middlings (flour)	*18–20*	*5*	*3.5*
	Wheat middlings (standard)	*17–19*	*5*	*7*
	Wheat mixed feed	*16–18*	*4.5*	*8.5*
	Wheat bran	*15–17*	*4.5*	*10*
Starchy (Carbohydrate) Feeds.	*Oat middlings*	*17*	*7*	*2.5*
	Rye feed	*15*	*3*	*4*
	Ground oats	*11*	*4*	*10*
	Ground wheat	*11*	*2*	*3*
	Barley meal	*11*	*1.5*	*6*
	Rye meal	*10*	*1.5*	*2*
	Corn meal	*9*	*3*	*2*
	Hominy meal	*10*	*7.5*	*4.5*
	Provender	*10*	*3.5*	*6*
	Corn and oat feed	*8–10*	*3–5*	—
	Fortified oat feed	*12–14*	*3–5*	—
	Oat feed	*5–8*	*2*	*20–26*
	Corn bran	*9*	*5*	*10*
	Dried beet-pulp	*8*	*0.5*	*18*
Poultry Feeds.	*Meat scraps*	*50*	*15*	—
	Meat and bone meal	*40*	*10*	—
	Bone Meal	*25*	—	—
	Poultry mash and meal	*15*	*4–5*	—
	Chick and scratching grains	*10*	*3*	—
	Alfalfa meal, entire plant	*14*	*1.5*	*25*
	Clover meal, entire plant	*12*	*2*	*25*

* Fiber is the least valuable of the several constituents: the above standards for fiber represent the maximum percentage which the feed should contain to be of standard quality.

CHEMICAL ANALYSES OF FEEDING STUFFS.

(Autumn Collection, 1907.)

1. Protein Feeds.

COTTONSEED MEAL.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein		Fat		Fiber
			Found	Guar.	Found	Guar.	
		%	%	%	%	%	%
HIGH GRADE							
American Cotton Oil Co., New York.							
Mackenzie & Winslow	Fall River	9.79	41.77	41.00	8.50	9.00	....
C. A. Pierce	Hinsdale	7.82	45.24	41.00	10.48	9.00	....
T. H. Bunch, Little Rock, Ark.							
Old Gold ...... Cutler Grain Co	S. Framingham	8.53	41.15	41.00	10.32	9.00	.....
Hunter Bros. Milling Co., St. Louis.							
H. A. Wilder	N. Hatfield	8.22	40.98	41.00	7.45	9.00	....
Springf'ld Fl. & Gr. Co.	Springfield	8.43	46 46	41.00	10.33	9.00	....
Average	....	8.56	42.12	......	9.42	....	....
MEDIUM GRADE							
Alabama Cotton Oil Co., Huntsville, Ala							
J. O. Ellison & Co.	Haverhill	7.25	37.69	38.61	8 30	8.00	..
E. A. Cowee	Worcester	8.70	39.10	38.61	8.11	8.00	....
American Cotton Oil Co., New York.							
W. N. Potter Grain Co	Gardner	8 27	38.57	41.00	8 48	9.00	......
F. W. Brode & Co., Memphis, Tenn.							
Owl ...... W.N. Potter Sons & Co	Northampton	9.38	38.92	41-43	10.16	7-9	....
Owl ...... E. C. Frost	Shelburne Falls	8.97	37.20	41-43	9.50	7-9	......
Owl ...... Taunton Grain Co	Taunton	11.53	38.22	41-43	9.35	7-9	....
Buckeye Cotton Oil Co., Little Rock, Ark.							
S. P. Puffer	N. Amherst	10 00	38.87	39 00	8.15	7.85	..
J. F. Ray	Franklin	10.09	37.51	38.60	7.21	....	......
T. H. Bunch, Little Rock, Ark.							
Old Gold ...... Thorne Bros	Millis	9.35	37.38	41.00	8.91	9.00	.....
Chapin & Co., Boston							
Green Diamond. D. F. Howard	Ware	9.20	40.01	41-43	9.25	9.00	.....
Chas. M. Cox & Co., Boston.							
Magnolia ...... G. B. Pope & Co	Waltham	9 60	39 84	41-43	9.57	7-9	......
Hunter Bros. Milling Co., St. Louis.							
G. M. Stratton	Montague	8.56	39.66	43.00	7.41	9.00	.....
Tenn. Cotton Oil Co., Jackson, Tenn.							
Potter Bros. & Co	N. Adams	8.59	37.60	41 00	7.49	9.00	....
J. Lindsay Wells Co., Memphis, Tenn.							
Moon ...... G. B. Pope & Co	Waltham	9 30	38.17	38-41	9.53	9-10	....
Star ...... G. B. Pope & Co	Waltham	9.88	37.38	41-43	7.97	9-10	....

Cottonseed Meal.—*Continued.*

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
		%	%	%	%	%	%
S. D. Viets Co., Springfield, Mass.							
W. J. Meek	Fall River	10.60	38.30	40-43	8.32	9.00	
Average		9.33	38.39		8.61		
LOW GRADE.							
D. L. Marshall Co., Boston.							
G. B. Pope & Co	Waltham	10.38	21.72	22.00	5.35	5.00	

LINSEED MEAL.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
1. NEW PROCESS.							
American Linseed Co., Chicago.							
Cleveland Flax — C. B. Sawin & Son	Southboro	11.03	35.93	36-40	3.30	1-3	
C. P. Washburn	Middleboro	10.88	33.13	36-40	2.74	1-3	
Dennison Plummer Co	New Bedford	11.25	35.80	36-40	3.29	1-3	
Average		11.05	34.95		3.11		
2. OLD PROCESS.							
American Linseed Co., New York.							
J. Cushing & Co	Fitchburg	10.58	36.50	32-36	6.64	5-7	
Cutler Co	N. Wilbraham	9.69	34.18	32-36	8.89	5-7	
Kellogg & Miller, Amsterdam, N. Y.							
F. W. Davis	Ashburnham	10.72	36.50	36.70	6.64	7.83	
E. J. Adams	Gt. Barrington	10.14	36.77	36.70	7.17	7.83	
Metzger Seed and Oil Co., Toledo, O.							
J. F. Ray	Franklin	11.05	35.71	30-36	7.67	5-7	
Weld & Breck	Southbridge	10.47	35.10	30-36	8.21	5-7	
Average		10.44	35.79		7.54		

FLAX FEED.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
H. Jennings, Boston.							
H. J. — T. J. MacDonald	Lowell	9.17	17.34	17.34	16.11	17.37	
H. J. — J. A. Bouvier	New Bedford	8.06	17.81	17.34	18.18	17.37	
H. J. — H. Knight	Newburyport	8.44	17.25	17.34	16.27	17.37	
C. R. Lull, Milwaukee, Wis.							
G'd flax flakes — Lexington Grain Co.	Lexington	10.62	15.79	17.34	10.80	17.73	
G'd flax flakes — Springfield Fl. & Gr. Co	Springfield	7.97	17.60	17.34	10.44	17.73	
G'd flax flakes — F. F. Woodward & Co	W. Fitchburg	8.71	18.42	14.00	10.08	15.00	
Average		8.83	17.37		10.14		

GLUTEN FEED.

Manufacturer or Jobber, Brand	and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
			%	%	%	%	%	%
Clinton Sugar Refining Co., Clinton, Ia.								
Clinton	J. B. Garland & Son.	Worcester	10.64	24.48	24-26	2.37	2½-3	...
Corn Products Mfg. Co., Chicago.								
Buffalo	E. H. Dyer	Belchertown	10.76	24.09	28.00	2.07	3.00	...
Buffalo.	F. A. Fales & Co.	Norwood	10.62	25.05	25.00	3.77	3.50	...
Buffalo.	W. H. Smith	Northampton	10.53	25.94	24.00	2.61	2.50	...
Buffalo.	R. E. Fairchild	Belchertown	9.42	25.36	23-25	2.74	3.50	...
Buffalo.	A. H. Brown & Co	Framingham	11.25	24.35	23-25	2.42	3.50	...
Buffalo	H. E. Noyes & Son	Lowell	8.99	25.50	23-25	2.68	3.50	...
Buffalo.	J. B. Cover & Co	Lowell	10.24	24.53	23-25	5.69	3.50	...
Buffalo	Ropes Bros	Salem	10.28	24.44	23-25	2.57	3.50	...
Buffalo	Hathaway & Mackenzie	New Bedford.	8.67	26.24	23-25	2.49	2.50	...
Buffalo	J. S. Wolfe & Co	Pittsfield	9.55	27.25	23-25	2.77	2.50	...
Buffalo.	F. P. Loud	Wollaston	9.38	24.88	23-25	3.11	2.50	...
Buffalo.	N. A. Seymour	Lancaster	10.43	23.66	23-25	2.92	2.50	...
Buffalo	Weld & Breck	Southbridge	10.89	23.34	23-25	2.61	2.50	...
	Average		10.08	24.94		2.95		...
Pekin	Griswold & Adams	Dalton	9.86	24.00	23-24	2.59	2.50	...
Pekin	N. Paquin & Sons	Fall River	9.99	26.67	23-24	2.47	2.50	...
Pekin	Millbury Grain Co	Millbury	8.11	26.72	23-24	3.15	2.50	...
Pekin	M. F. Huntington	Pittsfield	8.24	24.09	23-24	2.70	2.50	...
	Average		9.05	25.37		2.75		...
	A. E. Gilbert	W. Brookfield	9.99	25.67	24.00	3.77	2.50	...
Corn Products Mfg. Co., New York.								
Globe	Pierce & Winn	Arlington	9.67	27.09	26.00	2.77	2.50	...
Globe	Springfield Fl. & Gr. Co	Springfield.	10.27	27.69	26.00	3.91	2.50	...
Globe	Potter Grain Co	Shelburne F	8.61	26.50	25.00	3.90	2.50	...
	Average		9.52	27.39		3.53		...
Queen	S. Marin & Co	Haverhill	10.58	23.08	20-25	3.07	2-3	...
Warner's	G. M. Foster	Lowell	7.88	25.98	23-25	2.56	2.50	...
Warner's	Dennison Plummer Co	New Bedford.	11.13	24.62	24.00	2.36	2.50	...
Warner's	A. D. Potter	Orange	9.20	24.97	24.00	3.11	2.50	...
	Average		9.40	25.19		2.68		...
Warner's Diam'd	C. F. Rice	Brookfield	10.33	25.76	23-25	2.54	2.50	...
J. C. Hubinger Bros. Co., Keokuk, Ia.								
	G. F. Wetherbee Est	Gardner	10.22	24.18	27.00	3.17	2.50	
Narragansett Milling Co., Providence.								
	Taunton Grain Co	Taunton	12.09	24.27	20.00	3.17	2.50	
	Highest		12.09	27.09		5.69		...
	Lowest.		7.88	23.08		2.07		...
	Average		9.92	25.21		2.97		...
Second Grade.								
Deutsch & Sickert Co., Milwaukee, Wis.								
Prima	Jacob Burkhardt.	Beverly	8.68	17.03	24.00	6.17	4.00	...
J. E. Soper & Co., Boston.								
Bay State	F. W. Davis.	Ashburnham	10.04	20.67	25.00	0.70	3.00	...
Bay State	Mackenzie & Winslow	Fall River	8.78	21.20	24.00	6.50	3.00	...
Bay State	Mackenzie & Winslow	Fall River	8.08	21.10	24.00	5.62	3.00	...
Bay State	H. Knight	Newburyport	9.08	22.70	24.00	3.58	3.00	...
Bay State	Jaquith & Co	Woburn	8.57	19.27	24.00	3.68	3.00	...
	Average		9.09	20.62		5.23		...
New England.	J. Wadsworth & Co	Northboro	10.44	19.66	25.00	8.25	3.00	...

DISTILLERS' DRIED GRAINS

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
			%	%	%	%	%	%
J. W. Biles Co., Cincinnati, O.								
Fourex.	C. S. Barber	Bernardston.	7.04	31.77	33.00	12.15	11.00	12.32
Fourex.	J. Cushing & Co	Fitchburg.	9.28	31.41	33.00	12.60	11.00	
Fourex.	Potter Bros. & Co	N. Adams	6.47	32.34	33.00	13.41	11.00	
Fourex.	A Carr.	Northboro	8.58	32.38	33.00	12.95	11.00	
Fourex.	F. E. Smith	Amherst.	7.41	30.32	33.00	11.18	11.00	
Fourex.	J. W. Doon & Son	Natick .	8.47	30.32	33.00	13.22	11.00	
	Average		7.88	31.42		12.59		
Chapin & Co., Boston.								
Ajax Flakes	B. W. Brown	Concord	8.17	31.15	33.00	13.30	12.00	12.11
Ajax Flakes	Eastern Grain Co.	Bridgewater.	8.92	31.86	33.00	13.16	12.00	
Ajax Flakes	Walker Grain Co	N. Adams	6.77	33.61	33.00	11.83	12.00	
Ajax Flakes	W. F. Filmore	Palmer	6.72	33.08	33.00	11.14	12.00	
Ajax Flakes	A. D. Copeland	Brockton	6.00	28.87	33.00	13.18	12.00	
Ajax Flakes	W. W. Holmes	Webster	5.72	29.97	33.00	14.02	12.00	
	Average.		7.05	31.42		12.77		
C. F. Keck & Co., Milwaukee, Wis.								
	Wallace Lord	Athol	10.28	30.01	31.00	10.17	9.00	
	F. W. Woodward & Co	Fitchburg.	10.01	29.75	31.00	10.11	9.00	
	A. H. Wood & Co	Framingham	9.31	28.78	31.00	9.27	9.00	
	Average		9.87	29.51		9.85		
Average all samples			7.94	31.04		12.17		
SECOND GRADE.								
Husted Milling Co., Buffalo.								
	J. Burkhardt	Beverly	10.74	16.04	15.20	6.23	4-6	

MALT SPROUTS

Atlantic Export Co., Milwaukee, Wis.							
	Warner Bros.	Sunderland .	0.80	25.14	25.00	1.17	2.00
Chas. M. Cox Co., Boston.							
	J. E. Merrick & Co.	Amherst	10.05	25.19	25-27	1.11	1½-3
	W. A. Haynes & Co	Maynard	10.94	26.33	25-27	0.97	1½-3
	Robinson & Jones	Natick .	11.05	27.42	25-27	1.54	1½-3
Oneonta Milling Co., Oneonta, N. Y.							
	J. Wadsworth & Co	Northboro	13.67	25.94	24-27	0.85	1-2
A. B. Porter & Co., Philadelphia.							
	A. N. Whittemore & Co	Worcester	11.23	27.64	24-26	0.94	2.00
Atlantic Export Co., Milwaukee, Wis.							
	W. N. Potter Grain Co	Gardner	12.06	23.05	25.00	1.20	2.00
	Average.		11.48	25.90		1.11	

BREWERS' GRAINS.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein		Fat		Fiber
			Found	Guar.	Found	Guar.	
		%	%	%	%	%	%
Anheuser Busch Brew'g Assoc., St Louis							
J. C. Bellville	Feeding Hills	9.95	27.52	24.00	7.43	7.50	....
Cutler Co	Warren	10.25	30.32	24.00	7.93	7.50	....

WHEAT MIDDLINGS.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
1. FLOUR.							
Detroit Milling Co., Detroit, Mich.							
Apex .... Squier & Co.	Monson	11.29	16.23	....	4.64	....	....
Duluth Univ'sal Mill. Co., Duluth, Minn.							
Universal .... A. D. Thomas	Palmer	11.15	18.78	17.00	5.67	5.25	....
Eagle Roller Mill Co., New Ulm, Minn.							
Red Dog .... Hathaway & Mackenzie	New Bedford	11.34	17.55	18.57	4.45	5.62	....
Listman Mill Co., LaCrosse, Wis.							
Elmco Red Dog ... E. A. Cowie	Worcester	12.23	18.20	19.57	4.28	5.03	....
Northwest Cons. Mill Co., Minneapolis.							
XXX Comet .... C. S. Barber	Bernardston	10.78	18.83	20.25	5.49	5.25	....
XXX Comet .... C. P. Washburn	Middleboro	11.38	17.25	20.25	3.89	5.25	
Pillsbury-Washburn Co., Minneapolis.							
A .... J. H. Bosworth	Chicopee Falls	11.52	17.60	14-16	4.91	4½-5¼	....
XX Daisy .... C. F. Cole	Huntington	11.89	19.62	19-20	5.47	4½-6	....
Average	....	11.45	18.01	....	4.85	....	....
2. STANDARD.							
Banner Milling Co., Buffalo, N. Y.							
M. F. Nilan	Pittsfield	10.36	16.99	....	5.65	....	....
Brooks Elevator Co., Minneapolis.							
Gopher .... A. F. Sanctuary	Amherst	10.92	16.28	16.00	5.87	5.00	....
Gopher .... Springfi'd Fl. & Gr. Co	Springfield	11.46	16.14	16.00	5.82	5.00	....
Detroit Milling Co., Detroit, Mich.							
Apex .... A. F. Sanctuary	Amherst	7.93	16.46		4.92	....	....
Elkhart & Swan Milling Co., Chicago.							
Taunton Teaming Co.	Taunton	11.36	16.19	15-18	4.85	3-5	....
Northwest Cons. Mill Co., Minneapolis.							
C. H. Gentle	S. Ashburnham	10.97	16.76	18.75	5.91	5.25	....
Pillsbury-Washburn Co., Minneapolis.							
B .... Eastern Grain Co.	Bridgewater	11.71	16.10	14-16	5.08	4½-6	....
B .... W. R. Williams	Oxford	11.80	16.90	14-18	5.57	4½-5	....
Star & Crescent Milling Co., Chicago.							
Star .... C. H. Felker & Co.	Brockton	11.57	16.28	15.00	5.18	4.00	
F. W. Stock & Sons, Hillsdale, Mich.							
C. G. Burnham	Holyoke	11.58	16.72	....	5.25	....	....
Unknown .... Howard & Smith	Hatfield	10.60	17.81	16.00	5.66	4.00	....
Average	....	10.84	16.60	....	5.43		....

WHEAT MIXED FEED.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein		Fat		Fiber
				Found	Guar.	Found	Guar.	
			%	%	%	%	%	%
Acme Milling Co., Indianapolis, Ind.								
Acme	A. E. Lawrence & Son.	Ayer	11.80	16.00	15-17½	4.27	4-5	......
Acme	E. F. Cole	Billerica	11.04	16.28	15-17½	4.41	4-5	......
Allen-Baker Commission Co., St. Louis.								
Peerless	J. O. Ellison & Co	Haverhill	11.03	15.67	14-17	5.04	4-5	......
Gem	W. W. Holmes	Webster	10.67	15.53	14-17	4.14	4-5	......
Gem	J. B. Garland & Son	Worcester	11.60	15.32	14-17	4.43	4-5	......
Alma Roller Mills, Alma, Mich.								
Alma	G. M. Stratton	Montague	10.50	15.09		4.80	......	......
E. W. Bailey & Co., Montpelier, Vt.								
	J. E. Merrick & Co	Amherst	10.59	16.27	......	4.45	......	......
Bay State Milling Co., Winona, Mich.								
Bay State	Wachusett Grain Co	Clinton	10.78	16.46	14-18	5.79	3-5	......
A. A. Beltz, Minneapolis.								
Toppy	E. C. Packard	Brockton	11.81	16.10		5.12	......	......
Toppy	W. K. Gilmore & Sons	Walpole	12.03	15.58		4.70	......	......
Blish Milling Co., Seymour, Ind.								
Bull's Eye	Holmes Inc	Montello	11.86	15.05	......	4.61	......	......
Chapin & Co., Boston.								
Erie	J. W. Raymond	Concord	12.03	16.02	......	4.47		......
Chas. M. Cox Co., Boston.								
Columbia	C. B. Benedict	Gt. Barrington	10.57	16.27	......	4.16	......	......
Columbia	G. R. Doane	N. Brookfield	13.00	15.40		4.60	......	......
Regent	E. A. Cowee	Auburn	11.19	16.85	......	5.34		......
Wirthmore	J. H. Nye	Brockton	11.62	16.41	16-19	4.83	4-5	......
Wirthmore	Haverhill Milling Co.	Haverhill	12.62	15.97	16-19	4.08	4-5	......
Wirthmore	A. J. Richards & Sons	Quincy	12.20	16.02	16-19	4.77	4-5	......
Claro Milling Co., Lakeville, Minn.								
Claro	S. L. Davenport	N. Grafton	11.92	16.94	14-17	5.51	3-5	......
Claro	Cutler Co	N. Wilbraham	11.49	16.99	14-17	5.17	3-5	......
Duluth Super'r Mill. Co., Duluth, Minn.								
Boston	C. E. Terry	W. Springfield	11.57	16.81	16-00	5.07	4.50	......
Geo. T. Evans, Indianapolis, Ind.								
Hoosier	Dennison Plummer Co	New Bedford	12.55	15.67	......	4.13	......	......
Flint Mill Co., Milwaukee, Wis.								
Rutland	A. Carr	Northboro	11.72	16.50	14-18	5.21	4.65	......
Vermont	A. D. Copeland	Brockton	10.08	17.77	14-18	5.51	4-6	......
Vermont	L. A. Snow	Upton	10.76	16.00	14-18	4.76	4-6	
Vermont	W. G. Davis	Westfield	11.72	16.63	14-18	4.89	4-6	......
Garland Milling Co., Greensburg, Ind.								
Garland	B. & A. D. Fessenden Co	Townsend	11.85	16.50		4.49		......
Gopher State Mill. Co., Little Falls, Minn.								
Royal Quality	A. D. Copeland	Brockton	11.41	16.02	17.00	5.03	4.50	

Wheat Mixed Feed.—*Continued.*

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein		Fat		Fiber
				Found	Guar.	Found	Guar.	
			%	%	%	%	%	%
Hunter Bros., Milling Co., St. Louis.								
Sunshine	C. S. Barber	Bernardston	10.16	17.16	15.00	4.31	4.00	......
Sunshine	Griffin Bros	Fall River	11.85	15.79	15.00	4.37	4.00	..
Sunshine	Merriam & Rolph.	Fitchburg	11.58	15.09	15.00	4.54	4.00	......
Sunshine	J. Cushing & Co	Hudson	11.97	15.58	15.00	4.69	4.00	......
Kehlor Flour Mills Co., St. Louis.								
	W. G. Davis	Westfield	12.19	15.14	14-16	4.52	4-5	......
Lawrenceburg Roller Mills, L'burg, Ind.								
Snowflake	J. Enwright & Sons	Fall River	12.01	15.83		4.62	......	......
Snowflake	A. J. Richards & Sons	Quincy	11.54	16.10	......	4.41	......	......
Missouri Valley Mill. Co., Bismarck, N.D.								
Gold Heart.	R. E. Fairchild	Belchertown	10.44	17.11	16.50	5.60	5.30	......
R. P. Moore Milling Co., Princeton, Ind.								
King	Whitman Gr. & Cl. Co	Whitman	11.24	16.14	....	4.78	......	......
Northwest Cons. Mills Co., Minneapolis.								
Planet	F. W. Davis	Ashburnham	11.31	17.51	......	5.71	....	......
	A. D. Potter	Orange	9.32	16.14	17.00	4.86	4.75	......
Pillsbury-Washburn Co., Minneapolis.								
	F. A. Fales & Co	Norwood	11.09	16.59	15-19	4.81	4½-6	......
Quaker Oats Co., Chicago.								
Buckeye	H. C. Bowen & Son	Cheshire	11.08	16.50	13-17	5.00	4-4.70	......
Buckeye	Mackenzie & Winslow	Fall River	11.18	15.62	13-17	5.17	4-4.70	......
Buckeye.	Sprague & Williams.	S. Framingham	11.73	16.19	13-17	5.00	4-4.70	......
Buckeye	H. C. Puffer Co	Springfield	11.74	15.62	13-17	5.05	4-4 70	......
Henry Russell, Albany, N. Y.								
Regular	Sykes Coal & Grain Co	N. Adams	10.88	17.77	....	5.65	......	....
Regular	D. J. Harrington	Turners Falls	11.28	17.77	......	5.27	......	....
Russell-Miller Milling Co., Minneapolis.								
Occident.	E. C. Packard	Brockton	11.14	18.07	16-19	5.19	4-5	....
Occident.	Fred T. Loud.	Wollaston	12.32	17.16	15-16	5.10	4-5	......
Occident.	Wilson & Holden.	Worcester	11.81	16.72	15-18	5.19	4-5	......
St. Albans Grain Co., St. Albans, Vt.								
Hygrade	Sykes Coal & Grain Co	N. Adams	10.06	16.85	....	5.32		......
Sheffield-King Milling Co., Minneapolis.								
Gold Mine.	L. E. Moore	Millington	9.68	16.90	17.00	5.07	4.50	......
Gold Mine.	Robinson & Jones.	Natick	12.32	16.90	17.00	5.10	4.60	......
Sheffield Mill & Elevator Co., Minn'polis								
Big Diamond	J. F. Kirk.	New Bedford	12.75	15.97	19.00	4.86	4.50	....
A. B. Smith & Co., Springfield.								
Auto	A. T. Butler	Adams	10.25	16.50	......	5.13	....	....
Sparks Milling Co., Alton, Ill.								
Try Me	R. D. Bowen	Leominster	12.63	16.02	......	4.67	....	......
Try Me	C. B. Sawin & Son	Southboro	12.30	16.10	......	4.49	....	......

Wheat Mixed Feed.—*Continued*

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
			%	%	%	%	%	%
Springfield Flour & Grain Co., Sp'gfield.								
	A. F. Sanctuary.	Amherst	10.78	16.85	..	4.49	....	
F. W. Stock & Sons, Hillsdale, Mich.								
Monarch	C. G. Burnham..	Holyoke	10.35	17.07		5.53		
Monarch	Sprague & Williams	S.Framingham	11.37	16.67	..	4.25		....
Stratton & Co., Concord, N. H.								
	F. G. Morey	Billerica	13.32	15.36	....	4.36	......	....
Valier & Spies Mill. Co., Marine, Ill.								
	Miner & Crehore	Chicopee	11.77	15.53		4.48	....	.....
Waggoner-Gates Mill. Co.,Indep'd'ce,Mo.								
	W. L. Palmer.	Medway	12.43	15.49	......	4.37	...	
Washburn-Crosby Co., Minneapolis.								
Superior	H. L. Patrick	Hopedale	10.76	15.79	18.00	4.98	4.50	
Superior	C. G. Gardner	Weymouth	11.26	15.88	18.00	4.96	4.00	....
Whitman Grain & Coal Co., Whitman.								
Best	Whitman Gr. & C'l Co.	Whitman	11.40	16.41	16-18	5.06	4.5	......
Woolcott Milling Co., Harrisburg, Ill.								
	W. R. Williams.	Oxford	11.49	15.49		4.48	....	....
Unknown.								
Paragon	C. H. Smith	Dighton	12.10	16.02	....	4.81		......
	W. Baylies	N. Bedford.	11.75	16.00	.....	5.59	..	....
	Highest		13.32	18.07	...	5.79	....	
	Lowest		9.32	15.05		4.08	....	...
	Average		11.46	16.28	....	4.84	......	.....

WHEAT FEEDS WITH ADMIXTURES.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
Indiana Milling Co., Terre Haute, Ind.								
Jersey	A. A. Putney & Sons	E. Brookfield	11.04	10.44	10-12.05	3.04	2-3.20	
Jersey	Milford Grain Co.	Milford	10.09	8.05	10-12.05	2.56	2-3.20	
Jersey	J. A. Bouvier	New Bedford.	10.92	10.40	12.05	2.98	3.20	
A. Waller & Co., Henderson, Ky.								
Blue Grass	A. Altman	New Bedford.	11.01	10.14	10.00	2.82	2.50	
	Average		10.77	9.98	.	2.85	...	

WHEAT BRAN.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
Annan Burg & Co., St. Louis.								
	C. M. Buck	Stockbridge.	9.08	16.19	15.00	4.46	3.00	....

Wheat Bran.—*Continued.*

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
		%	%	%	%	%	%
Bay State Milling Co., Winona, Minn.							
Winona .... W. N. Potter Grain Co	Gardner	11.11	15.18	15.00	5.50	4.75	....
Winona .... W. N. Potter Sons&Co	Northampton	9.51	15.97	15.00	5.20	4.75	....
W. N. Flynt & Sons....	Munson	10.35	16.46	14.16	5.46	3-6	....
Cain Mill Co., Atchinson, Kan.							
Cain's ....Griswold & Adams	Dalton	8.46	16.41	13.00	4.45	3.00	....
Seymour Carter, Hastings, Minn.							
Cloverleaf .... Howe Bros	Gardner	11.75	14.48	14.30	5.20	5.20	....
Cataract City Mill Co., Niagara F. N.Y.							
Niagara .. .... H. A. Wilder.	N. Hatfield.....	9.55	16.06	14.75	5.44	5.65	....
Geo. C. Christian & Co., Minneapolis.							
Jersey ....E. F. Wilber & Son	Mansfield	11.70	14.83	15.00	4.76	4.00	....
Jersey. ....Taunton Grain Co........	Taunton	11.89	15.49	15.00	4.91	4.00	... .
J. G. Davis Co., Rochester, N. Y.							
J. S. Wolfe Co...	Pittsfield	9.17	15.97	....	5.52	....	. .....
Duluth Super'r Mill. Co., Duluth, Minn.							
Duluth Imperial ...Robinson & Jones. ...	Natick	11.20	15.74	14.50	5.03	4.00	....
Eagle Milling Co., Newton, Kan.							
Prentiss, Brooks & Co	Holyoke .. .	10.94	16.37	16.54	3.80	4.25	... .
E. Aughenbaugh & Co., Waseca, Minn.							
E. A. C. O... ....WhitmanGrain&C'l Co	Whitman. ..	11.87	15.40	14-17	4.89	3-5	....
Hunter Bros. Milling Co., St. Louis.							
H. C Bowen & Son .	Cheshire ..	10 76	16 63		4 20		.....
J. Lally, Jr.	Milford	11.77	15.49	14.00	4.31	3.50	....
Kansas Milling Co., Wichita, Kan.							
Climax .... E. H. Dyer	Belchertown	10.82	17.77	....	4.37	. ...	....
New Prague Flour'g Mill Co., N.P. Minn							
Go Far .. .. Lamb Bros. & Co..	Orange	10.07	15 14	14.00	5.05	4.75	...
Northwest Cons. Mill. Co., Minneapolis.							
J. B. Cover & Co .	Lowell	13.06	15.44	14.25	4.06	4 00	....
Ohio Cereal Co., Circleville, O.							
Esmeraldo . . .Marlboro Grain Co .	Marlboro .	12.32	14.66	16.10	3.70	1.45	..
Pillsbury-Washburn Co., Minneapolis.							
G. F. Green Coal Co	Brockton.	10.64	15.62	13-17	5.39	4-6	... .
E. J. Adams . .	Gt. Barrington	10.65	15.27	13-17	5.07	4-5	...
Squier & Co	Monson	11.77	15 18	13-17	5.00	4-6	....
J. B. Bridges & Co	S. Deerfield	9.23	14.92	13-17	5.25	4-6	....
Quality Mills, Enterprise, Kan.							
Wallace Grain Co.	Clinton	11.50	17 07	......	3.76	... .	....
Jas. Quirk Mill. Co., Montgomery, Minn.							
F. Diehl & Son	Wellesley. .	11.09	15.05	14.50	5.55	4.40	... .

Wheat Bran.—*Continued.*

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
		%	%	%	%	%	%
Shellabarger Mill & El. Co., Salina, Kan.							
C. A. Pierce	Hinsdale	9.99	16.80	14.00	4.10	3.50	..
Standard Milling Co., Buffalo.							
J. Paull & Co	Taunton	9.19	16.81	....	5.07	....	....
Washburn-Crosby Co., Minneapolis.							
N. Paquin & Sons	Fall River	11.22	14.62	15.00	5.00	4.00	....
M. T. Huntington	Pittsfield	9.87	15.14	15.00	5.18	4.00	....
D. McCarthy	Turners Falls	9.56	16.06	15.00	5.24	4.00	....
W. W. Hosmer	Westfield	11.50	15.23	15.00	4.79	4.00	....
Webster Mill Co., Webster, S. D.							
Mackenzie & Winslow	Fall River	11.12	15.88	....	4.97	....	....
Webster-Tapper Co., Boston.							
Hingham Gr'n Mill Inc	Hingham	12.58	14.53	....	4.81	....	....
E. S. Woodworth & Co., Minneapolis.							
Snow's Flaky .... H. A. Crossman.	Needham	10.44	15.49	16.00	5.32	4.00	....
Unknown.							
G. W. Pierce	E. Pepperell	11.42	16.37	....	4.09	....	....
White Canadian .. F. Harder	Springfield	11.08	14.44	....	4.23	....	
D. F. Howard	Ware	11.80	15.79	....	4.98	....	....
Highest		13.06	17.77	....	5.55	....	....
Lowest.		8.46	14.44	....	3.70	....	.
Average		10.81	15.67	....	4.84	....	....

DAIRY FEEDS.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
J. W. Biles Co., Cincinnati.							
Union Grains .... J. O. Ellison & Co	Haverhill	8.45	23.69	24.00	7.84	7.00	9.22
Union Grains .... D. H. Howard	Ware	8.65	22.41	24.00	6.45	7.00	9.22
Union Grains .... P. W. Eaton & Co	Williamstown	8.76	23.78	24.00	7.31	7.00	9.22
Chas. M. Cox Co., Boston.							
Wirthmore .... A. Culver Co	Rockland	11.58	24.70	24.26	6.54	4.5	....
H-O Co., Buffalo.							
Algrane Milk ... G. F. Greene Coal Co.	Brockton	9.47	14.13	14.00	3.51	4.00	...
Algrane Milk . Cutler Co	Warren.	7.70	13.86	14.00	3.77	4.00	....
Ralston-Purina Co., St. Louis.							
Protena .... J. W. Doon & Son	Natick	9.63	21.06	20.00	3.87	3.50	....

MOLASSES FEEDS.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein		Fat		Fiber
				Found	Guar.	Found	Guar.	
			%	%	%	%	%	%
American Milling Co., Chicago.								
Sucrene Dairy	Prentiss, Brooks & Co.	Holyoke	12.57	17.42	10.50	3.68	3.50	11.45
Sucrene Dairy	M. H. Cushing & Co	Middleboro	12.64	18.96	16.50	4.23	3.50	11.45
Sucrene Dairy	Beaver Coal & Gr'n Co	Norwood	13.75	19.18	16.50	5.12	3.50	11.45
Sucrene Dairy	B. & A. D. Fessenden	Townsend	13.14	17.81	16.50	4.64	3.50	11.45
	Average		13.03	18.34		4.42	....	....
Sucrene Horse	A. J. Richards & Sons	Quincy	10.85	12.90	13.50	2.90	3.50	....
Great Western Cereal Co., Chicago.								
Daisy	C. G. Burnham	Holyoke	9.72	20.36	16-18	4.19	3-4	11.72
Milwaukee Molasses Feed Co., Mil'kee.								
Prize	Bedford C'l & Gr'n Co	Bedford	11.30	10.93	18.00	3.44	3.00	14.55
Quaker Oats Co., Chicago.								
Molac Dairy	E. F. Cole	Billerica	12.65	14.26	16-18	3.54	2-4	13.12
Molac Dairy	H. A. Crossman	Needham	11.85	15.97	16-18	3.38	3-4	13.12
Molac Dairy	D. J. Harrington	Turners Falls	10.03	15.40	15½-17	4.49	3-4	13.12
Molac Dairy	A. N. Whittemore & Co	Worcester	11.78	18.07	16-18	4.64	3-4	13.12
	Average		11.58	15.93	....	4.01	....	....

RYE FEEDS.

Boutwell Mill. & Grain Co., Troy, N. Y.								
	J. B. Garland & Son	Worcester	11.83	15.71	14.58	3.38	3.22	....
Oneonta Milling Co., Oneonta, N. Y.								
	W. N. Potter & Co	Charlemont	11.14	16.10	14.75	3.08	3.50	....
	W. N. Potter & Sons	Greenfield	11.02	15.40	14.75	2.93	3.50	....
Cutler Co., North Wilbraham.								
	T. Smith	Westfield	12.03	15.01	15.00	2.70	3.00	....
	Average		11.51	15.56				....

CALF MEAL.

Blatchford's Calf Meal Fac'y, Wauk'n Ill								
Blatchford's	C. F. Rice	Brookfield	11.67	27.03	25.00	4.61	5.00	....
Blatchford's	D. H. Craig	Plymouth	11.83	26.72	25.00	4.43	5.00	....
	Average		11.75	26.88		4.52	....	....

II. Starchy (Carbohydrate) Feeds.

CORN MEAL.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
			%	%	%	%	%	%
S. D. Viets & Co., Springfield.								
	S. D. Vietz & Co	Springfield...	11.04	8.95	......	3.22	....	....
L. E. Moore, Millington.								
Cracked Corn Siftings	L. E. Moore	Millington	13.53	8.08		3.11	......	....

GROUND OATS.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
Dresser, Hull Co., Lee.								
	Dresser Hull Co	Lee	10.29	11.37	......	5.15	....	7.00
C. F. Rice, Brookfield.								
	C. F. Rice	Brookfield	12.41	11.63	......	4.59	....	9.96

HOMINY MEAL.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
Buffalo Cereal Co., Buffalo.								
	A. E. Lawrence & Son	Ayer	10.66	10.53	10.25	8.21	8.00	......
	E. F. Wilbur & Son	Mansfield	9.68	10.97	10.25	8.20	8.00	....
	Wm. Baylies	New Bedford	10.47	11.19	10.25	8.85	8.00	......
	D. J. Harrington	Turners Falls	8.58	10.84	10.25	8.63	8.00	...
Chapin & Co., Boston.								
Niagara	A. Dodge & Son	Beverly	11.50	10.75	10-11	8.24	7-8	....
Niagara	G. A. Stevens	Worcester	11.86	11.76	10-11	9.59	7-8	....
Chas. M. Cox Co., Boston.								
Paragon	R. E. Fairchild	Belchertown	8.13	10.88	10½-12	8.48	7½-9	....
Wirthmore	Torrence, Vary & Co	Lynn	11.55	10.32	9½-12	7.32	7½-9	....
Wirthmore	H. A. Crossman	Needham	11.30	10.49	9½-12	7.90	7½-9	......
Wirthmore	C. L. Marsh	Webster	9.15	10.44	9½-12	8.57	7½-9	......
Wirthmore	G. A. Stevens	Worcester	10.88	11.14	9½-12	8.83	7½-9	......
Rodney J. Hardy & Sons, Boston.								
	J. Cushing & Co	Hudson	12.23	10.75	10-12	7.95	7½-9	
Hunter Bros. Milling Co., St. Louis.								
	J. B. Garland & Son	Worcester	11.01	10.88	9½-10½	9.14	7-8½	
Miner-Hillard Mill. Co., Wilkesbarre, Pa.								
	Mackenzie & Winslow	Fall River	9.01	10.32	10-12	8.49	7½-9	
	Potter Grain Co	Shelburne Falls	10.00	10.62	10-12	7.80	7½-9	......
J. E. Soper & Co., Boston.								
Red Ribbon	G. B. Pope & Co	Waltham	9.50	11.81	10.00	10.03	8.00	
E. S. Woodworth & Co., Minneapolis.								
Yellow	G. B. Pope & Co.	Waltham	10.07	10.36	10-12	5.43	7-9	
	Highest		12.23	11.81	......	10.03	....	
	Lowest		8.13	10.32	......	5.43	....	
	Average		10.38	10.83		8.33	....	

Hominy Meal.—*Continued.*

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
		%	%	%	%	%	%
LOW GRADE.							
Hunter Bros., Milling Co., St. Louis.							
Mackenzie & Winslow	Fall River	10.04	8.48	8½-10½	5.66	7-8½	8.57
Toledo Elevator Co., Toledo, O.							
Star ... Warner Bros.	Sunderland	8.95	7.95	7-10	5.49	6½-8	......
Star ... S. P. Puffer	N. Amherst	8.84	7.95	7-10	5.47	6½-8	7.20

CORN AND OAT FEEDS.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
A. H. Brown & Bros., Boston.							
Queen ... Weld & Beck	Southbridge	8.07	9.92	10.00	6.99	4.00	......
Buffalo Cereal Co., Buffalo.							
Horse ... S. H. Nye	Brockton	11.38	11.54	12.00	4.59	4.50	......
Chas. M. Cox Co., Boston.							
Wirthmore ... Livingston Grain Co	Lowell	9.09	9.79	10-12	7.30	4-5	
Wirthmore ... E. C. Frost	Shelburne Falls	8.44	9.17	10-12	7.60	4-5	8.33
Wirthmore ... E. F. Wheeler	Stow	11.00	10.01	10-12	6.97	4-5	
Flint Mill Co., Milwaukee.							
Pearl ... P. Vigeant & Co	Lowell	9.79	8.08	8-10	4.00	3-6	......
J. B. Garland & Son, Worcester.							
Red Tag B ... J. B. Garland & Son	Worcester	11.00	10.79	10.00	6.11	3.25	......
Great Western Cereal Co., Chicago.							
Boss ... Stanley Grain Co	Lawrence	9.92	9.17	8.50	4.47	3.50	......
W. H. Haskell & Co., Toledo, O.							
Haskells ... Whitman Gr'n & C'l Co	Whitman	10.90	9.65	8-10	7.33	6.25	7.18
Haskells ... E. W. Kenerson & Co	Worcester	9.17	9.44	8-10	7.29	6.25	
H-O Co., Buffalo.							
N. E. Stock ... Beaver C'l & Grain Co	Norwood	10.13	9.70	9.00	4.26	4.00	......
Husted Mill. & Elevator Co., Buffalo.							
Husted Stock ... Wachusetts Grain Co	Clinton	10.55	8.91	9-10	4.87	4-5	......
Monarch Chop ... Lexington Grain Co.	Lexington	10.70	9.30	7½-9	4.07	3½-4½	......
Jaquith & Co., Woburn.							
Stock ... Jaquith & Co.	Woburn	9.12	10.58	10.00	6.65	6.00	......
Oneonta Milling Co., Oneonta, N. Y.							
Provender ... Mackenzie & Winslow	Fall River	11.39	9.26	8.75	*2.79	3.50	10.51
Quaker Oats Co., Chicago.							
Corn, oat & barley ... G. P. Rogers	Worcester	10.48	10.88	13.00	3.36	5.00	......
Schumacher's ... J. Enwright & Son	Fall River	10.42	10.18	10-12	3.36	4-5	
Schumacher's ... C. B. Benedict	Gt. Barrington	9.06	11.84	10-12	4.14	4-5	
Schumacher's ... Haverhill Milling Co	Haverhill	11.47	10.33	10-12	3.09	4-5	

Corn and Oat Feeds.—*Continued.*

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
			%	%	%	%	%	%
Schumacher's	Wight Thayer Co.	Indian Orchard	10.73	10.58	10-12	3.06	4-5	
Schumacher's	R. D. Bowen	Leominster	10.93	10.32	10-12	3.29	4-5	
Schumacher's	Millbury Grain Co	Millbury	9.43	11.37	10-12	3.46	4-5	*
Schumacher's	Thorne Bros.	Millis	10.59	10.88	10-12	4.69	4-5	10.18
Schumacher's	M. H. Rolfe	Newburyport	10.81	9.39	10-12	3.18	4-5	
Schumacher's	Potter Bros. & Co	N. Adams	9.21	11.19	10-12	3.65	4-5	
Schumacher's	V. E. Moore	Springfield	10.80	11.49	10-12	3.32	4-5	
	Average		10.36	10.79		3.60		
Victor	E. F. Cole	Billerica	11.23	7.19	9.00	2.82	4.00	
Victor	G. R. Hastings & Son	Boylston	10.23	7.54	7.5-9	3.11	3-4	
Victor	J. H. Nye	Brockton	10.05	8.25	7.5-9	3.99	3-4	
Victor	C. A. Pierce	Hinsdale	9.93	7.78	7.5-9	2.57	3-4	11.25
Victor	Thorne Bros.	Millis	9.04	8.04	7.5-9	3.81	3-4	
Victor	H. P. Howland	Spencer	10.93	7.99	7.5-9	2.84	3-4	
Victor	C. W. Shaw	Springfield	10.46	8.16	7.5-9	3.43	3-4	
	Average		10.27	7.85		3.22		
Strong-Lefferts Co., Springfield.								
Lenox	A. T. Butler	Adams	10.27	9.61	9.88	4.40	3.27	7.26

FORTIFIED STARCHY FEEDS.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
J. B. Garland & Son, Worcester.								
Red Tag A	C. H. Ballard	Oxford	9.00	13.60	12.00	6.14	3.50	
Green River Grain Co., Greenfield.								
O. K. Horse	W. N. Potter & Sons	Greenfield	10.17	12.38	12.00	5.75	4.25	
Husted Mill. & Elevator Co., Buffalo.								
Husted Horse	Wachusett Grain Co	Clinton	11.40	12.73	12-14	5.12	4-5	6.62
Husted Horse	Mackenzie & Winslow	Fall River	11.12	12.11	12-14	4.74	4-6	
Quaker Oats Co., Chicago.								
Quaker Dairy	W. N. Potter & Co	Charlemont	7.55	12.38	12-14	3.72	3-4	
Quaker Dairy	City Mills Co.	Holyoke	9.18	13.60	12-14	3.56	3-4	16.04
Quaker Dairy	Thorne Bros	Millis	8.87	13.34	12-14	3.80	3-4	
Quaker Dairy	A. J. Richards & Sons.	Weymouth	9.90	15.14	12-14	4.06	3-4	
Average			8.88	13.62		3.78		
	Average		9.65	13.04		4.61		

* Average for ten samples.

MISCELLANEOUS STARCHY FEEDS.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
						%	%
Natural Food Co., Niagara Falls, N. Y.							
Shred. Wt. Waste Ropes Bros	Salem	8.97	11.32	10.00	1.72	1.50	....
Quaker Oats Co., Chhicago.							
Ground Rice ... H. A. Wilder.	N. Hatfield	10.68	7.19	9.61	0.28	0.38	....
Ground Rice.. Lexington Grain Co.	Lexington	11.77	8.16	9.61	0.18	0.38	....
A. H. Brown & Bros., Boston.							
Dried Grains.. G. B. Pope & Co	Waltham .	8.17	13.56	10.00	3.97	2.50	...
Chas. M. Cox & Co., Boston.							
Oat Feed .... A. Culver Co	Rockland. ...	9.25	2 07	6-8	0.68	2-4	....

III. Poultry Feeds.

MEAT SCRAPS.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Ash
First Grade.							
American Agric. Chem. Co., New York.							
G. F. Green Coal Co	Brockton	8.39	47.87	40-60	15.16	5-6	25.17
Dresser Hull Co	Lee	8 19	48.70	40-50	13.12	5-6	25.12
Bowker Fertilizer Co., Boston.							
J. A. Sullivan.	Northampton	7.79	45.28	30.00	14 37	20.00	28.73
J. C. Dow & Co., Boston.							
C. G. Jordan	Weymouth . ..	10.01	49.01	50-55	18.81	15-17	22.20
N. E. Dressed Meat & Wool Co., Boston							
J. W. Day & Co	Lynn	7.82	66.24	53-57	15.54	10-15	10.45
H. C. Puffer Co., Springfield.							
F. Harder ...	Springfield	11.50	46.20	40-50	13.30	15-20	31.52
Pawtucket Rend. Co., Pawtucket, R. I.							
L. E. Moore	Millington ...	7.93	52.12	50.00	13.19	16.00	25.29
Springfield Rendering Co., Springfield.							
City Mills Co	Holyoke	7.90	46.64	40-60	14.36	15-20	30.65
Swifts Lowell Fertilizer Co., Boston.							
Swift's. Milford Grain Co.	Milford	8.57	45.94	40-50	14.55	15-20	29 35
Average	....	8.68	49.78	....	14 71	....	.....
Second Grade.							
Andrews & Spelman Co., Provid'ce, R.I.							
Star ..... F. A. Bradley	Pittsfield..	6.61	36.99	25-30	10.68	6-8	39 78
Joseph Breck & Sons, Boston.							
U. S. Adams & Co	Townsend	10.22	44.84	50-55	21.63	16-17	21.48

Meat Scraps.—*Continued.*

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
			%	%	%	%	%	%
Hinckley Rendering Co., Somerville.								
	J. W. Day & Co	Lynn	11.15	38.34	40-60	9.21	10-15	34.42
	C. P. Washburn	Middleboro	9.49	40.06	40-60	11.85	10-15	33.28
Whitman & Pratt Rend'ing Co., Lowell.								
	John Shea	Lawrence	8.89	42.11	35-45	14.48	10-15	29.28
Worcester Rendering Co., Worcester.								
	E. A. Cowee	Auburn	8.72	44.80	40-60	15.46	15-20	28.33
	Average		9.18	41.19		13.89		

MEAT AND BONE MEAL.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
Bowker Fertilizer Co., Boston.								
Animal Meal	J. Cushing & Co	Fitchburg	6.36	34.84	30.00	12.27	5.00	40.55
Animal Meal	Potter Grain Co	Shelburne Falls	5.44	35.85	30.00	10.04	5.00	40.84
Swift's Lowell Fertilizer Co., Boston.								
Swift's	Milford Grain Co.	Milford	6.47	42.46	40-50	10.89	8-15	34.83
	Average		6.09	37.72		11.07		

BONE MEAL.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
A. L. Warren, Northboro.								
Cracked Bone	J. J. Rowell	E. Pepperell	9.71	28.30	26.00	4.90	3.00	52.65

GRANULATED MILK.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
Bent-Croissant Co., Antwerp, N. Y.								
Milk Albumen	N. A. Seymour	Lancaster	10.19	44.84	43-50	0.74	15-20	30.12

POULTRY MASH AND MEAL.

Manufacturer or Jobber, Brand and Retailer		Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Fiber
American Milling Co., Chicago.								
Sucrene	Taunton Teaming Co.	Taunton	11.35	17.38	17.50	3.90	5.50	5.81
Buffalo Cereal Co., Buffalo.								
	Griffin Bros.	Fall River	11.40	14.48	17.00	4.85	5.00	2.53
	F. H. Crane & Sons	Quincy Adams	10.54	15.62	17.00	5.46	5.00	2.91
Chas M. Cox Co., Boston.								
Wirthmore	H. A. Crossman	Needham	10.35	16.28	20.00	4.28	3.00	10.04

Poultry Mash and Feed.—*Continued.*

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Ash
		%	%	%	%	%	%
N. E. Poultry Supply Co., Springfield.							
Quality .... N.E. Poultry Supply Co	Springfield	10.71	16.76	16-18	7.52	5-6	6.65
Park & Pollard Co., Boston.							
Dry Mash .... L. E. Moore	Millington	10.29	20.89	23.00	3.33	3.00	14.89
Growing Feed .... A. Culver Co	Rockland	13.52	14.21	14-15	4.75	3.5-4	6.13
Quaker Oats Co., Chicago.							
American .... M. H. Rolfe	Newburyport	9.67	13.47	12-14.5	6.34	3½-4½	3.04

CHICK AND SCRATCHING GRAINS.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Ash
Chick.							
Chas. M. Cox Co., Boston.							
Wirthmore .... C. H. Smith	Dighton	12.31	10.93	11.00	2.34	3.00	1.74
Park & Pollard Co., Boston.							
Gritless .... J. Shea	Lawrence	13.11	13.60	13.77	2.43	2.77	3.66
Ralston Purina Co., St. Louis.							
Purina .... S. D. Viets Co	Springfield	10.38	11.37	11.00	4.46	3.60	1.86
Ross Bros. Co., Worcester.							
Wyandotte .... Ross Bros Co.	Worcester	10.63	9.35	8.25	2.63	2.25	12.31
Scratching Grains.							
Chas. M. Cox Co., Boston.							
Wirthmore .... Eastern Grain Co	Bridgewater	13.49	10.44	11.00	3.67	3.00	1.56
Green River Grain Co., Greenfield.							
B. S. No. 2 .... Potter & Co	Athol	12.76	9.44	10-11	4.25	3½-4½	1.77
Park & Pollard Co., Boston.							
A. E. Lawrence & Son	Ayer	13.07	10.49	10.00	2.80	3.00	1.59
N. E. Poultry Supply Co., Springfield.							
Qual'y Devel'p'ng .... N.E. Poultry Supply Co	Springfield	10.73	13.42	12-14	3.91	3-4	5.81
Qual'y Devel'p'ng .... N.E. Poultry Supply Co	Springfield	10.76	13.34	12.5-14	4.22	4-5	6.70
Scorched Wheat .... Cola R. Nelson	Mt. Hermon	11.08	16.06	......	2.61	....	....

ALFALFA AND CLOVER MEALS.

Manufacturer or Jobber, Brand and Retailer	Sampled at	Water	Protein Found	Protein Guar.	Fat Found	Fat Guar.	Ash
Alfalfa.							
Ralston-Purina Mills, St. Louis.							
J. W. Doon & Son	Natick	10.35	14.09	16.00	1.33	2.40	....
Clover.							
Thos. W. Emerson & Co., Boston.							
F. A. Fales & Co.	Norwood	8.53	11.06	12.00	2.30	2.00	....

THE RESULTS DISCUSSED.

I. Protein Feeds.

Cottonseed and Linseed Meals. Pages 6-7.

Because of the many rainfalls in the autumn of 1906, large quantities of cottonseed were considerably damaged and as a result much of the meal was seriously off grade in color, texture and chemical composition. The results of the 75 samples collected and examined during the winter and early spring of 1907 are not published in this bulletin, but they were sent out in circular form in May with the necessary explanation to all important grain dealers in the state. Of the above number 65 were guaranteed to contain 41 or more per cent protein, and of this number 75 per cent fell below the guarantee, some very much more so than others. Three samples put out by Kaiser & Brown, Memphis, Tenn., bore a 41 per cent guarantee and tested 20 to 21.50 per cent of protein. These goods were unquestionably fraudulent. Of the 18 lots of Star brand put out by J. Lindsey Wells Co., Memphis, Tenn., guaranteed to contain 41 per cent protein, only 3 met their guarantees, 8 fell from 1 to nearly 5 per cent below and 7 showed a deficit of from 5 to 7 per cent.

Twenty-one samples have been collected and examined the present autumn, all of which represented 1906 meal, the 1907 product not being in the market at the time the inspection was made. Of this number, 15 were guaranteed to contain 41 per cent or more of protein and only 5 met the requirement, the remainder falling from 2 to 4 per cent below. The latter were not **choice** (41 per cent protein) but **extra prime** meals, (38.5 per cent protein) guaranteed as choice—a direct misrepresentation.

WHO IS TO BLAME?

The heavy rains which so injured the cottonseed were naturally beyond the control of man. Some northern brokers with a high reputation for honorable dealings frequently found it difficult to secure meal that fully conformed to the minimum guarantee. Others were **unquestionably lax** and attached a 41 per cent protein guarantee to whatever meal they shipped without any particular regard to its quality. The northern jobbers claim they were deceived and under the conditions prevailing were in a large measure powerless to help themselves; they stated that they bargained for 41 per cent meal and supposed they were getting it. That this claim is in a measure true cannot be denied. The writer is convinced, however, that certain parties knew, or soon discovered that the meal they were offering, although guaranteed to be choice or extra prime in quality, was really inferior; they proposed to take their chances, and in case they were found ont plead ignorance and bad weather, and if absolutely necessary settle with the local dealer with the least loss to themselves. The station has endeavored by all means in its power to keep both the dealer and consumer informed in this matter.

Cottonseed meal has been one of the most valuable protein concentrâtes available to the northern dairyman. Its consumption however, is sure to be curtailed, unless adulteration is checked and a reform in the methods of dealing is speedily brought about. It is assuredly for the interest of the southern merchant to use every means in his power to see that this most valuable product is unadulterated, that it is properly branded and that it substantially conforms to the guarantee placed upon it.

Northern and southern dealers must get together and arrange a more systematic and just code of business rules relative to the handling of this product.

RULES OF THE INTERSTATE COTTON CRUSHERS' ASSOCIATION FOR SAMPLING COTTONSEED MEAL.

Rule 17. Section 1. Samples shall in every case be drawn in the presence of representatives of both seller and buyer at American destination by a reliable party or parties who shall mtke affidavit as prescribed by these rules in the "form of claims."

Section 2. If the seller refuses or neglects for 48 hours after notification to appear in person or appoint a representative to draw the samples in the presence of the buyer or his representative for arbitration, then the buyer may appoint any disinterested person to draw such samples.

Rule 20. Two ounces or more from a sack shall constitute a sample of meal and must be drawn so as to fairly represent the entire contents of the bag. Twenty samples from each carload, or 50 sacks from each 100 tons, if not shipped in car lots, shall be sufficient to represent a shipment. Samples of meal if of approximately the same grade and quality need not be kept separate but may be commingled in which case they must be placed in a metal mailing or sample box and carefuly marked, showing the number of samples taken as well as car number and mark.

Form of Claims. Sec. 6. I, the undersigned, do hereby make affidavit that I have drawn fair and true samples from........ packages of..........being not less than........per cent of the entire number of packages embraced in a shipment made by .... from.................... as evidenced by bill of lading dated .... and issued by ....

The samples were carefully taken so as to secure a fair representation of the contents of the individual package and a true average of the quality of the entire shipment.

I certify to the correctness of the samples, which are marked as follows .... and which represents the shipments marked or identified as follows: .... or contained in ....

Sworn to before me, a notary or justice of the peace of........ county, and state of ...., and duly authorized by law to take depositions, this ...... day of .... 190..

....

....

STATION METHOD OF SAMPLING.

This station takes a core sample from 20 different bags in each lot by means of a tube run the entire length of the bag. These samples are carefully mixed and the necessary quantity put into a bottle bearing a label, on which is written all of the obtainable data. It is believed that a sample thus drawn is representative.

THE PROTECTION OF THE LOCAL DEALER.

It naturally is not possible for the station to send its representative to sample goods received by local dealers in all sections of the state. The dealer can, however, when purchasing, notify the jobber that he intends to sample the goods immediately on arrival and have the same tested by the experiment station or other responsible party. He should immediately notify the jobber on the arrival of the car as per Rule 17, Sections 1 and 2, and take the sample as therein specified. Open 20 bags, and if a sampling tube is not available, thoroughly mix the contents of the top of each bag and place on a clean newspaper. Mix the 20 handfuls and send preferably in a tin box not less than one-half pound by mail or express to the station, stating the name and number of the car, date received, of whom purchased, and enclose a guarantee tag. Samples improperly taken will not be tested. The station probably will be able to make returns in a few days.

CONCERNING REBATE.

Rule 9, Section 6, of the Cotton Crushers' Association:

"Cottonseed meal not coming up to contract grade shall be a good delivery if within one-half of one per cent of the ammonia contents of the grade sold, or the sale sample, but the settlement price shall be reduced at the rate of one-tenth of the contract price for each one per cent and proportionately for the fractions, of deficiency in ammonia."

Illustration: If a lot of cottonseed meal is guaranteed to test 41 per cent protein (8 per cent ammonia) and only tests 35.50 per cent (6.9 per cent ammoina) it shows a deficit of 1.1 per cent. If the contract price was $28.00 a ton, 1-10 of the price would be $2.80 and 1-10 of that .28, which added to the $2.80 would be $3.08 which is to be deducted from the $28.00 in the form of rebate.

NITROGEN, AMMONIA AND PROTEIN EQUIVALENTS.

One per cent of nitrogen equals 1.2 per cent ammonia equals 6.25 per cent protein.

One per cent ammonia equals .83 per cent nitrogen equals 5.2 per cent protein.

One per cent protein equals .17 per cent nitrogen equals .20 per cent ammonia.

PERCENTAGES.

Nitrogen.		Ammonia.		Protein.
5.75	equals	7.00	equals	36.00
5.90	equals	7.20	equals	37.00
6.10	equals	7.40	equals	38.00
6.25	equals	7.60	equals	39.00
6.40	equals	7.80	equals	40.00
6.56	equals	8.00	equals	41.00
6.70	equals	8.20	equals	42.00
6.90	equals	8.40	equals	43.00

AVERAGE ANALYSES AND RETAIL PRICES.

	High and Medium Grades.	High and Medium Grades.	High Grades.	Medium Grades.	High and Medium Grades.
	1904.	1905.	1906.	1906.	1906.
No. Samples,	62	61	23	29	52
Protein,	43.6	41.6	42.19	34.98	40.68
Fat,	9.0	8.8	8.79	8.56	8.66
Price a ton,	$28.87	$29.08	$32.54	$32.53	$32.54

	High Grades.	Medium Grades.	High and Medium Grades.
	1907.	1907.	1907.
No. Samples,	20	56	76
Protein,	42.45	38.76	40.61
Fat,	9.11	9.05	9.08
Price a ton,	$33.00	$32.78	$32.89

Linseed Meal. Linseed Meal is evidently not used to any extent as a cattle feed in Massachusetts. It is found quite generally distributed but in small lots. It is usually so high priced that its merits as a milk producing food have not been fully appreciated. At the present time it is, comparatively speaking, an economical concentrate. Of the three samples of new process meal collected, two practically maintained while one fell about 3 per cent below its protein guarantee. The new process meal now offered tests noticeably lower in protein than that found in the market several years ago.

With one exception in which the fat content fell below its guarantee, the old process meals were as represented and fully maintained their former satisfactory qualities.

AVERAGE ANALYSES AND RETAIL PRICES.

New Process.

	1904.	1905.	1906.	1907.
No. of Samples,	6	6	7	7
Protein,	37.24	37.49	35.82	35.89
Fat,	3.46	2.49	2.51	3.16
Price a ton,	$28.75	$31.50	$32.46	$32.67

Old Process.

	1904.	1905.	1906.	1907.
No. of Samples,	15	15	19	12
Protein,	33.10	34.29	33.57	35.27
Fat,	8.00	7.91	7.76	7.71
Price a ton,	$29.00	$33.87	$34.00	$34.64

Flax Feed consists of substantially one-third small flax seed together with two-thirds weed seeds and other foreign material which are separated from the better grade of flax seed during the process of preparing the latter for the oil mills. This residue is ground and offered either as H. J. Flax Feed or Ground Flax Flakes. These feeds have a decidedly bitter taste and a noticeable odor of linseed oil.

In a feeding trial of H. J. Flax Feed at the experiment station, the animals ate the feed rather grudgingly when fed by itself but consumed it readily when mixed with other grain. The bitter taste of the feed was not imparted to the milk. Material of this character may vary considerable in composition depending upon the purity of the seed from which it is separated. One sample of Flax Flakes contained very little flax seed and consisted largely of weed seeds, oat and wheat screenings. This fact was proved both by a microscopical examination and by its comparatively low fat content.

Gluten Feed. Page 8. Thirty-six samples of gluten feed are reported. Of these, twenty-six were manufactured by the Corn Products Manufacturing Company. The feeds ranged in color from a dirty yellowish grey to a golden yellow. Color, however, is not a correct index of their chemical composition as is shown by the analyses of the samples representing the product of the Clinton Sugar Refining Co. and J. C. Hubinger Bros. Company, both of which, although very light colored, were free from rancidity and contained over 24 per cent of protein.

With one exception, the samples representing the product of the Corn Products Manufacturing Company met their protein guarantees and also approximated very closely their fat guarantees. The one exception was where a local dealer had evidently used old tags bearing a protein guarantee of 28 per cent to guarantee an article purchased in bulk.

The brand put out by J. C. Hubinger Bros. & Company carried a guarantee of 27 per cent of protein and was shown by analysis to contain only about 24 per cent. Twenty-seven per cent of protein is higher than can be easily maintained and it would be safer to guarantee this feed at 24 per cent.

One sample put out by the Deutsch & Sickert Company contained only 17.03 per cent of protein and was represented to carry 24 per cent.

The Bay State and New England brands put out by J. E. Soper & Co. fell considerably below their protein guarantees and were considerable in excess of the guarantee of fat. J. E. Soper & Co. have been notified several times in the past in regard to this condition and must change their guarantee to correspond to the character of their product. This condition does not imply that the Bay State and New England brands are adulterated. It indicates however, that they are made either from inferior corn or that the germ and starch have not been as fully removed as is usually the case. The Bay State, Prima and New England brands sold at an average cost of $32.60 against $31.44 for the better grades. Dealers and consumers are advised when purchasing to give the preference to such brands as fully meet their guarantees.

AVERAGE ANALYSES AND RETAIL PRICES.

	1905.		1906.		1907.	
	First Grade.	Second Grade.	First Grade.	Second Grade.	First Grade.	Second Grade.
No. samples.	55	8	13	19	52	16
Protein.	25.01	17.71	24.98	22.59	25.97	21.52
Fat.	3.56	3.91	3.21	4.72	3.23	4.53
Price a ton.	$26.60	$26.43	$28.00	$26.94	$30.76	$31.83

Distillers' and Brewers' By-Products. Pages 9-10.

Distillers' Dried Grains consist of the residue from the manufacture of distilled liquor and spirit from the cereals. They vary widely in protein content and may be divided into several classes depending upon the proportions of the several cereals from which they are derived. Those obtained in the process of manufacturing whiskey and alcohol from corn, contain the highest percentage of protein and are the only class usually found on the Massachusetts market.

One lot of low grade distillers' grains was found. While it equaled its guarantee of 15 per cent in protein, its feeding value is much less than for the high grade goods and consumers should not be misled into believing that everything that bears the name of distillers' grains has an equal feeding value.

In purchasing distillers' grains the consumer should see that they are free from an excess of acidity and rancidity (due to fermentation before drying) and that they have not become charred during the drying process.

Of the fifteen samples reported only one maintained its protein guarantee, the others falling slightly below. A 30 per cent protein guarantee for high grade distillers' grains would be much easier to maintain than the 33 per cent guarantee which usually prevails.

AVERAGE ANALYSES AND RETAIL PRICES.

	1904. All Samples.	1905. All Samples.	1906. First Grade.	1906. Second Grade.	1906. Average.
No. samples.	15	23	12	10	22
Protein.	32.43	32.00	32.28	26.92	29.85
Fat.	12.48	11.90	12.87	10.43	11.75
Price a ton	$27.12	$27.29	$28.23	$28.13	$28.18

	1907. First Grade.	1907. Second Grade.	1907. Average.
No. samples.	16	11	27
Protein.	32.30	29.75	31.03
Fat.	12.75	11.94	12.35
Price a ton.	$30.43	$31.00	$30.72

Malt Sprouts. Malt sprouts, to be of standard quality, should be free from charred material and dirt, should not contain an excessive amount of barley hulls and should show at least 25 per cent of protein. With one exception, the seven samples collected were of good quality and maintained their guarantees. At prevailing prices malt sprouts are a very economical feed stuff.

AVERAGE ANALYSES AND RETAIL PRICES.

	1904.	1905.	1906.	1907.
No. samples.	8	11	6	13
Protein.	26.85	26.52	27.66	25.91
Fat.	1.22	1.06	1.51	1.20
Price a ton.	$19.25	$22.55	$21.13	$23.56

Brewers' Grains. But two samples of brewers' grains were collected. These were of satisfactory quality and maintained their protein guarantees. **A good quality of brewers' grains is usually an economical concentrate and attention is called to this seemingly neglected feed stuff.**

Wheat By-Products. **Pages 10-15.**

Flour Middlings are required to be guaranteed in several of the Western states but not in Massachusetts. It is a singular coincidence that of the eight samples examined seven bore a guarantee and that the unguaranteed sample contained the lowest per cent of protein. The XXX Comet brand was guaranteed to contain 20.25 per cent of protein—a figure, it is believed, somewhat in excess of what can be easily maintained.

Standard Middlings. Of the eleven samples examined, eight carried and maintained their guarantees. With two exceptions they were of satisfactory quality. The Gopher brand wholesaled by the Brooks Elevator Company, while maintaining its guarantee, was not a straight wheat middlings in that it contained a considerable amount of screenings. The manufacturers claim "that they are not sold as standard middlings but by sample instead." However, the sacks bear no such statement for the benefit of the consumer. These goods, in the future, must be sold for what they really are. The price asked was practically the same as for high grade goods.

Wheat Mixed Feed, to be of standard quality, should contain all of the by-products of the flour mill with the exception of the screenings and should maintain a minimum percentage of 16 per cent protein and 4 1-2 per cent fat. Several samples of Buckeye brand put out by the Quaker Oats Company, contained a noticeable amount of ground weed seeds; a number of other brands contained only a small amount of middlings. On the whole the wheat mixed feeds collected during the past year were comparatively free from screenings and of good standard quality. Of the 68 samples collected, 38 (or 56 per cent) bore guarantees as compared with 36 per cent in 1906.

Wheat Bran. The wheat bran reported was of good standard quality and comparatively free from weed seeds.

AVERAGE ANALYSES AND RETAIL PRICES.

Wheat Middlings, Flour.

	1904.	1905.	1906.	1907.
No. samples.	9	21	26	16
Protein.	18.70	16.20	17.67	17.62
Fat.	4.62	4.20	4.83	4.76
Price a ton.	$28.72	$27.82	$25.79	$30.39

Wheat Middlings, Standard.

	1904.	1905.	1906.	1907.
No. samples.	22	58	35	28
Protein.	17.64	15.93	17.30	16.78
Fat.	5.22	4.82	5.39	5.30
Price a ton.	$26.29	$24.39	$24.62	$28.50

Wheat Mixed Feed.

	1904.	1905.	1906.	1907.
No. samples.	72	128	67	97
Protein.	16.50	15.09	16.29	16.35
Fat.	4.62	4.45	4.71	4.86
Price a ton.	$25.87	$24.39	$23.99	$28.93

Wheat Bran.

	1904.	1905.	1906.	1907.
No. samples.	15	36	31	58
Protein.	16.07	14.39	15.11	15.60
Fat.	4.44	4.55	4.77	4.89
Price a ton.	$24.40	$23.09	$23.18	$29.67

It will be noted that the wheat by-products cost nearly 20 per cent more than a year ago.

Wheat Feeds with Admixtures. Page 13.

The feeds of this character were poorer than ever. The average protein analysis of those reported was 9.98 per cent as compared with 12.69 per cent for 1906.

Why are consumers willing to pay nearly as much for a feed containing between 30 and 40 per cent ground corn cobs to the ton as for a high grade wheat feed?

Every thinking dairyman who **counts the cost** should consider the above question ! !

AVERAGE ANALYSES AND RETAIL PRICES.

	Adulterated Wheat Feed.	High Grade Wheat Feed for Comparison.
No. of samples.	10	97
Protein.	11.03	16.35
Fat.	3.10	4.86
Price a ton.	$26.78	$28.93

Dairy Feeds. Page 15.

Union Grains. The three samples of Union grains collected fell slightly below their guarantee of protein and in one instance did not meet the guarantee of fat. This feed is composed of distillers' grains, malt sprouts, wheat by-products, hominy, linseed and cottonseed meals. It sold from $31 to $32 a ton, is a ready ration for dairy stock and at the prevailing prices is not considered expensive.

Wirthmore Dairy Feed contained a large amount of malt sprouts together with corn and oat by-products, cottonseed meal, linseed meal, and salt. It maintained its guarantee and sold for $30 a ton.

Algrane Milk Feed practically maintained its guarantee of protein but fell slightly below in fat. It is composed of corn, oat and wheat by-products, cottonseed meal, and a **noticeable amount of weed seeds.** The two samples collected sold for $30 and $32 a ton.

Protena Dairy Feed was represented by one sample which met its guarantee. It consisted of ground alfalfa as a basis together with cottonseed meal, wheat by-products, weed seeds and salt, and sold for $32 a ton.

For a special discussion of proprietary dairy feeds such as the previous four, see pages 39-40.

Molasses Feeds. Page 16.

Molasses Feeds are usually made up of some absorbent material like malt sprouts, oat or barley residues and grain screenings, together with one or more high-grade concentrates to bring up the protein content and from 20 to 35 per cent of molasses. Many of them contain an excessive amount of weed seeds, in some cases unground. The use of molasses and molasses feeds for farm stock is fully described in Bulletin No. 118.

Sucrene Feeds. The four samples of Sucrene dairy feed reported fully met their guarantees in protein and fat and sold for $27 a ton.

Sucrene horse feed tested slightly below its guarantee.

Daisy dairy feed exceeded its maximum guarantee. It was well dried, sweet, and in good mechanical condition.

Prize dairy feed made by the Milwaukee Molasses Feed Company ran 7 per cent below its guarantee of 18 per cent protein and contained a large amount of fiber. It consisted largely of screenings of an inferior character as well as many weed seeds.

Molac dairy feed with one exception ran slightly below its guarantee in protein and sold for from $29 to $30 a ton.

II. Starchy (Carbohydrate) Feeds.

Corn and Hominy Meals. **Pages 17-18.**

But two samples of corn meal were examined. One sample taken at the S. D. Viets Co. was light colored and slightly musty, having the appearance of a second grade product. The other sample was corn siftings, a by-product from the manufacture of cracked corn. It is used to some extent to replace corn in provender. As this material does not consist of the entire corn kernel, its use in provender is illegal unless the provender is guaranteed in accordance with the Massachusetts statute.

Hominy meal or feed to be of standard quality, should contain 10 per cent of protein and 7 1-2 per cent fat. It should be free from rancidity and should not contain an excess of cob. With three exceptions the hominy feed reported fulfilled these conditions. One sample put out by Hunter Bros. Milling Co., and two of the Star brand, manufactured by the Toledo Elevator Company, contained an excess of cob as is shown by their high fiber content. While they sold for practically the same price as the better grade feeds, their feeding value is considerably less.

AVERAGE ANALYSES AND RETAIL PRICES.

	1905.	1906.	1907.
No. Samples.	70	63	40
Protein.	10.25	10.54	10.71
Fat.	8.09	8.48	8.25
Price a ton.	$24.41	$24.32	$27.50

Corn and Oat Feeds. **Pages 18-19.**

Corn and oat feeds consist of the residual light oats, oat hulls and screenings, corn or hominy meal frequently of an inferior character, occasionally some wheat middlings to increase their protein content and more or less salt. The price asked is usually in excess of their actual feeding value.

All but six of the thirty-four samples of corn and oat feeds collected maintained their protein guarantees. The price asked ranged from $30 to $36 a ton.

When high-grade concentrates can be purchased for about the same price, **there is absolutely no economy** in using them for dairy cows. The better grades may form a satisfactory partial substitute for oats at the present time in feeding horses. Occasionally feed of this character is found which is rancid or tainted; such materials cannot be considered satisfactory horse feeds.

Schumacher's Stock Feed is classed with corn and oat feeds although it is free from screenings and generally contains some barley residue. In chemical composition it quite closely resembles oats and for horses can be used in place of this grain if desired. It is not considered as economical as corn or hominy meal for dairy stock, swine or poultry.

Fortified Starchy Feeds. Page 19.

These feeds consist of corn and oat products to which has been added some concentrate to increase their protein content. Most of them are intended for horse feeds. The eight samples (representing Red Tag A feed, O. K. horse feed and Quaker dairy feed) collected maintained their guarantees in protein and fat and ranged from $31 to $38 a ton—prices certainly much in excess of their true value.

Miscellaneous Starchy Feeds. Page 20.

Shredded Wheat Waste consists of the broken pieces resulting from the manufacture and packing of shredded wheat biscuit. Its principal use is as a feed for poultry.

Ground Rice consists of the broken kernels of puffed rice. Considering the price at which it was sold ($25 to $26 a ton) it was one of the cheapest starchy feeds on the market.

Dried Grains guaranteed by A. H. Brown & Bros., consists of the dried residue from the manufacture of a patent infant food.

Oat Feed. But one sample of oat feed is reported. It was of very inferior quality and fell considerably below its guarantee.

III. Poultry Feeds.

Animal By-Products. Pages 20-21.

Meat Scraps to be of good quality should contain at least 45 per cent protein. They should be comparatively free from taint and should not contain an excessive amount of bone or fat. Of the fifteen samples reported nine were considered first grade. They averaged 49.78 in protein and 14.71 in fat. The average price was $2.59 a hundred. Scraps testing below 45 per cent in protein were classed as second grade. Of these, the brands put out by Joseph Breck & Sons and the Worcester Rendering Company fell but slightly below. The sample representing the Star Brand, manufactured by Andrews and Spelman, while maintaining its guarantee, should more properly be classed with meat and bone meals as it contained an excessive amount of ash indicating a large amount of bone. Second grade scraps averaged 41.19 in protein and 13.89 in fat and sold for the average price of $2.44 a hundred.

Meat and Bone Meal. The three samples reported maintained their guarantees and were of good standard quality. One sample of cracked bone was clean and bright in appearance and exceeded its guarantee.

Milk Albumen. The sample of so-called milk albumen maintained its guarantee of 43 per cent protein but contained practically no fat in spite of its 15 per cent guarantee. It had a strong gluey odor and an unattractive appearance.

Poultry Mashes and Meals. Pages 21-22. A large number of ready-to-use mixtures for poultry are on the market, but as the samples were collected at a season of the year when the stock on hand was at a minimum, only eight samples representing seven brands are reported.

Sucrene Poultry Feed was collected for the first time. It consisted of corn, wheat and oat products, weed seeds and molasses.

Buffalo Poultry Feed fell considerably below its guaranteed analysis of protein. It was shown by microscopic examination to be made up of oat, wheat and corn products.

Wirthmore Poultry Mash contained meat scrap, ground clover or alfalfa, corn, oat and wheat products and weed seeds.

Quality Mash contained a wheat product, corn, linseed meal, some sort of wheat breakfast food waste, ground alfalfa, charcoal and weed seeds. It maintained its guarantee in protein and fat.

Park and Pollard's dry mash contained corn, wheat product, ground alfalfa or clover, and meat and bone meal. The growing feed prepared by the same company contained corn, oat and wheat products, buckwheat, linseed, weed seeds and millet and maintained its guarantee.

American Poultry Feed contained wheat, corn and oat products, cottonseed meal and weed seeds.

Chick and Scratching Grains. Page 22. Four brands of chick feeds are reported.

Wirthmore chick feed was made up of a mixture of millet, corn, Kaffir corn, wheat, peas, some weed seeds and charcoal.

Park and Pollard's gritless chick feed consisted of corn, oats, wheat, millet, Kaffir corn, flaxseed and more or less weed seeds.

Purina chick feed consisted of oats, corn, flaxseed, Kaffir corn, millet and wheat.

The Wyandotte brand contained corn, millet, peas, charcoal, wheat, grit and weed seeds.

The five samples of scratching grains reported practically maintained their guarantees. Corn and wheat were present in all of the samples. Other materials recognized were: oats in three samples, Kaffir corn in three samples, millet, barley, sunflower seed, puffed wheat refuse, meat and bone in two lots, while rice and weed seeds were noted only once.

One sample of scorched wheat had an offensive odor, was badly burnt and very unattractive in appearance. The price asked for this material was $25 a ton, which was excessive, considering the quality of the material.

But one sample each of alfalfa meal and cut clover were analyzed. They were of good appearance, but both samples fell slightly below their guarantees in protein.

HOME GROWN CATTLE FEEDS.

By J. B. Lindsey.

In these days of expensive concentrates, the feeders of farm stock naturally look for ways and means of reducing the grain bill. Attention is called briefly to the production of **corn** and **clover** and it is suggested that the farmer is warranted in experimenting with **alfalfa.**

Corn. There is no fodder crop that will produce so large a yield of digestible matter as corn, an average crop yielding some 4000 pounds including 275 pounds of digestible protein. Only those varieties should be grown that will **mature their seed,** such as Leaming, Pride of the North and Longfellow.

The corn crop rarely fails. In order to secure the best results the seed should be selected with great care; the land should be well fertilized;* the crop which may be grown in rotation with clover and potatoes should be planted and cultivated with modern machinery.**

It is believed to be the most economical as a rule for dairy farmers to ensile the bulk of the crop, using the corn harvester and modern silage cutter, rather than to cut, stack and husk in the old way. Before ensiling, some prefer to break off the well developed ears, and to cure, husk and grind them. One is thus enabled to feed the dairy cow a larger proportion of home grown grain † and also to have a supply for other farm stock. **Study to grow maximum corn crops at a minimum expense. Corn is king! !**

Clover deserves a great deal more attention from dairy farmers than is ordinarily given it. It is really a biennial or a short lived perennial and is best grown in rotation (corn—clover—potatoes). The seed may be sown August 1 at the rate of 15-20 pounds to the acre, or it may be seeded in the corn after the last hoeing.

---

* Four cords of manure, 300 lbs. phosphatic slag and 150 lbs. of high grade sulfate of potash, broadcast to the acre, form a desirable combination. If the land is quite deficient in fertility, a few hundred lbs. to the acre of manufactured corn fertilizer may be applied in the drill.

** See *Corn as a Grain Crop* by W. P. Brooks, in Massachusetts Crop Report, May, 1903; *Corn Harvesting Machinery*, Farmers Bulletin 303; *Methods and Cost of Preparing Silage from Corn*, Farmers Bulletin 292; *Corn Growing*, Farmers Bulletin 199, U. S. Department of Agriculture, Washington, D. C.

† A bushel of eared silage, the usual daily quantity for an average cow, contains an equivalent of 2½ pounds of dry grain.

If seeded in the corn and the land is in good heart no fertilizer need be applied until the close of the following year of growth, when an application of 200 pounds of high grade sulfate of potash, and 600 pounds of phosphatic slag will prove decidedly helpful to the growth of the second year. Two and perhaps three cuttings may be expected the first season with a total yield of 3 or more tons to the acre, equivalent to 3000 pounds of digestible matter, including 500 pounds of digestible protein. The clover can be used as a soiling crop or hayed. If hayed, it should be cut in early blossom, allowed to wilt, raked into winrows, cocked, covered with hay caps and thus cured. The cocks should be moved after two days to prevent the killing out of the sprouting plants beneath. On the day of drawing to the barn, the cocks may be opened and aired. The use of hay caps is strongly recommended; they protect from rain, check a too rapid drying and will amply repay for their cost and for any extra labor. If clover is cut in late blossom and hayed by the usual method it furnishes a very inferior fodder.

The fertilizer and labor cost of clover production is comparatively low, it improves the mechanical condition of the land, leaves it richer in nitrogen, is a large producer of protein and well adapted to climatic conditions ordinarily prevailing in Massachusetts. It is the most satisfactory crop for the production of home grown protein. **Don't neglect the clover crop.***

Alfalfa** has thus far proved itself rather of an uncertain crop in Massachusetts. The writer has been successful in growing it in a small way (1-3 acre) for several years upon the station grounds, securing three cuttings yearly aggregating 3.5 to 4.5 tons of dry hay (15 per cent water). It is his belief that the farmer **can afford to give it a trial** and he should not be discouraged if success is not at once attained. The following are important and must be observed:

1. Do not try to grow it on land with a hardpan subsoil, or where the water table it within 6 to 8 feet of the surface. It needs well drained land free from hollows that will permit of standing water.

2. The land must be in a good state of fertility. If necessary, apply a fair dressing of barnyard manure and plow in; then top dress with a ton of lime, 1000 pounds basic slag, 300 pounds high grade sulfate of potash and 100 pounds nitrate of soda to the acre. Apply also a few hundred pounds of soil secured from an old alfalfa field. The land should be well fitted, the soil being made almost as fine as for an onion bed.

---

*See the excellent article on Clover by W. P. Brooks in report of the State Board of Agriculture for 1906.

**For a fuller article on Alfalfa by the Director, see this bulletin, pages 44-46.

3. The seed may be sown in early May at the rate of 30 pounds to the acre together with one-half bushel of oats as a nurse crop, the latter checking the growth of weeds. It has also been suggested that the land be plowed in the spring and frequently cultivated to kill the weeds and the alfalfa sown in early June without a nurse crop.* Alfalfa should be cut just as the first blossoms appear. If allowed to stand later, it is very likely to be attacked by blight and is also less digestible. It should be cured in the same manner as described for clover.

4. If sown in the spring with oats, the first cutting may be expected about July 20, and another in early September. It is doubtful if more than two comparatively light crops are secured the first season. After the last cutting a growth of 6-8 inches will generally take place which may be allowed to stand as a winter mulch.

5. If an alfalfa field becomes well established, a yearly application either in the autumn or spring, of 800 pounds of phosphatic slag** and 300 pounds of high grade sulfate of potash is recommended. In case 500 pounds of acid phosphate are used in place of 800 pounds of phosphatic slag, it is advised to apply a ton of lime to the acre every 3 or 4 years. Patience, perseverance and a careful study of the peculiarities of the alfalfa plant are necessary before success is likely to be achieved.

PURCHASED CATTLE FEEDS.

By J. B. Lindsey.

(a) Standard By-Products.

The cost of all standard concentrates at the present time is relatively high, and dairymen are desirous of knowing which of the many feeds offered are most economical for profitable milk production.

Do not Purchase Starch.

On general principles it is unwise for the farmer to purchase corn and similar starchy foods, the farm being especially fitted to produce them. In fact the farm has been aptly termed the carbohydrate factory, and the farmer as manager should fully utilize its resources.

* Western farmers advise sowing alfalfa in late summer without a nurse crop. The writer suggests seeding it about August first.

** Phosphatic slag, containing 16-17 pounds of phosphoric acid and 40 45 pounds of lime in 100 can be obtained of the Coe-Mortimer Company, New York and of Ross Bros., Worcester, Mass.

§ For fuller information also see the following: Alfalfa Growing and Alfalfa in the Eastern States, Farmers' Bulletins 215 and 276, U. S. Department of Agriculture, Washington, D. C., also Alfalfa by F. D. Coburn, published by the Orange Judd Co., New York.

Buy Protein.

Only those feeds **should be bought*** that are **rich in protein** and in **mineral matter.** Such feeds supplement the home grown starchy products, are very necessary for the production of milk, meat and eggs and likewise greatly improve the fertility of the farm. The most economical protein concentrates are cottonseed meal, gluten feed, distillers' and brewers' dried grains, malt sprouts and flour middlings.

Wheat bran relatively speaking, is almost always an expensive source of nutrition. It is, however, uniformly palatable; it can be fed in considerable quantities without producing any ill effects, it acts as a slight laxative and serves as a very satisfactory diluter of the heavy concentrates. In view of the extremely high prices at which bran is held, many feeders feel compelled to substitute malt sprouts, distillers' dried grains and corn silage.

Malt sprouts are not palatable and absorb large quantities of water, hence not over two and one-half pounds daily should be fed dry preferably mixed with other more palatable feeds. (See rations for dairy stock.)

(b) Proprietary Mixtures or Ready Rations.

By a proprietary mixture is meant a combination of several grains or by-products offered as a ready grain ration for dairy stock. The requirements of a ready ration may be outlined as follows:

1. It should be bulky, palatable, and free from mould and rancidity.
2. It should contain from 16 to 18 pounds of digestible protein in 100.
3. It should contain approximately 70 pounds of digestible organic nutrients in 100, and not over 9 per cent of total fiber. The latter should not be derived from corn cobs or similar material. More than 9 per cent of fiber indicates an excess of grain hulls which naturally renders the feed less digestible.

* An exception to this may be made in case of those who are obliged to buy all of their feed. In such cases the dairyman will find it advisable to include some corn or hominy, a few pounds daily being very helpful in furnishing the necessary digestible matter.

The station has made a study of the digestibility of a number of proprietary feeds, and presents the following condensed statement of results:

BRAND.	—Pounds in 100 of:—			Retail Price a Ton ‡	Cost 1 lb. Digest. Org. Matter.
	Digest. Protein.	Digest. Organic Matter.	Total Fiber.		
Alfalfa Meal (Chapins)*	15.1	59.2	17.0	....	....
Biles Union Grains	17.8	66.7	9.6	$31.50	$2.36
Buffalo Creamery Feed	16.1	62.1	12.4	....	....
H. O. Dairy	13.8	60.3	12.9	....	....
Green Diamond Sugar†	11-12	61.2	10.5	....	....
Holstein Sugar	7.9	62.0	10.0	....	....
Hammond Dairy	10.6**	59.4**	11.9	....	....
Molac Dairy	10.6**	58.3**	12.8	29.50	2.53
Sucrene Dairy	10.11	58.1	10.0	27.75	2.40
Proteina*	12.8	56.3	18.3	....	....
Quaker Dairy	9.2	52.7	16.8	34.00	3.22
Schumachers Stock	7.5	65.3	10.6	34.50	2.64
Average 5 Home Mixtures for Comparison	18.7	69.0	7.5	32.40	2.33

The above results show that only one proprietary feed—Biles Union grains—substantially conformed to the requirements as above outlined. This feed contained 17.8 pounds of digestible protein, 66.7 pounds of digestible organic matter, and 9.6 pounds of total fiber in 100. The other feeds showed from 7.5 to 16.1 pounds of digestible protein, from 52 to 62 pounds of digestible organic matter and from 10 to 18 pounds of total fiber in 100. Unground weed seeds were quite prominent in many of the molasses feeds. Most of the above feeds are quite expensive as a source of digestible protein and furnish digestible matter at a higher cost than it can be bought in the ordinary standard grains and by-products.

* A mixture of ground alfalfa and grains or their by-products.
† Not in market at present.
** Estimated from average digestion co-efficients.
‡ When grains were at highest prices.

COMPLETE RATIONS FOR DAIRY STOCK.

By J. B. Lindsey.

If the dairyman has well eared silage and a nice quality of early cut hay, clover or alfalfa, he can get fairly good results by feeding daily 1 bushel silage, 15 pounds clover hay, 1 1-2 pounds cottonseed meal and 1 1-2 pounds flour middlings, the mixture of the two grains being sprinkled over the silage to distribute it.* Rye feed, buckwheat middlings, or oat middlings may be substituted for the wheat middlings. Should the matured ears have been removed before the corn was ensiled, it would be advisable to add 3 pounds of corn or corn and cob meal to the grain ration.

In case the dairyman desires to feed more liberally of grain and does not care to take the trouble to mix the same with the silage, the following combinations are suggested:

1.

100 lbs. wheat bran, †
100 lbs. gluten feed,
35 lbs. cottonseed meal,
Mix and feed 7 lbs. (8-9 qts.) daily.

7 lbs. contains:

1.40 lbs. digestible protein,
4.70 lbs. digestible organic matter,
7 lbs. cost 10.85 cents. ‡

2.

125 lbs. malt sprouts,
100 lbs. corn or hominy meal,
125 lbs. gluten feed,
Mix and feed 7 lbs. (6½-7 qts.) daily

7 lbs. contains:

1.20 lbs. digestible protein,
4.90 lbs. digestible organic matter,
7 lbs. cost 10.5 cents. ‡

3.

100 lbs. distillers' grains,
100 lbs. malt sprouts,
150 lbs. corn meal,
50 lbs. cottonseed meal,
Mix and feed 7 lbs. (7-8 qts.) daily.

7 lbs. contains:

1.2 lbs. digestible protein,
5.1 lbs. digestible organic matter,
7 lbs. cost 10.8 cents. ‡

4.

200 lbs. distillers' dried grains,
150 lbs. flour middlings,
Mix and feed 7 lbs. (8-9 qts.) daily.

7 lbs. contains:**

1.12 lbs. digestible protein,
5.20 lbs. digestible organic matter,
7lbs. cost 11.4 cents. ‡

5.

75 lbs. malt sprouts,
75 lbs. wheat bran,
200 lbs. gluten feed,
Mix and feed 7 lbs. (8-9 qts.) daily.

7 lbs. contains:

1.35 lbs. digestible protein,
5.00 lbs. digestible organic matter,
7 lbs. cost 10.6 cents. ‡

6.

200 lbs. brewers' grains,
100 lbs. corn meal,
50 lbs. cottonseed meal,
Mix and feed 7 lbs. (9 qts.) daily.

7 lbs. contains:

1.26 lbs. digestible protein,
4.40 lbs. digestible organic matter,
7 lbs. cost 10.4 cents. ‡

---

* It is important that the heavy grains be mixed with the silage.
† If it is desired to feed less wheat bran, 50 pounds of malt sprouts may be substituted for a like amount of the bran, slightly reducing the cost of the mixture.
** Six pounds of this mixture makes a very satisfactory ration.
‡ The cost of these rations was figured when grain was at its maximum.

The cost of the above mixtures naturally will vary in proportion to the cost of the several by-products of which they are composed. If desired, linseed meal can be used in place of cottonseed meal, or hominy in place of corn meal.

Quantity of Grain Daily. The quantity of grain to be fed daily naturally depends upon the size of the cow, the quantity of the daily milk yield, and the local market value of the milk. The richer the milk, the more food required to produce a given quantity and vice versa. Seven pounds daily is a fair average amount for cows weighing 800-900 pounds, which produce ten quarts of 5 per cent milk. Grain prices continue high and feeders in localities where there is not a quick demand for milk may find it economy to use only 5 pounds of grain daily and a maximum amount of home grown coarse feeds.* Heavy milking cows weighing 1,200 pounds may require 12 or more pounds of grain daily, depending upon their ability to utilize it. It is not good economy to unduly force the cow, especially if it is desired to keep her in the herd from year to year.

The usual daily roughage ration to go with the above grain mixtures will consist of what hay the animal will eat clean (18-24 lbs.) or one bushel of corn silage and 10-16 lbs. of hay.

* Early cut hay, hay of peas and oats cut when in blossom, clover hay, rowen and well-eared corn silage all aid in reducing the grain bill.

MARKET PRICES OF CATTLE FOODS FOR 1907.

FEED STUFFS.	Monthly Wholesale Ton Prices—1907.												Averages
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Cottonseed Meal	$28.70	$28.55	$28.50	$26.75	$26.95	$28.50	$28.50	$28.60	$30.63	$30.75	$29.06	$29.19	$28.72
Linseed meal, (N. P. and O. P.)	29.10	28.50	29.00	28.00	28.30	29.00	29.25	29.70	30.44	31.25	30.75	30.70	29.50
Gluten feed (sacked)	28.40	28.40	27.90	26.98	26.44	27.30	27.30	28.08	30.10	30.75	30.23	30.45	28.53
Gluten feed (bulk)	26.90	26.40	26.27	25.23	25.32	25.90	25.90	26.69	28.61	29.16	28.40	28.53	26.93
Distillers' dried grains	27.88	28.10	28.08	27.25	27.00	27.63	28.13	28.88	30.75	32.25	32.00	32.00	29.16
Malt sprouts (sacked)	20.10	20.00	20.10	18.85	18.66	19.02	18.75	19.07	....	....	....	....	19.32
Flour middlings (Red Dog)	24.60	25.80	25.69	25.19	26.45	26.88	27.69	29.25	31.19	31.69	30.38	30.38	27.93
Standard middlings (shorts)	23.85	24.29	24.53	23.75	24.68	24.63	24.35	26.98	29.63	29.66	26.72	26.57	25.80
Mixed feed	24.65	25.40	25.65	24.44	25.05	25.38	24.72	26.43	29.41	0.50	29.69	28.22	26.63
Bran, Spring	23.20	24.13	24.38	22.56	23.10	22.94	22.19	23.95	27.13	27.96	25.56	26.25	24.45
Bran, Winter	23.90	24.48	24.63	23.13	23.75	23.88	22.94	24.25	27.50	28.69	26.25	26.63	25.00
Hominy meal (sacked)	22.14	23.15	23.50	23.29	24.58	25.75	25.94	26.35	29.94	30.76	28.56	28.25	26.02
Hominy meal (bulk)	20.70	21.65	22.11	22.00	23.73	24.39	24.36	25.04	28.40	29.16	26.93	26.27	24.56
Corn meal	21.00	21.40	21.80	21.60	24.10	25.00	24.90	26.20	30.20	29.40	27.50	28.60	25.14
Corn No. 2, yellow	19.25	20.07	20.64	20.64	23.08	20.06	22.25	25.00	28.47	26.72	25.71	27.79	23.31
Oats, No. 2, clipped white	27.31	31.25	32.88	31.75	32.81	32.81	33.00	38.63	39.13	37.69	36.06	37.73	34.25
Rye No. 2	26.61	26.29	26.30	31.20	28.93	32.32	32.85	32.15	32.50	35.04	33.54	32.04	30.83
Feed barley	22.08	25.00	28.13	27.50	28.33	32.50	31.25	30.92	33.54	38.33	34.19	34.38	30.51

ALFALFA AS A CROP FOR MASSACHUSETTS.

Wm. P. Brooks, Director.

For about twelve years alfalfa has been under trial—for the most part on small areas—on various portions of the College Farm in Amherst, and until recently the results have in all cases been quite discouraging. The alfalfa has usually started well and in a number of instances has for a year or two given quite satisfactory crops, but only to gradually die out, to be replaced by grasses and clovers. In view of these results the Director has not felt warranted in encouraging efforts to produce alfalfa upon an extensive scale, though he has always advised experimenting with it. At the present time there are three small areas of alfalfa on different parts of the grounds from one to three years of age. All of these gave three excellent crops in 1907.

As the result of the experience at Amherst, the Director does not even yet feel justified in recommending the putting of large areas into alfalfa. It is feared that the present apparent success is due to unusually favorable climatic conditions and that in the future, as in the past, alfalfa will be found an uncertain crop. It is the judgment of the Director that its nutritive value does not exceed that of the more common clovers grown in mixture with grasses to a sufficient degree to make it expedient to incur much risk in the effort to produce it. In support of this view, the following results of analyses are presented:

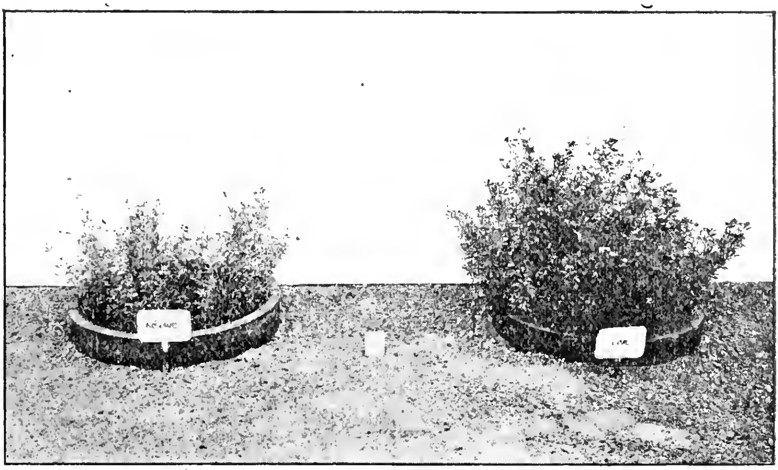
COMPOSITION OF CLOVER AND ALFALFA HAYS.

	WATER. Per Cent.	ASH. Per Cent.	PROTEIN. Per Cent.	FIBRE. Per Cent.	NITROGEN FREE EX-TRACT. Per Cent.	FAT. Per Cent.
Alfalfa,*	15.	7.9	13.5	27.2	33.2	3.2
Alsike Clover,**	15.	9.7	14.	23.1	36.1	2.1
Medium Red Clover,**	15.	7.6	13.2	24.2	37.4	2.6

These figures indicate that there can be no great difference in the food values of alfalfa and clover hays. Alfalfa, however, is a long-lived plant: when once established it should continue to yield three crops annually for a considerable number of years. The alsike and red clovers on the other hand are short-lived. It is this difference chiefly which makes it worth while to attempt to produce alfalfa.

*Calculated on basis of two analyses published by the New Jersey Agricultural Experiment Station.
**Average of analyses in the Massachusetts Agricultural Experiment Station.

Experience at Amherst has indicated that the cost of starting the crop must always very materially exceed the cost of seeding to ordinary mixed mowing. A brief statement of the conditions which seem to be most likely to insure success will be of interest. The soil should be one which is thoroughly drained: standing water within less than six to eight feet of the surface would mean almost certain failure. The best results in Amherst have



NO LIME. LIME.

been obtained on a medium loam made up principally of very fine sand and silt underlaid at a depth of from three to five feet with gravel. The soil should be as free from weeds and weed seeds as possible, and it should be thoroughly enriched. In most localities a heavy application of lime seems to be essential.

The cuts illustrate the effects of liming in a striking manner. The cylinders in which the alfalfa here shown were grown are four feet in depth and two were filled with equal quantities of thoroughly mixed soil. We are therefore certain the conditions in the two were identical save as regards the use of lime. The quantity of lime will in most cases vary from one to one and one-half tons per acre. This should be spread upon the freshly plowed surface and deeply worked in with a disc harrow.

In all localities where sweet clover (Melilotus alba) does not grow spontaneously inoculation of the soil with the bacteria for alfalfa is essential to the highest success. Pure cultures may be obtained both from the United States Department of Agriculture and from dealers, but in the experience at Amherst the most satisfactory results have followed the use of earth taken from an alfalfa field in a locality where the crop has been for some time successful. There are a number of such localities in the state of New York. In the experiment at Amherst some 300 or 400 pounds of alfalfa soil per acre have been used, but the statement is made that from 100 to 200 pounds will be sufficient. This earth should be evenly spread upon the field and immediately well worked in with a harrow. Even a comparatively short exposure to sunshine will kill the bacteria.

In the earlier experiments at Amherst the seed was usually sown in the early spring. Under these circumstances, it was found that the annual weeds almost invariably outgrew the alfalfa and greatly retarded its development. In our more recent experiments we are seeding somewhat later. We plow the land in early spring and harrow it repeatedly at intervals sufficiently close to prevent all growth of weeds. Under this treatment the seeds of the annual weeds which lie near enough to the surface to germinate will almost all have started previous to the date of sowing and these weeds having been destroyed, the alfalfa has a much better chance. It is now believed that the seed should be sown from about June 10th to the 20th.

Unless the field is already rich, it is wise when it is broken up in the spring to give it a heavy dressing of manure, and in connection with the manure the Director of the Experiment Station would advise the application of the following mixture of chemicals:

Per acre:

Basic slag meal,............1000 to 1200 lbs.
High grade sulfate of potash,.. 300 to 350 lbs.
Nitrate of soda,................75 to 100 lbs

When well started, alfalfa will not require further additions of manure nor of any chemicals or fertilizers which supply nitrogen, as it can draw this element from the air, but in the early stages of its growth it is dependent upon a soil supply of this important element.

The best possible seed should be obtained, and it would seem wise to obtain that grown as far to the north as possible. Experience at Amherst has indicated that heavy seeding is advisable, and from 25 to 30 pounds of seed per acre are usually used. If sown at the time indicated, the alfalfa and the few weeds which start with it will need cutting before the end of the summer. It seems wise, however, to allow it to grow as long as it continues healthy and is not too much shaded by the weeds. If the leaves show rust and turn yellow, it should be immediately cut. If the growth is not too heavy, it will be best for the permanent good of the field to allow what is cut to remain on the ground, and this will be true also of a second cutting, if such cutting is necessary during the first season. The last cutting should never be late, as there should be considerable growth at the opening of winter to afford protection. Unless the mulch afforded by the previous cuttings and the growth which remains on the ground at the approach of winter affords thorough protection, a heavy top-dressing with strawy manure has been found advisable. Even after the crop is fully established, late autumn cutting should be avoided. Considerable growth to hold the snow and afford protection during the winter will always be desirable.

A TRUE STORY.

THE PROFITABLE COW.

A Year's Record: 6975 lbs. milk testing 4.87 per cent fat equal to 340 lbs. fat, equal to 396 lbs. butter. **Food cost** of one quart milk 2.76 cents; 1 lb. butter 2.29 cents. **Profit** from milk at 3 3-4 cents a quart, $31.38; from butter at 30 cents a lb., $31.31.

THE UNPROFITABLE COW.

A Year's Record: 3141 lbs. milk testing 4.38 per cent fat equal to 137.4 lbs. fat, equal to 165 lbs. butter. **Food cost** of one quart milk 4.53 cents; 1 lb. butter 39.2 cents. **Loss** from milk at 3 3-4 cents per quart, $11.27; loss on butter at 30 cents per lb., $15.22.

Query: Which kind of cows are **you** keeping? **If you don't know,** isn't it about time you found out?

BULLETIN No. 121. FEBRUARY, 1908.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION.

Seed Separation and Germination

BY

GEORGE E. STONE

This bulletin gives a brief account of the methods used in and the advantages to be derived from the separation of seeds, together with some experimental data showing the results obtained from seed separation.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

DIVISION OF BOTANY.

Seed Separation and Germination

George E. Stone.

It is generally recognized that large, heavy and well developed seeds will as a rule produce larger plants than light and poorly developed seeds of the same variety. It is also recognized that seed uniform in size, weight and development will produce crops of a more uniform type than those grown from seed characterized by variations in development, etc. Those seeds possessing an embryo supplied with an abundance of reserve material are better qualified to meet the struggle for existence, other conditions being equal, than those poorly endowed. Therefore, seed separation has come into vogue among growers of special crops as a means of securing more uniform crops and plants of greater vigor.

In the growing of any crop it is wise to secure good seed, and, as is well known, many failures may be attributed to the use of poor seed; but at the present time seed selection is not common in the case of many crops. Much more attention might profitably be given to such matters as seed purity and vitality, especially in intensive agricultural pursuits, than is common at the present time.

Already valuable results have been obtained from the use of separated onion and tobacco seed, and the careful selection of the seed of various cereal crops has also proved profitable.

Methods of Seed Selection.

Seed selection of one kind or another has been in vogue from time immemorial, and it is customary for agriculturists to select the most desirable types of plants for propagating purposes. The selecting of the most thrifty seedlings from a seed bed is practically the same thing, since the inferior seedlings are largely those grown from inferior seeds, and are discarded.

Various devices are used in separating seed, the operation of which does not involve a great amount of labor. These consist of blowing and sifting, separation by water, chemical solutions, etc. An account of results obtained by the use of chemical solutions, or the specific gravity method, is given by V. A. Clark.* By this method the relative specific gravity of seed can be obtained and the heavier seeds selected. In the water method of separation the seeds are placed in a quantity of water, shaken thoroughly, and allowed to stand for a few moments. The seeds which do not sink (the light ones) are removed; while those which sink (the heavy ones) are reserved for planting.

Another method of selection is based upon the difference in the volume weight of the seeds. No separation of seeds is involved, those seeds being selected which give the greatest weight per given volume, and the method consists in simply choosing the heaviest from several samples on a basis of volume weight.

The separation of seed by sieves is one of the simplest, easiest and most practical methods employed, and is applicable to a large number of varieties. Various kinds of sieves can be purchased with perforations corresponding to either millimeters or inches, and of round, oval, oblong or slot form. For general purposes we prefer sieves having circular perforations. Perforated metal is manufactured by various firms, and the size of the perforations varies greatly, some of them apparently not corresponding to any standard unit of measurement. However, it is not a difficult matter to select perforated metal with perforations closely approximating certain sizes, and sieves are easily made by soldering strips of this material to the bottom of any metal vessel of suitable size or by fastening them to wooden frames. A large variety of perforated metal, quite accurately gauged in fractions of an inch, can be obtained from the Harrington and King Perforating Co., 114 Liberty St., New York, and a variety of sizes can usually be obtained from any tinsmith.

Small, light seeds are best separated by the air method, and various devices are used for this purpose. Some of the different types of winnowing machines, used for cleaning the chaff from seed, may be employed, and a form manufactured in Germany, has been exclusively employed by us for separating onion seed, with very

* N. Y. (Geneva) Exp. Sta. Bul. 256, October, 1904.

satisfactory results. With this machine many pounds of onion seed can be separated in a short time. It would not be a difficult matter

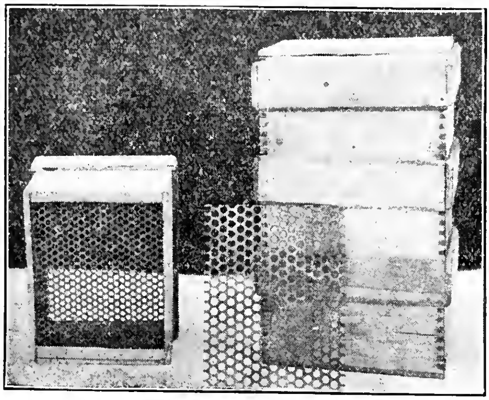


FIG. I.
Various Types of Wooden Sieves for Separating Seeds.

for anyone skillful in the use of tools to duplicate this machine at small cost.

The tube and bellows method has been much used for separating tobacco seed and is well adapted to this purpose, since tobacco seeds are small and it does not require many ounces to supply the average farmer. An appliance of this sort is capable of separating in a short time enough tobacco seed to plant many acres. The principal features of this device consist of a foot bellows, a glass tube $\frac{3}{4}$ or more inches in diameter and 2 or 3 feet long, and a separate air space to receive the air. See Fig. II. The bottom of the tube must be covered with cheese cloth with a large enough mesh to allow the air to readily pass through, but fine enough to hold the seed. The pressure of the air and the diameter and length of the neck are features which must be adjusted to one another to secure the best results. Various kinds of blowing appliances are used, all having the same object,—to properly separate the seed. For our purposes we have devised an apparatus consisting of a series of tubes placed in a block side by side, (see figures III and IV,) and while certain ones are being operated, others can be emptied and refilled. The tubes are set in holes and imbedded in paraffine, rendering them secure. The block holding the tubes is in two sections, and the two halves are held together by large screws. The tube extends to the middle of the block and rests upon a square piece of folded perforated tin "r," between which is placed bolting cloth, preventing the seed from falling through. The perforated tin and bolting cloth which cover the lower end of the tube are held in a horizontal position by means of a spring and when the seeds are separated by turning the handle marked "Y" it brings the seed support in a vertical position, as shown by the dotted lines "Y," emptying the seeds into the Mason jar below "G," which is provided with a metal cover securely and permanently fastened to the underside of the block. The process of emptying the seed from the tube into the jar

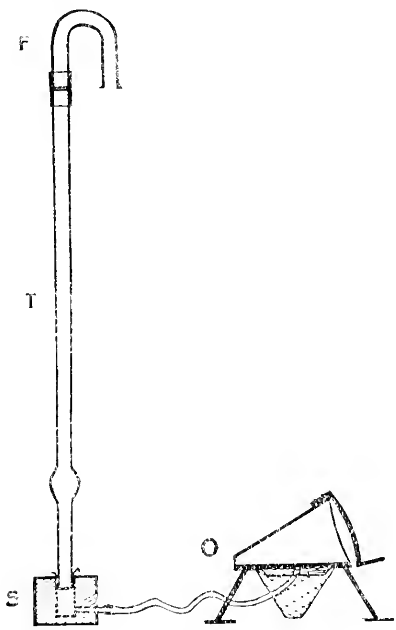


Fig. II.
Simple Device for Separating Seed.
O. Bellows. T. Tube containing seed, provided with bulb. F. "U" tube attached to top with rubber. S. Block to support the tube T. and containing air cavity.

is easily accomplished and saves much time and labor. The top of each tube is provided with a light brass funnel having a simple shut-off at "e." Fastened to the same axis which carries the funnel there is another support which carries a bent piece of glass "t."

This is for the purpose of directing the light seed into the cylinder "M." Both the funnel and the glass tubes are centered over the long tube and held in position by a simple click or spring at "O-C," and either can be readily swung in any direction. The blowing arrangement consists of a Bishop & Babcock Little Wonder

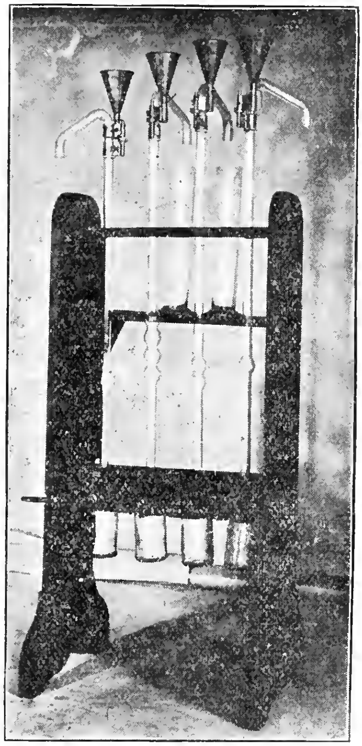


Fig. III.
Device for Separating Seed Used at the Station.

Hydraulic Air Compressor[1] provided with a 50 gallon tank, "A-D." This is connected with thick-walled rubber tubing, pressure gauges, reducing valves and shut-offs. The pressure is obtained by means of water, and with a large supply tank and high pressure the air supply can be kept quite constant. A special feature of this appa-

[1] These can be obtained from Bishop & Babcock, 47 Great Jones St., New York, N. Y.

ratus consists in the bulbs in the tubes of which various types are used. In successful separation much depends upon the number and size and shape of these bulbs.

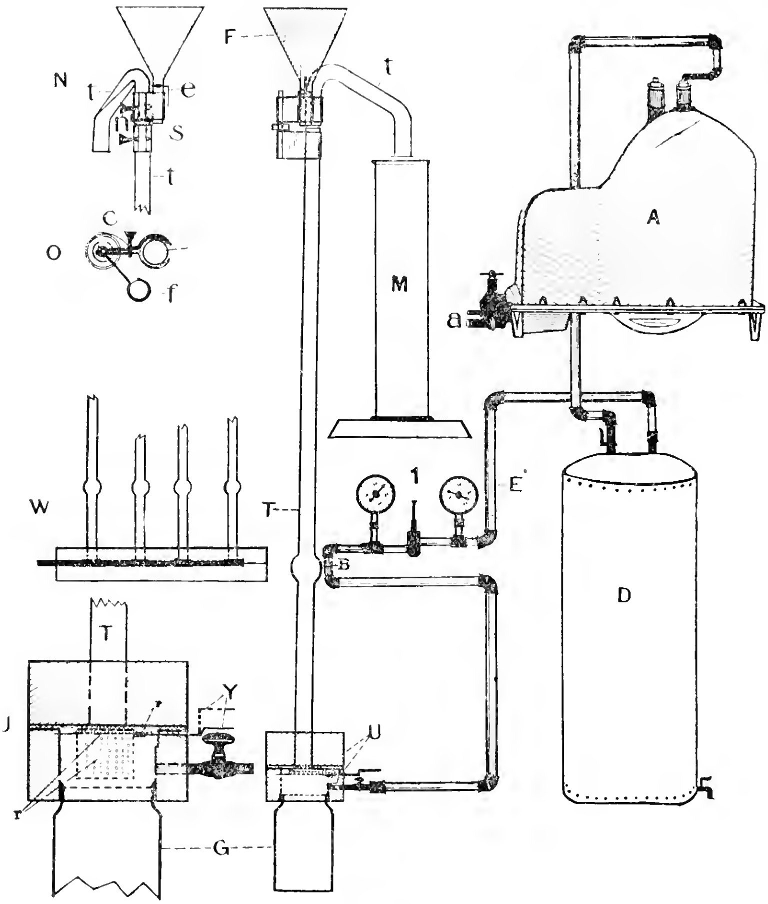


FIG. IV.

Details of Device Shown in Figure III.

A. "Little Wonder" pump operated by water. D, Tank. i, Reducing valve and gauges. G, Mason jar. T, Tube with bulb. f, Funnel. M, Jar to collect blown seed. N-O, Showing detail of operation of funnel, etc. Y, Device to hold seed in place and empty them into the Mason jar.

Seed Separation as Related to Germination and the Growth of Seedlings.

The experiments made in our laboratory for the purpose of verifying other experiments and illustrating the value of seed separation show decided differences between small, light seed and large, heavy seed, both in respect to germination and to the growth of seedlings. These experiments have been mainly confined to about a dozen different varieties of seeds. Shamel and Cobey[2] have also demonstrated differences in the case of tobacco plants, and they have given some striking illustrations of tobacco plants grown from heavy, medium and light tobacco seed. Clark obtained many similar results with other seed possessing various specific gravities. In our experiments the difference between seedlings grown from large and small seeds was quite marked. The results which we obtained with lettuce were similar to those to be observed in any lettuce seedling bed where thousands of these plants are growing. In these beds may be seedlings or prickers of various sizes and degrees of development which were derived from different sizes of seed. The small seed in such cases produced the small seedlings and the heavy seed the larger ones. These prickers have to be selected carefully and the inferior ones discarded. It is much easier, however, to accomplish the separation by the use of a sieve before the seed is sown than afterwards to depend upon the eye and hand.

The results of the separation of various seeds as shown by their germination and the growth of seedlings are given in the following tables. The superiority of the large seed is shown in almost every instance.

---

[2] Shamel & Cobey, Bul. 91, Bur. Plant Ind., U. S. Dept. Agr., August, 1906.

TABLE I.

SHOWING RESULTS OF SEED SEPARATION BY THE WATER METHOD.

Name of seed.	No. seed germinated. Light.	Heavy.	Per cent of increase in germination of light over heavy seed.
Lettuce,	68	90	32.
Onion,	100	117	17.
Onion,	38	85	142.
Lettuce,	44	88	100.
Onion,	50	58	17.
Average,	60	87	61.

TABLE II.

SHOWING RESULTS OF SEED SEPARATION BY THE WATER METHOD ON GERMINATION AND GROWTH OF SEEDLINGS OF ONIONS.

TOTAL OF 400 SEEDS USED.

	Per cent of germination.	No. of plants.	Wt. of plants. (Grams.) Total.	Average.	Ave. per cent gain of heavy over light.
Heavy (sank),	42.5	85	18.1	.213	37.42
Light (floated),	19.5	38	5.9	.155	

TABLE III.

SHOWING THE RESULTS OF SIFTING 10 GRAMS OF LETTUCE SEED.

Size of seed.	Weight in 10 grams of seed.	Per cent.
2.0—1.5 mm.	1.015 grams.	10.15
1.5—1.0 mm.	6.689 grams.	66.88
1.0— .5 mm.	1.800 grams.	18.00
.5	0.491 grams.	4.91

TABLE IV.

Kind of seed.	Per cent of germination.	Size of sieve.	No. of seedlings.	Ave. wt.	Per cent gain of heavy over light seed.
Sweet pea,	48.5	Over $\frac{3}{16}$ in.	97	.517	49.8
Sweet pea,	33.5	Under $\frac{3}{16}$ in.	67	.345	
Carrot,	29.6	Over 2 mm.	54	.0392	56.1
Carrot,	44.0	Over $1\frac{1}{2}$ mm.	88	.0482	92.03
Carrot,	43.5	Over 1 mm.	87	.0272	8.38
Carrot,	3.0	Under 1 mm.	6	.0251	
Cucumber,	14.0	Over $\frac{5}{32}$ in.	28	.162	35.0
Cucumber,	22.5	Under $\frac{5}{32}$ in.	45	.120	
Tomato,	48.0	Over $\frac{1}{8}$ in.	96	.731	
Tomato,	82 0	Under $\frac{1}{8}$ in.	164	.751	
Spinach,	58.5	Over $\frac{1}{8}$ in.	117	.105	13.5
Spinach,	61.5	Under $\frac{1}{8}$ in.	123	.0925	
Cabbage,	43.5	Over 2 mm.	87	.944	80.1
Cabbage,	91.0	Over 1.5 mm.	182	.524	
Lettuce,	56.7	Over 1.5 mm.	672	.518	98.46
Lettuce,	53.5	Over 1 mm.	642	.457	75.09
Lettuce,	40.4	Over .5 mm.	485	.261	
Radish,	28.2	Over $\frac{1}{8}$ in.	56	.90	592.00
Radish,	37.7	Over $\frac{7}{64}$ in.	75	.85	553.00
Radish,	28.0	Over $\frac{3}{32}$ in.	57	.37	184.00
Radish,	40.0	Over $\frac{1}{12}$ in.	80	.13	
Millet,	32.0	Over $\frac{7}{64}$ in.	65	.201	392.00
Millet,	30.5	Over $\frac{3}{32}$ in.	61	.188	366.0
Millet,	19.0	Over $\frac{1}{14}$ in.	38	.160	311.00
Millet,	7.5	Under $\frac{1}{14}$ in.	15	.05	

The average increase in germination of the heavy seeds as shown by the water separation method was 61%. In these experiments the seeds were placed in a funnel filled with water, and after shaking and letting them stand for a few moments the seeds which had sunk were drawn off and equal numbers of each series selected and planted. The difference in the weight of onion seedlings grown from heavy and light seed which had been separated by water is shown in table II, there being a gain of 37.42%. In table III the weight and percentage are given of the different sizes of lettuce seed which were passed through a series of millimeter sieves. In table IV are given the results obtained from the use of a number of varieties of seeds, and in this series of experiments 200 seeds were used from each sifting with the exception of lettuce and radish, the latter representing an average of two experiments and the former three.

In these experiments different sizes of sieves with round perforations were used, some of which were cut to millimeters and some to inches. In every instance the percentage of gain was based on the lightest seed. Undoubtedly in some cases sieves of other sizes might be employed to advantage. All sweet pea seed passing through a sieve with $\frac{3}{16}$ inch perforations, and carrot seed through a $1\frac{1}{2}$ millimeter sieve should be discarded. In the case of cucumbers there is a difference of 35% in the two sizes of seed, but cucumber seed might better be separated by a slot perforation. A $\frac{1}{8}$ inch sieve could be used for tomatoes and spinach, a 2 millimeter sieve for cabbage, 1 millimeter for lettuce, $\frac{3}{32}$ inch for radishes and either a $\frac{3}{32}$ or $\frac{1}{14}$ inch for millet. The percentage of germination in some cases is the highest with the largest seed, and in others with those of medium size, but with the exception of the carrot and tomato seed the greatest weight of seedlings was obtained from the largest seed. In the case of the tomato there was practically no difference in the average weight of the seedlings.

From a sample of onion seed separated by the air method we obtained 33% of light seed. 200 seeds were selected from this sample and germinated with the following results:

The heavy seed gave 92.5% and the light seed 55% of germination.

In our experiments in the separation of celery seed by means of an air blower there was a marked difference in the number of seeds which germinated and the size of the seedlings, the larger seeds giving the best results. A sieve with perforations about $\frac{3}{4}$ millimeter or $\frac{1}{36}$ inch in diameter would be suitable for separating celery seed. From our experiments we find that it would well pay one to separate celery seed, planting the separated seed in sterilized soil or soil free from the germs of diseases peculiar to celery. If these precautions were taken we believe much better crops of celery, less subject to infection, could be raised.

As regards the value of seed separation, Mr. E. N. Foote, an extensive onion grower of Northampton, Mass., writes:

"I had $33\frac{1}{3}$% of all the seed I bought blown out, which I consider was the best investment I ever made in the onion business. I want to follow the same lines this year. As I sow 25 acres the blown-out seed is quite an item, but it pays."

TABLE V.

SHOWING THE STANDARD OF GERMINATION OF SOME SEEDS.

Kind of seed.	Percentage germination.	Kind of seed.	Percentage germination.
Alfalfa,	85-90	Muskmelon,	85-90
Bean,	90-95	Oats,	90-95
Blue grass, Kentucky,	45-50	Onion,	75-80
Cabbage,	90-95	Peas,	90-95
Carrot,	80-85	Pumpkin,	85-90
Celery,	60-65	Radish,	90-95
Clover, red,	85-90	Squash,	85-90
Clover, white,	75-80	Spinach,	75-80
Corn, sweet,	85-90	Timothy,	85-90
Corn, field,	90-95	Tomato,	85-90
Cucumber,	85-90	Turnip,	90-95
Lettuce,	85-90	Tobacco,	75-80

Seed Work at the Station.

During the past two years a great many samples of onion and tobacco seed have been separated by this Department for farmers. The percentage of discarded onion seed from a number of samples separated averages 12.6% ; that of 85 samples of tobacco seed, 15.5%. Only 2% was discarded from the best tobacco seed, and from the poorest sample 37%. In the case of onion seed 1.6% was discarded from the best sample and 43% from the poorest.

Germination tests have been made of 373 samples during the past two years. The average percentage of germination of onion seed was 82.5, the highest 100% ; and the lowest 28%. The standard of germination for onion is held to be 75-80%. For germination tests 200 seeds are generally used, the tests being largely made in Zurich germinating dishes. Occasional use is made of sawdust and filter paper, and seeds are frequently planted in soil.

Directions for Sending Seeds for Separation, Germinating Tests, Etc.

In sending seeds to be tested for germination a sufficient quantity should be forwarded to enable a fair average of the sample to be obtained. 200 seeds at least should be sent, and as it requires several days to make a test, samples should be sent in sometime previous to the proposed date of planting. Samples sent in for separation should include return postage or express, together with statement as to whether discarded seed should be returned. All packages and letters pertaining to seed testing and separation should be addressed to G. E. Stone, Mass. Agr. Exp. Sta., Amherst, Mass.

Conclusions.

The principal object of this bulletin is to set forth the advantages to be gained from the use of separated seed and to interest farmers and gardeners in seed separation, and we recommend it particularly to those following lines of intensive agriculture. Onion and tobacco growers make use of separated seed, and we strongly advocate market gardeners doing this also. Lettuce seed can be easily separated with a sieve, in this way saving labor and space, besides securing more uniform and vigorous seedlings.

We regard seed separation as an important aid in securing larger, more vigorous and more uniformly developed crops and recommend its use wherever practicable.

BULLETIN No 122. MARCH, 1908.

MASSACHUSETTS
AGRICULTURAL EXPERIMENT
STATION.

Poultry Keeping for Egg Production

BY

WILLIAM P. BROOKS

This bulletin is a brief guide to poultry keeping for eggs. It discusses:—houses for growing birds and for laying stock, the question of breed, incubation and brooding, and the general management and feeding both of chickens and laying stock. It summarizes the results of experiments on the following points:—use of condition powder, clover rowen vs. cabbages, influence of the cock on egg production, vegetable vs. animal feeds, cut fresh bone vs. animal meal, morning vs. evening mash, wide vs. narrow rations or corn vs. wheat, buckwheat vs. corn and effect of fibre in the ration.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

Poultry Keeping for Egg Production.

WM. P. BROOKS, DIRECTOR.

It is the design in this bulletin to present briefly what are regarded as the leading essentials for success in poultry keeping for eggs. In its preparation, not only our own, but outside sources of information as well will be freely drawn upon, with due acknowledgment in all cases. The experiments summarized have extended over a period of thirteen years, and have been under the general oversight of the writer as the head of the agricultural department of the station.*

The proportion of the citizens of Massachusetts directly interested in poultry keeping is large—greater, no doubt, than the proportion engaged in any other single agricultural industry. The principal reasons are that the amount of land required is relatively small, the necessary investment moderate and the labor comparatively light, while it is supposed that a modicum of knowledge will suffice. In the popular estimate, "anyone knows enough to successfully manage a few hens." Nevertheless, the ruins of poultry plants—large and small—so frequently met with make it apparent that disappointment has frequently been the lot of once enthusiastic and hopeful novices. It is so easy and costs so little to engage in poultry keeping that it is not strange that many who are unfitted to succeed undertake it.

We have in the state all the necessary conditions for success. The winters, it is true, are long, and the costs of caring for fowls therefore somewhat greater than in a more genial climate; but, on the other hand, our markets are probably the best in the world—certainly they are unsurpassed in the United States. The home product falls far short of meeting the demand. Mr. A. F. Hunter, in a letter

* The immediate responsibility for the execution of the work has been carried successively by the different assistants in the department. Special acknowledgments are due to these men, all of whom are graduates of the College. Not only have they faithfully looked after the work; their suggestions and advice have been valuable. The writer takes pleasure in naming them in the order of their service: H. M. Thomson, F. R. Church, S. B. Haskell, and E. F. Gaskill. To Messrs. Haskell and Gaskill, special acknowledgment is due also for assistance in bringing results together in preparation for publication.

addressed to the late Pres. H. H. Goodell in 1903, states that $20,000,000 of poultry products from without the state were sold in Boston and thirteen of the other cities of the Commonwealth in 1902; and that the United States census for 1900 showed the total value of poultry and eggs produced in the state in 1899 was a little less than $4,000,000—hardly one-fifth of the value of the poultry and eggs received from outside the state.

Of course it does not necessarily follow that the poultry and eggs now purchased without the state should be produced within its borders. It may be that our people are otherwise more profitably employed or that localities with greater natural advantages can lay their products down in our larger markets at prices lower than home producers can meet.

The following facts, however, will not be disputed:

1. Many land owners—large and small—make little profit in the lines of farming or gardening now followed.

2. This state contains many acres of relatively infertile land, held at a low valuation and well suited for poultry farming.

3. Experience shows conclusively that while considerable areas are preferable, poultry keeping may be made successful even in comparatively restricted quarters.

4. Much of the work connected with poultry keeping can be performed by those not capable of hard work. It is especially suited, therefore, to women, young people and those not physically strong—classes now often finding it difficult to obtain congenial and profitable work.

5. Poultry products can invariably be readily sold, and, on the average, at prices which under wise and efficient management afford a profit.

6. Poultry products command prices which are higher in proportion to bulk and weight than most farm products, and they can accordingly better pay the necessary costs of transportation to distant markets.

This statement of facts and conditions, considered in connection with the statistics of sales of poultry products from without the state in our large cities makes it apparent that Massachusetts affords a promising field for a large increase in poultry farming. An attempt will be made in this bulletin to present the essentials for success in one branch of the industry—egg production—to which single line of poultry farming the work of this experiment station has been almost exclusively devoted. The conclusions presented will be based for the most part upon our own experience and experiments ; but through the courtesy of Director C. D. Woods, of the Maine Experiment Station, it is possible to include also the conclusions of the experts of that station upon a number of important points—chief among them : the problems of housing and the value of the dry mash system of feeding.

The different phases of the general subject will be discussed under the following headings :

How to House the Stock.
The Breed to Select.
Hatching and Rearing the Laying Stock.
Experiments in Egg Production.
Feeding for Eggs.
General Care.

How to House the Stock.

Under this topic will be considered :

The Location of Poultry Houses.
Close vs. Open Houses, or Pure Air for Poultry.
The Maine Houses.
The Station Houses.
The Tolman House.
The Portable Brooder House (Maine).
Movable Coops.

The Location of Poultry Houses.

The selection of the best possible site for poultry houses is a matter of prime importance. Comparatively few realize the extent of the variation in local climate in places which may be only short distances apart. The writer lives upon the southern slope of a hill, wooded to the west and north, in a house lying at an elevation of less than one hundred feet above the College hot houses, which are not a stone's throw distant. During every extremely cold period the average temperature in the shade is four to five degrees higher at his home than at the hot houses. In the hottest weather of the summer, on the other hand, the temperatures at his house are almost invariably about the same number of degrees lower than at the lower elevation. It is apparent from these statements that a moderate elevation and shelter mean a more agreeable and less trying climate —warmer in winter, cooler in summer. Such a location, too, will be relatively free from fogs and the cold evening mists; it will have a drier air. If, in addition to moderate elevation and shelter, the location has perfect natural drainage and a coarse and naturally dry soil, it will present ideal conditions for poultry. It may not always be possible to secure the elevation. With good drainage and a naturally dry soil success is possible. Shelter can be secured within a few years by planting evergreens on the side from which come most of the cold winds.

Close versus Open Houses or Pure Air for Poultry.

One of the most striking changes of modern times is the fuller and more general recognition of the value both to man and to the lower animals—whether in health or disease—of abundance of pure air and sunshine. This change has greatly affected the views held by the well-informed as to the best type of house for poultry. There was a reaction first against a large proportion of glass in the south side, as this type of house suffered too great variations in temperature, being excessively hot during bright sunshine, even in winter, and cold at night. Such houses were also almost certain to be damp These undesirable conditions were in part removed by a reduction in the size and number of windows, but with this type of construction the houses were, under some weather conditions, too dark and they were still often damp. The need of better ventilation was then recognized, and improvement in that direction reduced the difficulties from impure air and dampness. The houses were still sometimes too dark, sometimes over hot and likely to be damp.

The scratching shed style of construction next came into vogne. These sheds were often permanently closed by muslin curtains, but in the course of time were so planned as to be open during pleasant weather, so that the fowls were practically in the open air by day, unless the weather should be stormy. This change marked a great improvement, but it was for some time regarded as essential to provide each flock with a closed and warm room for the roosts and nests. Many have not yet advanced in their belief in open air beyond the stage represented by this type of construction.

The believers in a yet more radical departure from the "faith of the fathers" are, however, now numerous, though relatively few have yet adopted the full open front house. The majority of open air advocates still hold to the belief in the necessity of special protection for nignt and recommend the curtained front roosting compartment.

An Open Air Crank.

The writer frankly confesses himself an open air crank. He believes that with the hardy American breeds with small combs, indeed with any of the hardy breeds with small combs, a full open front house without special provision for protected and warmer roosting compartment, will not only prove entirely satisfactory, but will be better than a greater degree of protection with its accompanying greater risk of overheating, impure air and dampness. He is convinced that the latter are the predisposing causes of roupy colds and roup, and has never seen a case of either developed in the open air.

Roup Cured by Open Air Treatment.

On the other hand, the writer has seen complete recoveries from roup under the following heroic treatment. Early in December of 1905, one of two roosters recently purchased and put in with a pen of pullets was seen to be seriously affected with roup. He was promptly removed, and as he had cost a considerable sum of money, he was placed in a coop in a well-

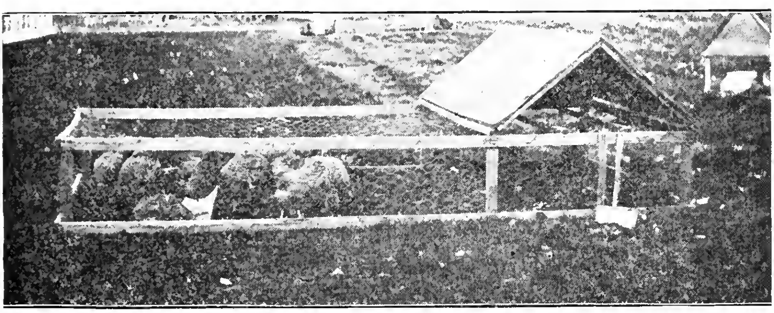


Fig. 1. Movable Wire Coop.

lighted and moderately warm basement. The pullets were carefully examined and two roupy individuals were discovered. These were at once removed, and no other course being convenient they were placed in a wire coop standing in the open air not far distant from the poultry house.

The cut shows the general construction of this coop. Its dimensions on the ground are 6 x 12 ft.; height 20 inch. The roof is of paper and there are perches for the fowls beneath it.

No Medicine Used.

Neither the rooster in the basement nor the pullets received medicine. Both were, however, supplied with ordinary feeds, pure water, shells and grit. The cases were all quite severe. The pullets, although one lost an eye, made a rapid recovery. The rooster grew steadily worse, and at last the writer, convinced that he would die where he was, put him into the coop with the pullets. His improvement and complete recovery were rapid, although he also lost one of his eyes. In this coop, protected only by a strip of burlap around the west end, these three fowls remained throughout the entire winter, which was one of full average severity—7.5° below zero being registered in March. After each snowfall one edge of the coop was raised and the snow beneath it removed. The pullets suffered no apparent inconvenience; the rooster's comb and wattles were frozen, but not to greater degree than is frequent in houses of ordinary construction, and not enough to lessen his vigor and influence.

Eggs in a Snow Bank.

Not only did the pullets suffer no apparent discomfort; but they began to lay before the end of January, and laid as well throughout the winter as the average of their more warmly housed sisters.

Ex-Church Windows Removed.

The writer, on taking possession of the premises he now occupies found a hen house with three pens, each 8 x 10 feet and about 8 feet high at the front and 5 feet at the back. In each pen was a window, evidently from an old church, occupying nearly the entire front. All these were removed after the experience of three or four years. The fronts of two of the pens were closed in and shingled, with one ordinary 3 x 6 window in each. The space formerly occupied by the window in the other was closed with poultry netting and provided with a muslin curtain, it being his design to use this pen as an open scratching shed. After his experience with fowls in the open coop during the entire winter, he had sufficient courage to winter flocks of fowls in this pen and to have the curtain up (except during storms driving in) both night and day. The fowls so wintered have maintained perfect health and vigor and have produced more eggs than the similar fowls in the closed pens with windows open. In the open pen, the floor of which is thickly covered with straw, the fowls scratch and crake merrily even in the coldest weather. The window sill is about two feet above the floor, so that the birds are not likely to feel direct currents of air.

The Maine Poultry House for Laying Fowls.

The type of house now recommended by the Maine Experiment Station for large flocks possesses many features of unusual value, and the writer is glad to present illustrations of this house and to make extensive quotations from a recent bulletin.* He is not convinced of the utility of the drop curtain in front of the roosts for such breeds as the Plymouth Rocks, Wyandottes and others of similar characteristics under Massachusetts climatic conditions, though ready to admit that they may be useful in the severer climate of Orono.

"During the summer of 1905 a laying house was built to accommodate 2,000 hens. It is 20 feet wide and 400 feet long. It is on the same general plan as House No. 2 and 3 at the Experiment Station. House No. 2 is 12 feet wide; House No. 3 is 16 feet wide, and this one at Go-well farm is 20 feet wide. The widths have been increased in the last two houses, as experience has shown the advisability of it. At first it was thought that the houses should be narrow, so that they might dry out readily, but the widest house dries out satisfactorily as the opening in the front is placed high up, so that in the shortest winter days the sun shines in on the floor to the back.

Nearly two years use of this wide house shows its advantage over the narrow ones to be greater than was anticipated when it was planned. Its great width and the low down door in the back wall make it much cooler in hot weather.

During July and August the birds go into the yards early in the morning, but they nearly all come back into the house as the day gets warm, and remain on the floor in the back part of the room,

* Bul. 144, Maine Experiment Station.

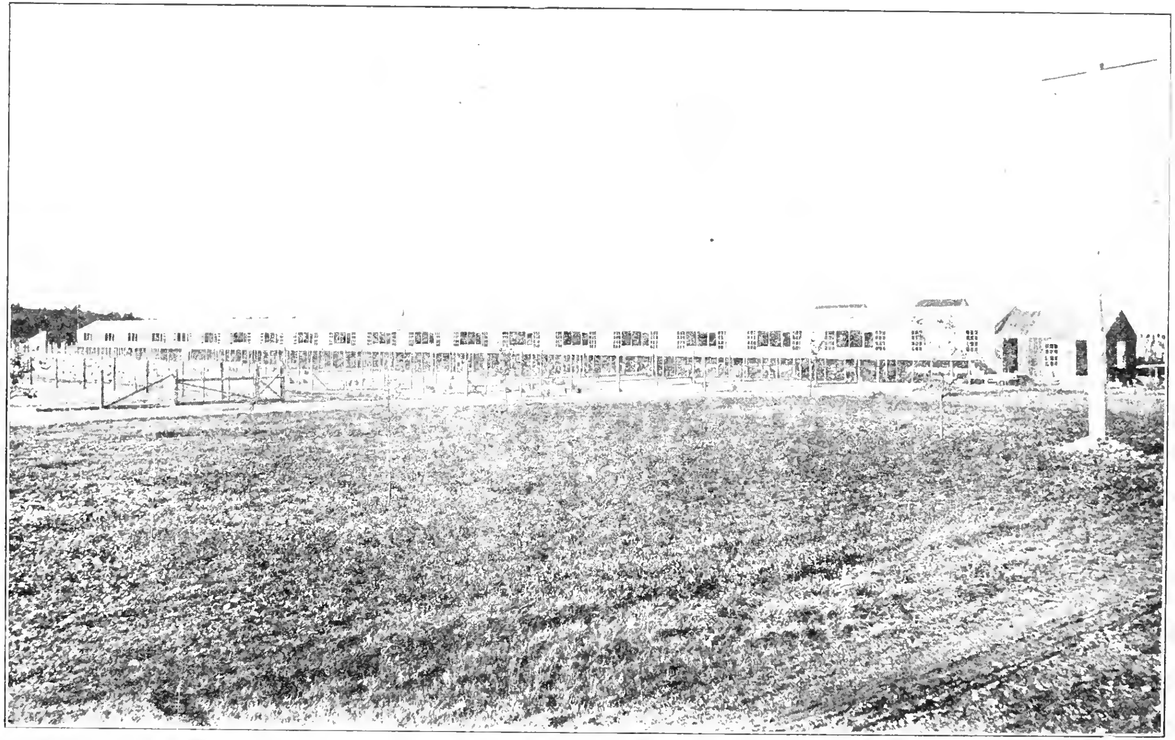


Figure 2. Laying and breeding house at Go-well farm. See page 9.

apparently enjoying the shade and the cool air which draws across the floor, even when the air seems very still outside.

The differences in the temperature of the wide and narrow houses is very great, and the birds show what they think about it by staying in the yards in preference to the narrow houses. Of course, the comfort of the birds is not greater than when they have good shade out of doors, but the runs have not trees or shrubs sufficient to furnish shelter.

The economy in the cost of the wide house over the narrow ones, when space is considered, is evident. The front and back walls in the narrow house cost about as much per lineal foot as those in the wide house, and the greatly increased floor space is secured by building in a strip of floor and roof, running lengthwise of the building. The carrying capacity of a house 20 feet wide is 66 per cent. greater than that of a house 12 feet wide, and is secured by building additional floor and roof space only. The walls, doors and windows remain the same as in the narrow house, except that the front wall is made a little higher. Three sills, which are six inches square, run lengthwise of the house, the central one supporting the floor timbers in the middle. They rest on a rough stone wall, high enough from the ground so that dogs can go under the building to look after rats and skunks that might incline to make their homes there. The stone wall rests on the surface of the ground. The floor timbers are 2 x 8 inches in size and rest wholly on top of the sills. All wall studs rest on the sills; the front ones are 8 feet long and the back ones 6 feet 6 inches long. The roof is unequal in width, the ridge being in 8 feet from the front wall. The height of the ridge from the sill to the extreme top is 12 feet 6 inches. All studding is 2 x 4 in size and the rafters are 2 x 5. The building is boarded with inch boards and papered and shingled with good cedar shingles on walls and roof. The floor is of two thicknesses of hemlock boards, which break joints well in the laying.

The building is divided by tight board partitions into 20 sections, each section being 20 feet long. All of the sections are alike in construction and arrangement. The front side of each section has two windows of twelve lights of 10 x 12 glass, screwed on, upright, 2 feet 8 inches from each end of the room. They are three feet above the floor. The space between the windows is 8 feet 10 inches long, and the top part of it down from the plate, 3½ feet, is not boarded, but

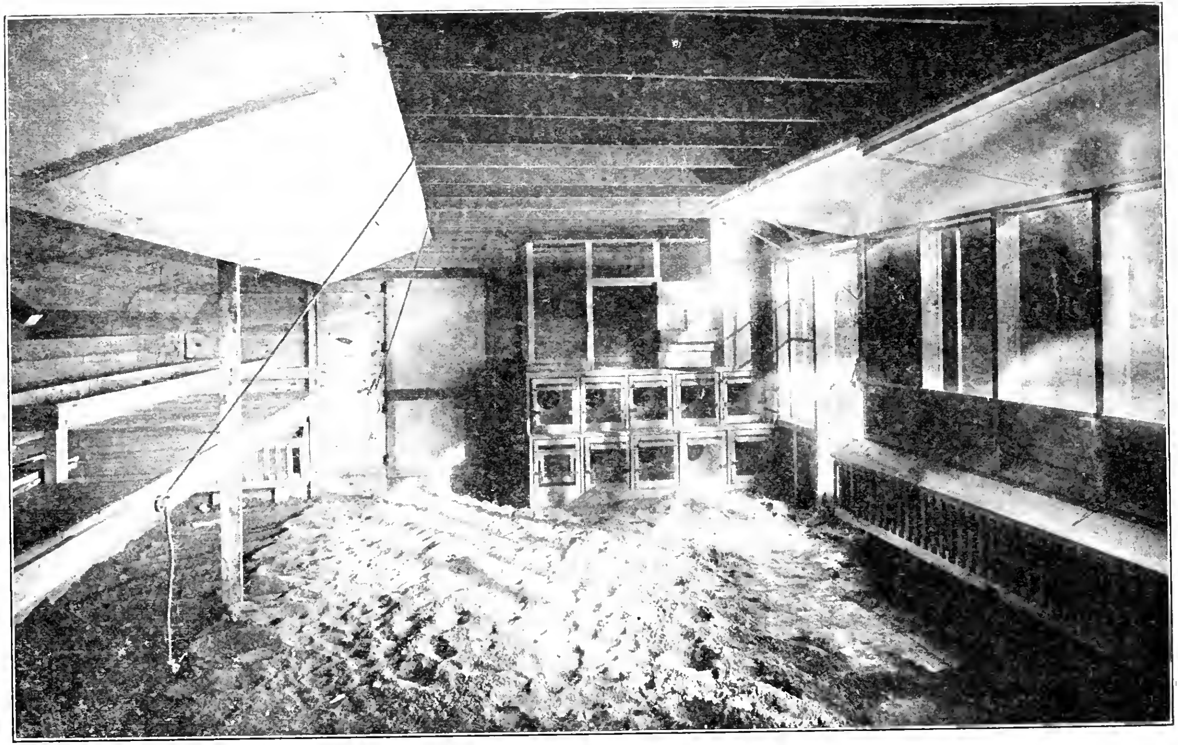


Figure 3. Interior of one section of curtain front house. See page 9.

left open to be covered by the cloth curtain when necessary. This leaves a tight wall, 3 feet 10 inches high, extending from the bottom of the opening down to the floor, which prevents the wind from blowing directly on to the birds when they are on the floor. A door is made in this part of the front wall for the attendant to pass through when the curtain is open. A door 16 inches high and 18 inches wide is arranged under one of the windows for the birds to pass through to the yards in front. It is placed close down to the floor. A similar door is in the center of the back wall to admit them to the rear yard when that is used.

A light frame, made of 1 x 3 inch pine strips and 1 x 6 inch cross ties, is covered with 10 ounce white duck, and hinged at the top of the front opening, which it covers when closed down. This curtain is easily turned up into the room, where it is caught and held by swinging hooks until it is released.

The roost platform is made tight and extends along the whole length of the room against the back wall. It is 4 feet 10 inches wide and three feet above the floor, high enough so that a person can get under it comfortably when necessary to catch or handle the birds. There are three roosts framed together in two 10 feet sections. They are one foot above the platform and hinged to the back wall so they may be turned up out of the way when the platform is being cleaned. The back roost is 12 inches from the wall, and the spaces between the next two are 16 inches. They are made of 2 x 3 inch spruce stuff, placed on edge, with the corners rounded off. The roosting closet is shut off from the rest of the room by curtains, similar to the one described above. For convenience in handling, there are two of them, each 10 feet long. They are three feet wide and are hinged at the top so as to be turned out and hooked up. The space above this curtain is ceiled up, and in it are two openings each 3 feet long and 6 inches wide, with slides for ventilating the closet when necessary. There is a door in every partition, placed five inches out from the edge of the roost platform. They are three feet wide and seven feet high; they are divided in the middle, lengthwise, and each half is hung with double acting spring hinges, allowing them to swing open both ways and close.

Ten nests are placed against the partition in each end of the room in two tiers. They are of ordinary form, each nesting space being one foot wide, one foot high and two feet long, with the entrances near the partition, away from the light, and with hinged covers in front for the removal of the eggs. Each section of five nests can be taken out, without disturbing anything else, and cleaned and returned. In constructing the house it was designed to use these nests only one year. At the end of that time they were removed and 400 trap nests substituted for them.

Troughs are used for feeding the mixtures of dry meals, shell, bone, grit and charcoal. The bottoms are made of boards 7 inches wide, the ends being of the same width and 18 inches high. The back is of boards and the cover is of the same material and slopes forward sufficiently so the birds cannot stay on it. A strip five inches wide is nailed along the front edge of the bottom to make the side of the trough. Pieces of lath are nailed upright on the front, two inches apart, between which the hens reach through for the food. A thin strip two inches wide is fastened to the front of the trough at an angle of about 45 degrees to catch the fine meal that the birds pull out and would otherwise waste. They clear it up from this little catchall and so waste is mostly prevented.

Two lines of 4 x 4 inch spruce are arranged as an elevated track above the doors. The track extends the entire length of the building and being faced with narrow steel bands on top, a suspended car is readily pushed along, even when heavily loaded. The platform of the car is 2 x 8 feet in size and is elevated a foot above the floor. All food and water are carried through the building on this car. The 10 iron baskets, into which the roost platforms are cleaned every morning, are put on the car and collections made as the car passes through the pens to the far end of the building, 400 feet away, where the roost cleanings are dumped into the manure shed. As the car is pushed along, the guard at the front end comes in contact with the doors and pushes them open and they remain so until the car has passed through, when the spring hinges force them to close again. This car is a great labor saver as it does away with nearly all lugging by the workmen. It has enabled one man to take good care of 2,000 hens throughout the year, except on Saturdays when the litter has been removed and renewed by other men.

At one end of the building there is a temporary food and water house for dish washing and scalding and where the car remains when not being used.

There is a walk outside of the building extending along its entire front. It is four feet wide and is made of two inch plank; it is elevated 2 feet above the floor of the building, which allows the doors, through which the birds pass to the front yards, to be opened and closed without interference. The door which opens out of each room through the curtain section, is above the outside walk and necessitates stepping up and down when passing through, which is not a very serious objection, as the door is used but little in the daily work, but mostly in cleaning out and renewing the floor litter. A guard of wire poultry netting, a foot wide along the outside of the walk prevents the birds from flying from the yards up to the walk. The advantage of the elevated walk, over one on a level with the sill of the building is that it is unobstructed by gates, which would be necessary were the low walk used, to prevent the birds from passing from one yard to another.

YARDS.

"The yards conform in width to the 20 foot sections of the house and are 100 feet deep. The fence is five feet high and is made from two strips of two inch mesh No. 19 poultry netting. By using two strips of 30 inch width, instead of one strip double that width, two strong lines of wire are brought in the middle and the liability of bagging is much lessened, while the cost is not increased.

To give free passage for teams near the door of the building, openings 12 feet wide are left in the yard fences. They are 15 feet away from the front of the building, so that the road may not be obstructed with snow which is liable to accumulate near the building. The frame fence sections, which fill in the openings during the summer, are quickly taken out and replaced on cleaning days, and the delivery of bedding and worn litter, back and forth, from wagon to buildings is very directly made."

The Station Houses.

In planning for experimental work with poultry in the Agricultural Experiment Station at Amherst it was decided that detached houses of precisely similar construction, each accommodating a single flock. would most surely afford that identity of house conditions for each of the different flocks under comparison which is essential for accurate experimental results. A view and plan of one of these houses and the full specifications for construction are presented. This house does not satisfy the present ideas of the writer as to poultry house construction. It is faulty in a number of particulars to which attention will be called : but it seemed best to include these views and data for several reasons :—

1. The experiments referred to later in this bulletin have all been tried in houses of this type.

2. With slight modifications later suggested the house should prove well adapted to the needs of those keeping small flocks.

3. The style of construction adopted while involving greater first cost than is common in such buildings has proved in the main satisfactory and should prove economical in the long run. The houses although erected in 1894 have required practically no repairs, although the steel roofs have been several times painted.

Poultry House Specifications, Mass. Agric. Exp. Station.

Dimensions—

18 feet long, 12 ft. wide, 8 ft. high in front, 5½ ft. high at rear. Divided into two compartments—a closed room 10 x 12 ft., and an open shed 8 x 10 ft.

Foundation—

For closed portion stone wall laid in trench 2½ ft. below surface of ground, extending to within 6 inches of surface. Wall 1½ ft. wide. On stone, 1 foot of 8 inch brick wall. Under outer end corners of shed, piers of stone and brick as above. Grade to top of wall.

Frame—

Sills 2 x 8, chestnut, set on edge, halved together. Posts 2 x 4, pine, halved to sill and plate, set 2 feet on centers.

Rafters 3 x 4, yellow pine, 14 ft. long, 2 feet apart on centers.

Cover, sides and roof, 1 inch hemlock planed on inside. Sides covered with good quality building paper and clear butt cedar shingles laid five inches to the weather.

Roof of Neponset block paper and flat steel.

Roof to project 6 inches beyond frame on all sides.

Windows—

In pen 2, 12 lights, 8 x 10 in.

In shed doors 2, 12 lights, 6 x 8 in.

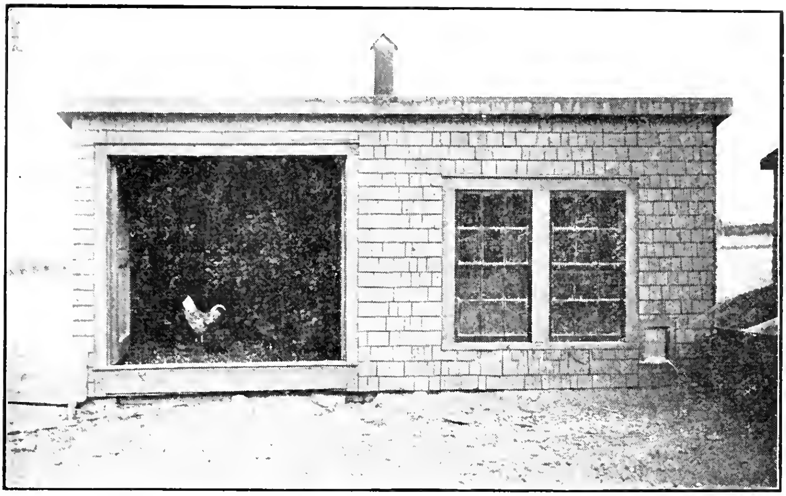


Fig. 4. Scratching Shed Poultry House, Mass. Ag'l. Exp. Station.

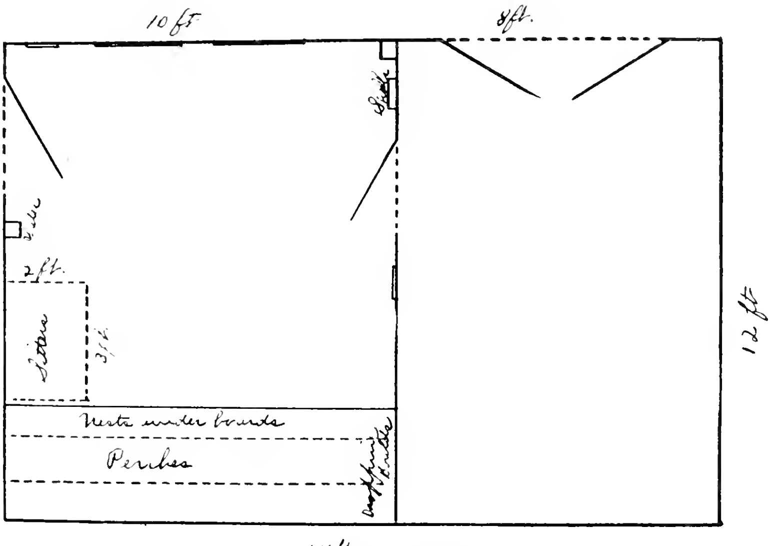


Fig. 5. Plan of Poultry House, Mass. Ag'l Exp. Station.

Doors—

Of matched pine boards.

Partition—

Matched boards.

Dropping board—

3 ft. wide and 2 ft. from floor, matched boards.

2 roosts, 1 ft. shorter than dropping boards, 2 x 3 in. planed four sides, placed one foot from the wall at the back and one foot apart ; hinged by cleat to back wall to stand 6 in. above dropping board.

Sitter coop—

2 x 3 ft. bottom and sides made of pine strips 3 x 1 in. Coop placed 4½ ft. from the floor.

Water platform—

1 ft. square, nailed to the top of sill.

Ventilator—

In roosting room, extending from floor to 2 ft. above building ; six inches square inside, 2 doors full width and 8 inches high. one placed 6 ft. from ground, one at the ground.

Material required—

2	2 x 8—18 ft. chestnut.
3	2 x 8—12 ft. "
17	2 x 4—14 ft. pine.
11	3 x 4—14 ft. "
671	ft. hemlock boarding planed one side.
200	ft. matched pine boards 14 ft. long.
4	sash, 6 lights, 8 x 10 glass.
2	" 12 " 6 x 8 "
1	window frame for 12 lights 8 x 10 glass.
¾	roll building paper.
½	roll Neponset block paper.
3000	clear butt cedar shingles.

Small amount planed pine for finish.

Changes Suggested. 1. The steel roofing is expensive in first cost and maintenance, and on the whole unsatisfactory. Shingles, slate or one of the better patent roofings such as Paroid will usually be preferable.

2. This building if to be used as a scratching shed house will be better if the width of roosting room and shed are changed. Make the roosting room 7 or 8 ft. wide and give balance of space to scratching shed.

3. Instead of hinged door to scratching shed opening to the floor substitute a window with muslin or duck curtains. Have width of window nearly full width of shed, and window sill about two and a half or three feet above floor.

4. Unless designed for housing Leghorns, Minorcas or other breeds requiring a warm house, the writer would either divide such a house into two equal pens—each with one open curtain front— for two small flocks: or remove the partition entirely, putting in the two large curtain front windows and using the house for a single flock of forty to fifty fowls.

5. With the curtain front style of construction the ventilating shaft will be unnecessary.

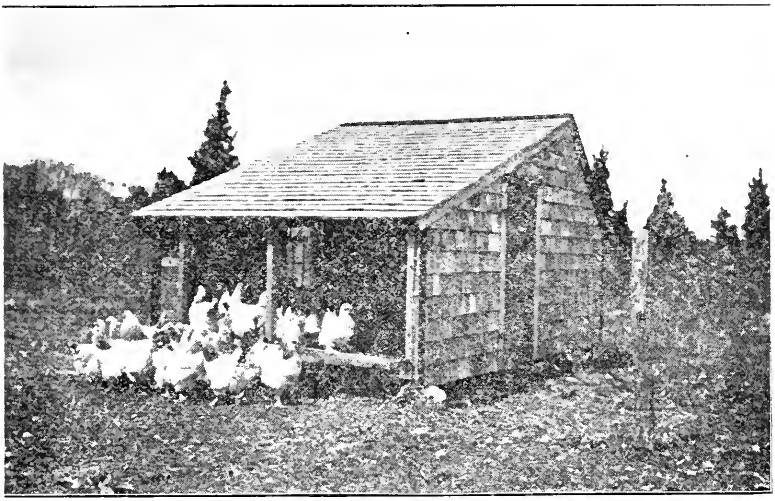


Fig. 6. Tolman Fresh Air Poultry House.

The Tolman House.

Through the courtesy of Mr. Joseph Tolman, of Norwell, Plymouth County, it is possible to present a cut of his small fresh air poultry house.

This house (see figure 6) is intended to accommodate forty breeding fowls. Its dimensions are 10x16 feet. The roof as will be seen is double pitched. The ridge is 12 feet from the front. The height of the house at the front is 3½ feet, at the ridge 8 feet, at the back 5 feet. There is a single window in the west end, which Mr. Tolman regards as important to insure access of sunlight to the extreme rear of the house, roosts and dropping board.

Mr. Tolman is also using a house of similar general proportions, 14x24 feet in size. He states that this accommodates one hundred fowls and that the results obtained in its use are extremely satisfactory.

Housing Growing Stock. Wherever chickens are reared in considerable numbers the problem of housing and a suitable range are important. The brooder house heated by hot water or steam pipes is satisfactory as long as the chicks are small and they can be cared for more cheaply in such houses than in separate lamp heated brooders but there are many who will feel unable to make the investment necessary to put up and heat such a house. For such the experience and suggestions of the Maine Experiment Station will prove valuable.

Maine Portable Brooder House.*

" Portable brooder houses of several different sizes and styles of construction are in use, sufficient to accommodate 2000 chickens to maturity. The style of house that has proved most satisfactory with us, is here described.

Each of the houses accommodates 125 or 150 chicks from the time brooding commences until they are moved into winter quarters. They are large enough so the necessary work can be done comfortably in them. During rainy days, when the birds must be kept indoors, there is room for them, and they will not suffer seriously if the floors are generously covered with cut clover or chaff. The birds in them are safe at night from storms, and all thieves that walk on four feet, crawl, or fly. They are built on shoes so that they can be drawn near together for convenience in the brooding season, during April, May and June, and then to the grass fields for the range season.

*Bulletin 144, Maine Agricultural Experiment Station.

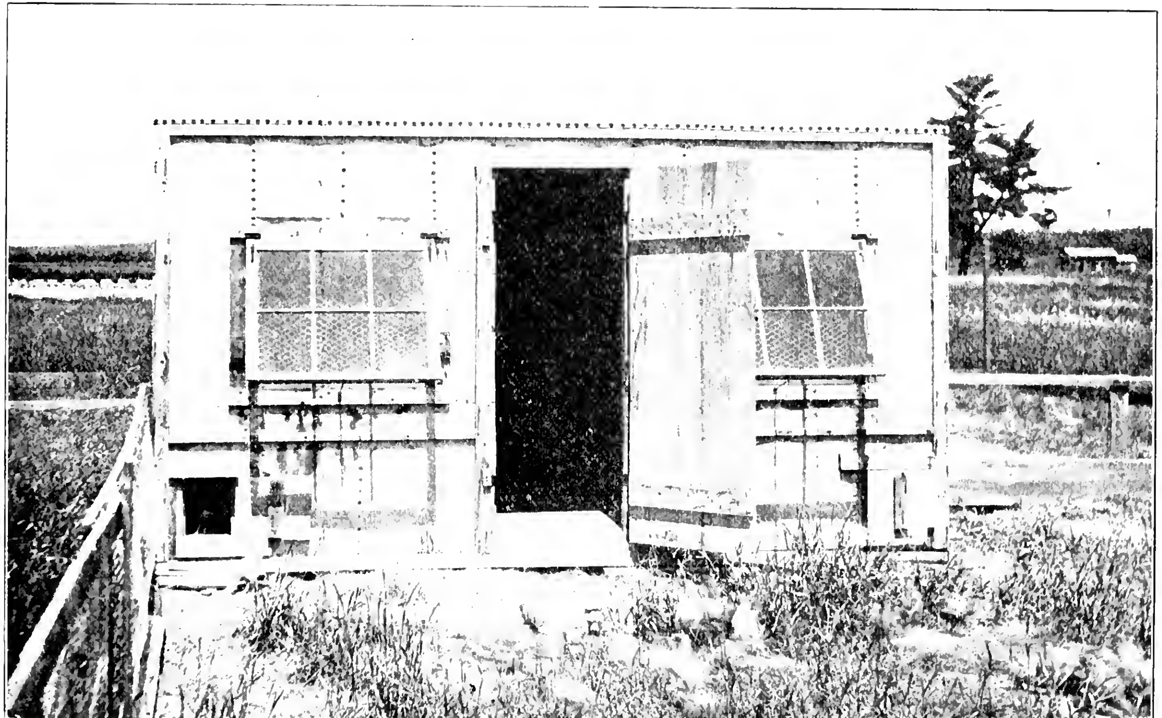


Fig. 7. Movable brooder house. See page 20.

Such houses are almost indespensable to the person who raises few or many chickens. Their use removes many of the obstacles that tend to annoy and defeat chicken raisers.

Each house is 12 feet long and 7 feet wide. The front wall is 6 feet 2 inches high, and the back 4 feet 2 inches high from floor to roof, inside. This allows a full grown person to stand erect in the front part of the house. The two shoes on which it is built are 4 by 6 inches in size and lie flat. Their ends are chamfered on the under side so as to give them a sled runner turn. They are 14 feet long, and extend a foot outside of each end of the building. An inch auger hole slanting backward, and outward, is bored through each end of the shoes. For convenience in moving the houses, a short chain with an eye bolt in each end, which can be slipped through the auger holes and keyed, is used.

The floors are of two thicknesses of boards, breaking joints so as to prevent the air from drawing through. The walls and roof are boarded and covered with one of the better qualities of sheet roofing materials. A door 2 feet wide and 6 feet high is placed in the center of the front wall with a window on each side of it. Each window contains 6 lights of 10 by 12 glass in one sash. It is hinged at the top and turns out, like an ordinary storm window. It is either closely buttoned down, or held open at different spaces, by hooks of various lengths. The longest opening is a foot, which leaves the window slanting out at an angle sufficient to give plenty of fresh air in warm weather when both windows are open, and the house full of birds. The advantages of hinged, over sliding windows, are that in stormy weather, rains and winds do not beat in to wet or annoy the birds, and free ventillation is not interfered with. The window openings are covered with wire netting on the inside. A slide door, a foot square, is made down at the floor, near each end of the front of the building, for the chicks to pass through. A temporary board partition about 15 inches high divides the building crosswise into halves. Two No. 4 Peep-O'-Day brooders* are used in each of these houses. They are put about 2 inches away from the back wall so as to allow the free passage of air to the intake openings in the sides of the brooders. They set about a foot away from each end of the building, and this space is filled in with an elevated platform and incline, which allows the chicks to go out through the brooder door, and down a broad easy grade to the floor. The Peep-O'-Day brooders* are all made alike, with the lamp door at one side and the chick door at the other. They are located so that the lamp doors are towards the middle of the building and about 4 feet from each other, which gives about 2 feet between the lamp door and the temporary partition, sufficient room in which to attend to the lamps. The hinges to the brooder cover are put at the back, which allows the cover to turn up against the back wall out of the way.

These portable brooder houses are well made, of good material, and if the shoes are kept blocked up from the ground, they should last as long as other farm buildings. When they are drawn to the range for the warm season, they are turned back to the south, so that the sun may not shine in the windows to heat the house and make it uncomfortable for the birds. Facing the north, the houses furnish good cool shelter during the heat of the day.

The houses which the pullets occupy are blocked up about a foot and a half and the open space between the house and the ground gives cool shelter which the birds enjoy. The pullets do not trouble about going under the house to spend the night, but the cockerels do, and we find it necessary to board around the cockerel houses and deny them the cool retreat. As the cockerels develop in September and October, they become quarrelsome and there are bullies among them, at every house, that domineer over their mates during the day, and stand guard at the doors at dark. With such fellows in the way it is difficult getting the underling into the house at shutting up time at night, if they have a chance to skulk under the building.

When the houses are drawn to the fields, they each contain from 50 to 75 pullets, as they are relieved of their brothers who are taken out and put into the fattening pens a few days previously. If the houses are located near to each other the chickens are liable to collect in some of them at nightfall and neglect others as the season advances, but if the houses are separated from each other by a distance of 100 feet, or thereabouts, the birds keep, for the most part, to their own homes.

When the houses are drawn to the fields, small yards about 12 feet square are made in front of them, in which the birds are confined for a few days, so as to get them acquainted with the new location of

* No extended tests of incubators, brooders, and other appliances have been made at the Maine Station. In this bulletin the makes that are in use at this Station are named. These may not be the best of their classes but have worked satisfactory here.

their homes, rather than let them go out into the new neighborhood at once, with the liability of their getting confused and lost."

Movable Coops for Chickens.

The type of coop shown on page 7 will sometimes prove valuable for housing growing stock. By its use many of the advantages of a free range can be secured in localities where the area is insufficient to permit such range. Confinement in such coops is not recommended as superior to the Maine system just described, but it may sometimes be the best available substitute. The usual practice is to place these coops on grass land and one or more times daily to move them their length or width so that the fowls may have a fresh supply of green feed and unsoiled ground. Of course any given area can be fed over in this way several times during a season. The coops are light and very readily moved. Dragging would be made easier by shaping the lower edges of the ends of the bottom scantling of the frame like a sled runner. The coop can be still further improved:

1. By putting doors about a foot square in the gables so that fowls on the perches beneath the roof can be reached from the outside.

2. By putting a hinged gate large enough to admit the blade of a hoe opposite the end of the feed trough so that it may be conveniently cleaned when necessary.

3. Light diagonal braces in the corners will render such coops firmer and more durable. Wires might undoubtedly be used with advantage for this purpose.

Open Coops Useful for Laying Stock. Such coops have frequently been used with satisfactory results for confining laying hens during the summer. The care of the fowls will take rather more time than in houses, but the use of the coop moved daily solves the problem of green feed: it makes it possible to carry a large number of fowls with many of the advantages of free range on limited areas and it is the observation of the writer that hens kept in this way (with no fixed habitation) become broody less than those in houses and may consequently lay more eggs. An orange box beneath the roof with a hinged gate in front of it for removal of the eggs affords the needed nests. This can be set on and fastened to the bottom frame at one corner so that it moves with the coop. Such a coop will accommodate from ten to twelve hens. As a consequence, in part no doubt of the frequent movings to fresh ground, the fowls suffer relatively little from vermin.

The Breed to Select.

There are many who in writing for advice in relation to poultry keeping, inquire what is the best breed of fowls. There is no one best breed for any purpose, or at least if there be such a breed, there is no general agreement as to which it is. The breed which will give the most satisfactory results will vary with the conditions of environment and with the person caring for the fowls. In the production of eggs, which is the only phase of the poultry industry especially discussed in this bulletin, the selection of the breed must be determined within certain limits by the type of egg demanded in the market which the producer has in view. In Boston market and in most markets in this state, a dark shelled egg is preferred. In New York City on the other hand, a white shelled egg sells at a somewhat higher price than one which has a dark shell. The breeds belonging to the Asiatic and American classes produce eggs with the character of shell in favor in Boston market. Those of the Mediterranean and Polish classes produce white shelled eggs. The English and French breeds are variable in respect to the color of egg produced. No exhaustive statements covering this point will be here attempted as anyone about to engage in poultry industry can very readily learn the color of egg produced by the breeds taken into consideration.

The Strain more Important than the Breed.

In almost any of the breeds which have been long established, there is a very wide difference in the capacity for egg production in different strains or families of the breed. The degree of difference between strains or families of some of the breeds specially selected and improved for egg production on the one hand or as table fowls on the other, is likely to be greater than between almost any two breeds of the same class. The selection of a good laying type of fowl is an important prerequisite for success in poultry farming for eggs and it is highly important to keep in mind the fact of the enormous difference in strains or families. Fowls which have taken premiums in the poultry exhibitions have often been bred for fancy points, utility as measured by egg production being almost absolutely neglected.

A number of private breeders and notably the Maine Experiment Station have been breeding for improvement in egg production, using for that purpose some form of trap nest whereby individual records can be kept. Marked improvement has already been effected.

The writer's preference for egg production is a strain of one of the American general purpose breeds, especially bred for improvement in that direction. He is aware that some of the non-sitting breeds of the Mediterranean or Polish classes are under conditions suited to them very superior egg producers, but in his judgment, the greater abillty of the American breeds to endure cold and the greater value of the males as table birds renders them superior under conditions most usually existing in Massachusetts. Fowls belonging to strains of these breeds especially improved for egg production, although at some seasons of the year frequently broody, are nevertheless persistent layers and will probably under average conditions prove more profitable even where egg production is the first object in view, than the Mediterranean and Polish breeds which require more careful housing and protection. They are, on the other hand less frequently broody than the Asiatic breeds. They are perhaps equally satisfactory with these breeds as producers of winter eggs and are likely to produce on the average a larger number of eggs in a year.

Hatching and Rearing the Laying Stock.

In hatching and rearing laying stock, the object usually prominent in view is to bring the pullets forward at such time that they will produce abundance of eggs during the season of high prices. The date at which the chicks should be hatched in order to accomplish this result will naturally depend in a measure upon the breed and the strain, for fowls of different breeds and strains require variable lengths of time to come to laying maturity. If the chicks are hatched too early, there is always danger that they will begin to lay in late summer or early fall, producing a relatively small or moderate number of eggs only, and that they will then molt partially or completely. Under these conditions, the pullets are not likely to produce eggs druing the season when the prices are usually highest, for from two to three months will be occupied by the molt and during this period the fowls seldom lay. Cornell Experiment Station reports* in presenting the results of different methods of feeding pullets that "in nearly every case the hens beginning earliest to lay were molting during December and January when eggs were at a high figure."

It has been thought that in cases when early hatched pullets seemed likely to come to laying maturity too early, their development might be retarded by putting them on a grass range and feeding whole grain with a limited amount of beef scraps and that if so managed, the fowls would not be likely to produce eggs early nor to molt. The Cornell Expertment Station** has tested this method and reports that it was a failure in so far as preventing the molt is concerned. Although the pullets fed with a view to retarding development laid less eggs early in the season than those which were fed a forcing ration, they molted at about the same time and to about an equal degree.

It seems best in view of the facts which have been stated to time the hatches so that the pullets will naturally reach laying maturity during the latter half of October or very early in November With hatches so timed, there is usually no tendency to molt during the first fall. No attempt will be here made to give the exact date best for hatching the different breeds. The writer's experience with an early maturing strain of the Barred Plymouth Rock bred for egg production inclines him to prefer chicks hatched during the first of May, though such birds hatched any time during that month can usually be brought to laying previous to the middle of November.

Natural Hatching Best for Small Numbers.

When fowls are kept in relatively small numbers, hatching the eggs under hens will be the most satisfactory method, provided the breed kept is one likely to furnish quiet sitters and good mothers. The American breeds satisfy these conditions. To secure good results, it is necessary to isolate the sitting hens. A considerable number of these may be placed in the same room, though under this condition, it will be advisable to confine the sitters to their nests, to remove them daily that they

*Bulletin 249, p. 251.

**Bulletin 249.

may take food and water and to see that they return to their nests. One of the principal disadvantages connected with hatching under hens is the fact that the chickens often suffer from vermin. Of course, under the best management the fowls are kept as free as possible from their insect parasites. Under these circumstances, if a good insect powder, is dusted through the feathers at the time the hen is set and again two or three days previous to the date of hatching, there should be little or no trouble. The nests used must, of course, be clean.

Whole corn is probably as good a feed as can be used for the sitting hen and when removed from the nest she should have access to grit, shells and pure water. She should also be allowed to enjoy a dust bath and may safely be absent from the nest from 15 to 30 minutes according to the prevailing temperature.

The number of eggs which a single hen can satisfactorily cover will depend upon the size both of the eggs and of the hen. It is a mistake to attempt to hatch too large a number. Thirteen eggs are in most cases as many as can be satisfactorily brooded.

Incubator Hatching Essential for Large Numbers.

While chickens hatched in incubators are often inferior in vitality and suffer a higher mortality than those hatched under hens, it is the judgment of almost all poultrymen that incubators are essential where large numbers of chickens are to be hatched. The management of an incubator requires less time and labor than caring for a large number of sitting hens. The use of the incubator, moreover, makes it possible to hatch whenever desired, whereas if dependence be placed upon broody hens it not infrequently happens that they are not available in sufficient numbers when needed. A good incubator well managed will give hatches of strong and healthy chicks provided the eggs are from vigorous and healthy stock properly mated.

The Station has not made such tests as justify a report as to the relative merits of different incubators. Cyphers incubators have been most largely used in the Station work and they have given fairly satisfactory results. There is probably no doubt that there are other machines which are capable of giving similar results. The placing of the incubator is a matter of some importance. It will be most easily and surely regulated if it stands in a room with equable moderate temperature and hatches will usually be best if the air is not excessively dry. For these reasons, a cellar or basement room with walls so constructed as to be poor conductors of heat or cold and not exposed to the direct rays of the sun is usually most satisfactory. It is important that this room be so constructed that it can be freely ventilated. In managing the incubator, it is best to be guided by the rules and instructions sent with the machine. These are in all cases prepared with much care after wide experience with the machines and by the most competent men. A beginner should under no circumstances neglect to follow instructions closely. The man of experience may sometimes find minor variations advisable to better meet local conditions.

Brooders or Brooder Houses Necessary with Incubators.

Where chickens are hatched with incubators, it is the almost invariable rule to place them in brooders or brooder houses, though occasionally a person is found who prefers to give them to hens. They will require less close attention with the hens, but where chickens are raised in considerable numbers, the labor of caring for them in brooders or brooder houses is less than it would be with hens and one of these methods is almost invariably preferred.

Outdoor Brooders.

The Station has not made any experiments with brooder houses. It has for a number of years reared a considerable number of chickens annually by the use of out-door brooders. A number of different types of brooders have been used, but no exhaustive comparisons of the different kinds have been made. Among those employed the Peep-o'day, Cyphers and Prairie State have proved quite satisfactory. It is by no means an easy matter, however, to so regulate an out-of-door brooder as to secure satisfactory results. With practically all the brooders offered in the market, the regulation of the temperature is a matter of considerable difficulty. Several automatic contrivances for controlling the temperature in brooders have been placed upon the market, but none of these have been found to satisfactorily accomplish the objects in view. The variations in outdoor temperature are very wide. Exposure to bright sunshine will cause the temperature to run up very rapidly; while, on the other hand, the disappearance of the sun behind the clouds or the coming up of a cool spring wind will cause an equally rapid fall in temperature. Outdoor brooders should, of course, be set in as sheltered a location as possible. It might be easier to regulate them if they should stand in the shade, but sunshine is essential for the well being of the chickens. Satisfactory results with out-door brooders are for the reasons which have been briefly referred to, impossible without rather close watch and constant attention. The brooder is much more easily managed if it stands under cover, where the variations in temperature will be relatively small and if the room in which the brooder is placed is so constructed that the chickens can get into the sunshine, the conditions will be as good as it is possible to make them where this style of management is adopted. The Maine brooder house, described and illustrated on pages 20 to 23, appears to admirably meet the required conditions. In the management of brooders, as in that of incubators, it is the part of wisdom for the beginner to closely follow the directions fnrnished by the manufacturers.

A Good Brooder House.*
(See Figures 8 & 9.)

Exterior dimensions 70x16 feet. All posts and sills that come in contact with the ground are Kyanized spruce. Frame spruce. Front and middle posts 4″x4″x2′-0″, back posts 4″x4″x3′-0″, all set five feet apart and two feet into ground on stones at bottom of holes. Sills 2″x4″ spiked to posts. Studs 2″x4″, one over each post, sawed beveling at top to suit pitch of roof. Plates spiked to top of studs. Roof timbers 2″x4″, 2′-6″ apart between centres, and can be lapped on centre plate if short lengths are used. These are toe-nailed to plates. Covering boards are hemlock. Roof covered with one-ply Ruberoid roofing and sides clap-boarded over building paper.

Studs of 2″x4″ are placed at each side of window frames. Windows are without hinges, and are swung in by means of 1″ square sticks from alley. Triangular side pieces attached to window frames prevent side drafts. A piece 1″x2″ is nailed across from one triangular piece to the other to keep window from falling into pen. Window slides up against this piece to roof when cord running over pulley is pulled from alley. Windows are fitted with detachable frames outside covered with 1″ mesh wire.

Sliding doors operated by cords from alley, are under each window.

Pieces of 2″x3″ are spiked across from centre studs to back posts near ground. From heater end of house to the other end each

*For these plans and description the station is indebted to a well-known poultry expert who prefers that his name be not published.

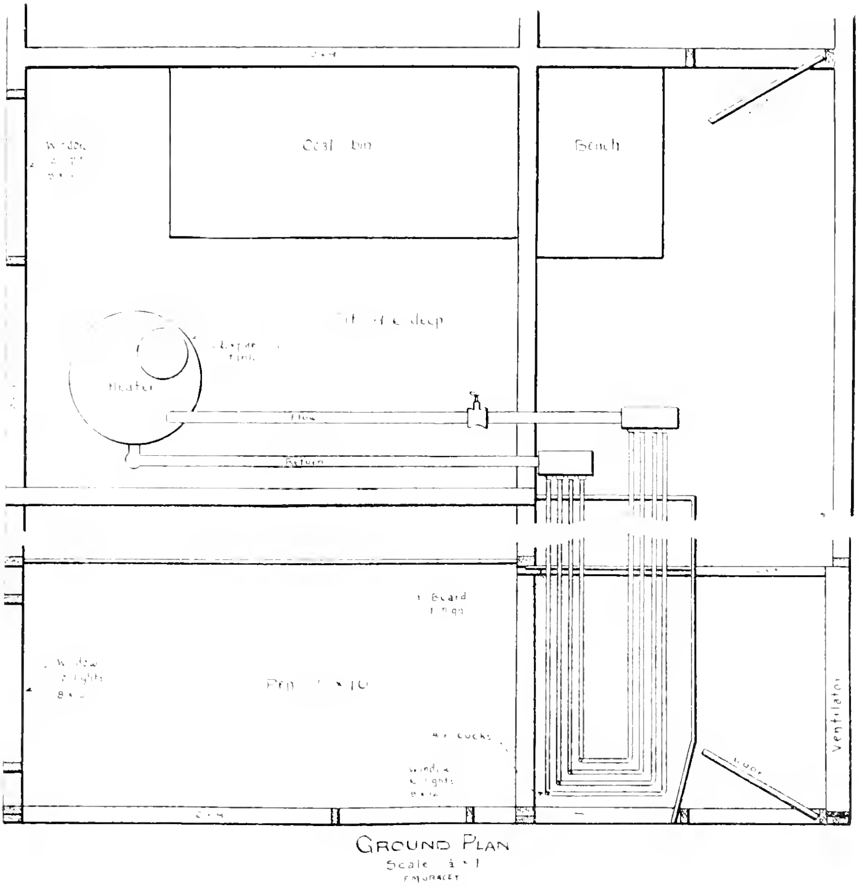


Fig. 8. Plan of Brooder House.

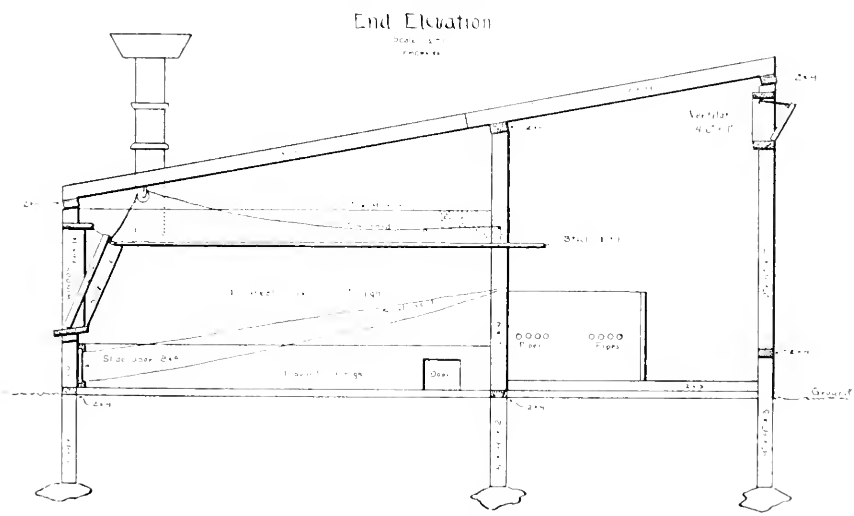


Fig. 9. End Elevation of Brooder House.

2"x3" is ½" higher than the one before it. This gives a pitch of 6" in 60'. Upon each 2"x3" and parallel to it is placed on edge, and nailed to the center stud, a piece of pine board 1' wide and 3'–2" long, lapping 2" on to stud. Against the ends of these boards next the alley long boards 1' wide are nailed at right angles to the 2"x3" pieces. This makes lower portion of wall between pens and alley. Notches are cut in tops of cross boards to receive pipes. After the pipes are in, another set of boards like the others is placed on top of the others, making a tight fence between pens and between pens and alley of a height of 2'–0".

The heater pit is walled with stone and cement, and the floor cemented.

The heater is a Dragon, 17" fire pot, sold by Smith & Thayer Co., Boston, Mass. Pipes running from heater to headers are 2" and brooder pipes are 1". Expansion tank is at top of pipe set in one of top outlets of heater. Top of expansion tank close to roof.

Heater drafts are controlled by electric regulator made by Electric Heat Regulator Co., Minneapolis, Minn. Cost $20 when purchased. Operated by thermostat placed under pipes of first pen. About eight inches of pen is fenced off for this purpose. A second thermostat operates bell in sleeping room of attendant wherever it may be. The first governs the temperature within 2°, while the second rings bell in case of accident to the first, if the temperature runs up or down 7° from normal.

Pens are 5'x10' outside the pipe sections, which are 5'x3'. Pens are separated by boards 1' wide and above that 1" mesh wire 3'–0" wide. Holes are cut through the separating boards by which chicks may be driven from one pen to the next. 1" mesh wire was laid on the ground and nailed to the sills before any of the inside work was started. This is to keep out rats and is buried under the dirt with which pens and alley are filled.

There are 12 pens, the heater pit and a room the size of two pens on the other side of the pit. Doors in both ends of the building.

Chimney is of tile set in galvanized collar on roof.

No hovers are used, the open pipe system being preferred. Hovers were not successful and were discarded.

This house is a successful chicken raiser."

Feeding the Chickens.

A large proportion of the losses in raising chickens is due to improper feeding. At the very outset, many make the mistake of removing the chickens from the incubator and beginning feeding too early. The chickens should remain in the incubator forty-eight hours after hatching. They do not need, nor are they ready to digest food earlier. Many methods of feeding are followed with success. If we investigate, we shall find that all these are alike in the following particulars. The chicks are fed with regularity and the greatest care is taken especially for the first three or four weeks never to overfeed. The chickens should never be allowed to gorge themselves. They should be fed frequently in relatively small amounts and whenever it is found that they are not hungry at meal time it should be recognized that the preceding meal was too heavy. If in any case food is given in excess of such an amount as will be fully consumed within from 15 to 20 minutes, whatever is left should be removed. If this is not done, the chickens get out of condition, lose their appetites, contract diarrhœa and die in large numbers. They should have access at all times to pure water, artificial grit of suitable size and, I believe, also to fine shells and charcoal. They should be kept also under conditions allowing plenty of opportunity for exercise and it is best to force or encourage such exercise by scattering part of their dry grain in light dry and not over coarse litter, such, for example as cut clover rowen.

The Writer's Method of Feeding.

The writer has had excellent success in raising chickens by the following method of feeding. Infertile eggs which have been boiled some 15 or 20 minutes are put through a meat grinder, shells included, in connection with stale bread in the proportion of one part of the egg to four to six parts of the bread. If not well mixed in the grinding, the bread crumbs and ground egg should be more thoroughly mixed by rubbing together. This should make a slightly moist and rather crumbly mass. This is the first feed and is used about three times daily, at first alternating with rolled oats. This feed is used for about two or three weeks, but the proportion is gradually reduced until at the end of the three weeks it is withdrawn altogether. After about three or four days a little hard cracked or broken grain is given. For this purpose both fine cracked corn and steel cut oats are employed. This fine grain is scattered on short cut clover or chaff and usually is given about the middle of the forenoon and the last thing in the afternoon. As the proportion of the boiled egg and stale bread mixture is reduced, a very slightly moistened mash made of a mixture of about equal parts by bulk of corn meal and good clean wheat bran takes its place. When the chicks are about four weeks old, they begin to receive fine beef scraps. These are fed dry and at first in very small amounts. The quantity of scraps is gradually increased and when the chicks reach the age of five or six weeks they may usually with advantage and perfect safety be kept before the birds all the time. When the chickens are some five or six weeks old, the steel cut oats may be discontinued. Satisfactory results may be obtained if cracked corn only is used as a dry grain, but whole wheat may be used occasionally or may be mixed with the cracked corn in moderate proportion if preferred. The chickens will need feeding five times daily for only about three or four weeks. Later than that three feeds daily will suffice. It will be a great advantage if the fowls can be allowed a range in yards furnishing fine sweet grass in abundance.

Maine Experiment Station Methods.

The Maine Experiment Station describes a number of methods with which good results have been obtained. In all of the methods which are described* the mixture of hard fine broken grains referred to is made up of equal parts of cracked corn, cracked wheat, millet seed and pin head oats. This mixture is always fed in the litter, care being taken to limit the quantity so that they shall be hungry at the next meal.

The following descriptions of three different methods are quoted from the bulletin just referred to:

Maine Method No. 2.

" Early in the morning the chicks are given the hard food on the floor litter. * * * * At 9 o'clock they are fed a mixture consisting of 2 parts rolled oats, 2 parts wheat bran, 2 parts corn meal, 1 part sifted beef scrap and one-half part linseed meal. This is given in the plates or troughs and the dishes are removed after 10 minutes use.

At 12.30 the hard grains are fed again and at 4.30 or 5 the dry meal mixture is given to them for half an hour or left until their bed

* Bulletin 144.

time. The meal being dry the chicks cannot eat it as readily as they can the egg and rolled oats, or the moistened mash, and for that reason it is left for them to feed upon longer than when moistened with the egg and water, but is never left before them more than 10 minutes at the 9 o'clock feeding time. The aim is to give them enough at each of the four meals so that their desire for food may be satisfied at the time, but to make sure that they have nothing left to lunch upon. It is desired to have their crops empty of food before feeding them again. When treated in this way they will have sharp appetites when the feeder appears, and come racing out from the brooder to meet him. If they have been overfed at the previous meal, and have lunched along, when they saw fit, they do not care for the feeder's coming. If overfed a few times the creatures become debilitated and worthless.

What has been said so far is with reference to chicks that are hatched out in early spring before the young things can get out of doors for work."

Maine Method No. 3.

"When warm weather comes and the later hatched chicks are able to get out on the ground they find much to amuse them, and they work hard and are able to eat and digest more food. Under these conditions the dry meal mixture described in Method 2 is kept constantly before them in troughs with good results. With two feeds a day of the broken grains in the litter they have hard food enough to insure health and they can safely peck away at the dry meal mixture—a mouthful or two at a time—when they seem to happen to think of it, and thrive. This method has been considerably used in feeding April and May hatched chicks. Many times the results from it have been good. At other times, when the weather was dark and raw out of doors and the little things were held inside, they would hang around the troughs and overeat. They would grow rapidly for a few days, then commence to cripple, eat little, and seek the warm hover never to recover."

Maine Method No. 4.

"This consists in feeding the cracked corn, cracked wheat, pin head oats and millet seed in the litter, four times a day, and keeping a trough of fine beef scrap within their reach all of the time. Sometimes commercial chick foods have been used instead of the cracked corn, wheat, oats and millet. By this system the losses of birds have been small when the feeding has not been so liberal as to clog the appetite. Much care is necessary in adjusting the quantity of food to the needs of the birds.

Other methods of feeding young chicks have been tried and the results watched. Method 1 has been used for several years and no other has been found that gives better growth or less losses of birds. The only objection to it is the labor required in preparing the food and cleaning the dishes after each meal.

In the work at this Station, Method 2 is preferred and used. Many weighings of the birds in comparative pens lead to the belief that the growths are as great under this dry mash system as from the moist mash used in Method 1. The losses of chicks are small by either method. The labor in Method 2 is considerably less than is required in Method 1. Where either Methods 1 or 2 are used, the liability of injury to the chicks is much less than when Methods 3 or 4 are followed."

A Plymouth County Method.

In some parts of Plymouth county, poultry raising is more generally followed than in any other part of the state. The production of broilers and capons are leading features of the industry and such breeds as the White and Barred Plymouth Rock and the Light Brahma are very largely kept. A prominent and highly successful producer gives the following description of the method of feeding the chickens usually followed:

"For the first few weeks we feed a mixture of two parts by measure of coarse bran and one part of corn meal, also feed a little chick food and beef scraps when a few days old with the bran and meal mixture. When three to four weeks old give cracked corn and gradually increase quantity of beef scraps until you keep cracked corn and scraps before them all the time. Also give any and all kinds of vegetables."

The bran and meal mixture referred to is fed dry.

The Surplus Cockerels.

In most lots of chickens raised, the sexes are usually about evenly divided, and there will be a considerable number of cockerels to be disposed of. The separation of these cockerels from the pullets at a relatively early age is advisable. They will thrive better by themselves than if kept with the females. A considerable proportion of the surplus cockerels will usually be sent to market as table fowls. According to conditions, it may prove more profitable either to hold them until they are large enough for roasters or to force them forward as rapidly as possible and to dispose of them as broilers.*

Preparation of the Cockerels for Market as Roasters.

The cockerels should be separated from the pullets at the age of about nine to ten weeks. They will develop best and make the most rapid progress if they can be given a large range on grass land. With such a range, their principal feed may be, first: cracked corn, and later whole corn, but they should have a plentiful supply of beef scraps, which may wisely be kept before them at all times. A few weeks previous to the time when they will be marketed, it will be wise to place the birds in confinement and to give them from half to two-thirds the total amount of food they will consume in the form of a moderately moist mash made up principally of corn meal, with which, however, it may be advisable to mix wheat bran or middlings in the proportion of about one-fourth. During the fattening period, as earlier, the beef scraps should be continued.

Preparing for Marketing Early, Maine System.

The system followed in the Maine Experiment Station and described below has not been tried in Amherst, but is presented on the strength of their approval.†

"When the chickens are about nine or ten weeks old and the cockerels weigh a pound and a quarter to a pound and a half, the cockerels are put by themselves into vacated brooder houses, 100 to a house. Each house has a yard in front, about twelve feet square. They are fed on porridge, three times a day, in V-shaped troughs, with four inch sides. The porridge is made of six parts corn meal, two parts middlings, one-half part linseed meal and two parts beef scrap. Not having milk, it is mixed with tepid water. It is made thick enough so that it will drop and not run, from the end of a wooden spoon. They are given all they will eat in half an hour, when the troughs are removed and cleaned. When the yards get dirty, they are bedded down with sand, straw or hay. The birds will stand this feeding for two or three weeks with

* In some localities it has been found highly profitable to caponize the cockerels and to dispose of them when practically full grown as fancy roasters. This branch of poultry keeping has not been tried at the Experiment Station, and it will not be discussed in this bulletin.

† Bulletin 144.

good appetites. When they commence taking less food they are dressed for market and usually weigh about $2\frac{1}{4}$ pounds dressed weight."

The Management of the Pullets. The objects in view in the management of the pullets after the cockerels have been removed are to promote rapid and healthy growth and development of sound, vigorous birds. To accomplish these results, pure air, exercise and a plentiful supply of nourishing foods are among the most important requisites. A liberal supply of animal food of some sort is essential. The object in feeding should be to promote development of bone and muscle rather than fat.

The Station Plan of Managing Pullets. Owing to the peculiarities of the location of the poultry work in Amherst, it has not been found possible to allow the pullets free range. In its absence, the system of confinement in the open coops described on page 7 has important merits. With this system, the factors named above as essential for the best development may all be realized to the full, except physical exercise, and even in this direction the system is not open to very serious criticism, for the birds confined in small numbers in these open coops (moved daily) take a great deal more exercise than might be anticipated by one without experience in their use. They hunt their comparatively limited territory over with the utmost industry for tidbits of food, consume the grass, chase the insects and scratch for worms and grain concealed in the grass. Undoubtedly, however, the free range should be preferred whenever conditions allow. The labor cost of caring for the fowls is considerably greater in the coop system than with free range.

Good results in development and growth have been obtained in Amherst under the following system of feeding. In the morning, a slightly moist, crumbly mash is given in such quantity as the fowls will consume within about one-half hour.

This is made up as follows:

25 lbs. corn meal
5 lbs. meat scraps
5 lbs. gluten feed
5 lbs. bran
2 lbs. charcoal

At noon and night, cracked corn is scattered in the grass. Artificial grit and shells are kept before the birds all the time.

The Dry Meal (Mash) System. The system of feeding on a mixture of dry meals kept constantly before the fowls has not been tried in Amherst, but it has been followed with favorable results in many places. It clearly has the following distinctive and important merits. It saves labor. It prevents crowding at feeding time and reduces the danger of over-eating. This system is followed in the Maine Experiment Station and is preferred to any other. It is thus described :*

"When the cockerels are taken out for finishing, the pullets of the same age, are moved to the grassy range, still occupying the same portable houses in which they were raised. At this time the method of feeding is changed, and dry food is kept by them constantly, in troughs with slated sides and broad detachable roofs, so it may not be soiled or wasted. The troughs are from 6 to 10 feet long, with the sides 5 inches high. The lath slats are 2 inches apart and the troughs are 16 inches high from floor to roof. The roofs project about 2 inches at the sides and effectually keep out the rain except when high winds prevail.

The roof is easily removed by lifting one end and sliding it endwise on the opposite gable end, on which it rests. The trough can then be filled and the roof drawn back into place without lifting it. This arrangement is the best thus far found for saving food from waste and keeping it in good condition. When dry mash is used in it there may be considerable waste by finer parts being blown away. When used for that purpose it is necessary to put it in a sheltered place out of the high winds.

In separate compartments of the troughs, they are given cracked corn, whole wheat, oats, dry meal mixture, grit, dry cracked bone, oyster shell and charcoal."

The dry meal is a mixture made up as follows: 2 parts good wheat bran and one part each, middlings, corn meal, gluten meal † or brewers' grain, linseed meal, and beef scraps.

"The troughs are located about the field in sufficient numbers to fully accommodate all of the birds.

* Bulletin 144.

† It is doubtful if gluten meal can now be found in the market. Gluten feed is likely to be the best substitute, though much coarser and containing more fiber.

The results of this method of feeding are satisfactory. The labor of feeding is far less than that required by any other method. The birds do not hang around the troughs and over-eat, but help themselves, a little at a time, and range off, hunting, or playing and come back again, when so inclined to the food supply at the troughs. There is no rushing or crowding about the attendant, as is usual at feeding time, where large numbers are kept together.

For the last 8 years the first eggs have been lain when the pullets were from 4 months and 10 days, to 4 months and 20 days old. There is some danger of the pullets getting developed and commencing laying too early for the best results, under this system of feeding. In order to prevent such conditions, the houses should not be located too close to each other, or to the feed troughs, and a large range should be given them so they may be induced to work, which they will do if given the opportunity, early after their removal to the fields. Should the birds show too great precocity, and that they are liable to commence laying in August, the supply of cracked corn and wheat in the feeding trough is reduced, or taken away altogether, which causes them to eat the oats and dry meal instead, and they continue to grow and develop without getting ripe too soon."

Experiments in Egg Production.

During the past thirteen years the Experiment Station has devoted a moderate amount of attention each year to experiments with poultry. These have been designed for the most part to throw light upon the methods of feeding for eggs. A very brief account of the experiments of the preceding year has usually been included in the annual reports published since the experiments began. It is the purpose of this paper to present a brief summary of this work with a view to emphasizing the practical conclusions which the results appear to justify. In presenting this summary, free use is made of the annual reports above referred to and wherever the phraseology used in these reports has seemed best adapted to express the idea in mind, it has been used and without quotation marks.

A general statement of the conditions under which this work has been done will be of interest. The plant which has been available has been a small one. Six houses described and illustrated on pages 15—18 were erected in 1893 and these houses together with an old ice house which has been used for incubators, and a stock of incubators, out-door brooders and coops has comprised the equipment. The poultry plant is located in the immediate vicinity of plots used in field experiments. It has accordingly been necessary to keep the fowls in close confinement practically all the time. In a few instances chickens when ready to leave the brooders have been placed on private farms until they reached laying maturity. Fowls of the following breeds have been used: Light Brahma, Minorca, Barred Plymouth Rock and White Wyandotte. During the greater part of the time, we have used fowls of the last two breeds. In the experimants where the influenee of the treatment adopted on egg production was the object in view, we have usually used pullets of our own raising. In a few instances, we have purchased the fowls used. We have almost invariably placed twenty pullets in each house at the beginning of an experiment and usually have kept with them two cockerels of the same breed. In a few instances, we have used some year old hens on account of not having a sufficient number of pullets. In every instance, the fowls in flocks which were to be compared one with the other were most carefully matched bird by bird as regards all points which could be detected by a very close examination, including the following: weight, size of bone, general conformation, age and degree of maturity. In most cases, the flocks which were to be compared have been fed and treated in every particular alike for a short period previous to the beginning of the experiment, for the purpose of determining whether the conditions as indicated by the number of eggs produced appeared to be equal. In short, no precaution which suggested itself to us as essential to ensure reliable results has ever been neglected.

Connected with the houses and on the south side of them are yards of precisely equal area (87 square yards per house) for each. The soil in these yards has been frequently stirred in order to keep it fresh throughout the summer season. It should be understood that in every case the general conditions essential for egg production have been as good as we could make them. The fowls have been provided with a dust bath. The scratching shed has been kept deeply covered with clean litter. The fowls have always had a plentiful supply of pure water. They have also always had access to shells and grit. Every year before a new lot of fowls has been put into the houses they have undergone a thorough cleaning and disinfection and care has been taken throughout the year to keep both the houses and fowls free from vermin. The latter have in general been healthy, although in a few instances they have suffered somewhat from roup or roupy colds. The doors in the south side of the scratching shed have been kept open winter as well as summer, save when a storm prevailed which drove into it.

The fowls used in these experiments were invariably selected late in the fall, and were usually kept until about the middle of the following autumn. The experiment, while usually of the same nature as affecting any given houses throughout the year, was in most cases divided into two periods, winter and summer, the former usually extending from the time when the experiment was begun, as a rule in December, until early in April; the summer period from that date until sometime in October in most cases. In some of our experiments the egg product has been too small to be satisfactory. This has usually been due to the fact that the pullets were hatched late or were of a late maturing strain, and that the fowls were kept a number of weeks in the autumn after they began to molt, the object of so doing being to observe whether the system of feeding followed affected the molt. When the pullets have been early hatched or of an early maturing strain, and when the experiment had not been continued after the molt began in the autumn, the egg product has been satisfactory, in view of the fact that the fowls are kept in such close confinement.

Methods of Feeding Followed.

Except in those experiments, few in number, where the time of giving the different feeds was the subject of inquiry, the methods of feeding have been as follows: Early in the morning, a slightly moist, crumbly mash is fed. This includes all the ground grains and by-products and the animal food which has been used. In some cases this mash has been mixed with boiling water the evening before. In other cases, it has been mixed with moderately warm water in the morning and immediately given. If the grains in use include small as well as large kinds, the smaller grains have usually been fed for the most part at noon, being scattered in the litter. The larger grains, or in cases where there has been no difference, rather more than one-half the total amount of dry grains fed has been scattered in the litter about an hour before dark. In feeding, we have aimed to give all the food the fowls would consume without loss of appetite and keen relish for their rations, and it has been our intention to keep the litter in the scratching shed sufficiently deep so that the fowls should be busy a considerable share of the time in scratching for their grain.

Subjects Investigated.

The subjects which have engaged our attention during the past thirteen years have been as follows :

I. The effect of condition powder used in accordance with directions furnished by the manufacturers, on egg production ; three experiments.

II. Clover rowen compared with cabbages as a source of the coarser vegetable feed in winter ; one experiment.

III. The influence of the cock on egg production ; two experiments.

IV. Vegetable versus animal albuminoids ; two experiments.

V. Animal meal versus fresh cut bone ; five experiments.

VI. Morning versus evening mash ; two experiments, one in winter and one in summer.

VII. A wide versus a narrow nutritive ratio, which has practically been a comparison of a ration made up largely of corn and corn meal, with one in which wheat, wheat bran, middlings, etc., were prominent ; thirty-six experiments, under variable conditions as regards the following points : nature of the animal food used, the proportion of fat in the ration, and the proportion of fibre.

VIII. A comparison of a ration in which buckwheat is prominent, with one in which corn is prominent ; four experiments.

IX. The effect of fibre in the ration on egg production ; eleven experiments.

Brief reports of the results of these experiments follow. A word of explanation may be necessary in regard to some of the terms used. The number of " hen days " is calculated by multiplying the total number of days through which the experiment extended by the number of fowls at its commencement, and subtracting from the product the number of days lost because of death or removal of fowls. The number of eggs per hen day is obtained by dividing the total number of eggs produced by the number of hen days obtained as above stated. All calculations as to the cost either of feeding the hens or the food cost of the eggs in these experiments are based upon prices current at the time the feeds were purchased. **The nutritive ratio** represents the proportion existing between the nitrogenous compounds of the ration and the non-nitrogenous; or, in other words, the proportion between the protein and the carbohydrates and fat, the latter being converted into an equivalent amount of carbohydrates. The terms "flesh formers" in place of protein, and "heat producers" in place of carbohydrates, have been proposed for popular writings. These terms, however, are not accurate as indicating all the uses which the different constituents of the feeds may serve. Protein may be oxidized in the body as a source of heat, and carbohydrates and fat may undoubtedly be used as sources of body fat as well as sources of heat. These so-called popular terms will not accordingly be used in this paper.

I. The Effect of Condition Powder on Egg Production.

These experiments were continued three successive years, two flocks of fowls being used, both receiving precisely the same kinds and amounts of foods, and one, in addition, condition powder mixed with the morning mash in accordance with directions furnished by the manufacturers. There was no great difference in the number of eggs produced by the fowls under the two systems of management. In two of the three experiments, the fowls receiving no condition powder laid the larger number of eggs. In one of the three experiments, the number was the same under the two systems. At the close of two of the experiments, the average weight of the fowls receiving the condition powder was slightly greater than that of the others. The eggs, also, in two of the experiments, were slightly heavier, a consequence possibly of the fact that the number was smaller. These slight differences in favor of condition powder are not sufficient to offset the cost of the powder used. **These experiments certainly indicate that condition powder used in accordance with directions was not beneficial. It is believed that poultry keepers throw away money expended for it.** Such powder is not essential, and it may be doubted whether it is useful in helping to maintain a condition of vigorous health.

II. Clover Rowen vs. Cabbage for Egg Production in Winter.

The comparison of these two feeds has engaged our attention during only one experiment. The cut clover was fed in the morning mash. In the other house a fresh cabbage was kept before the fowls most of the time. The feeds aside from those which were the subject of experiment were practically alike in kind and quantity in the two houses. In both houses the fowls maintained good health, although one in each died from unknown causes.

The number of eggs laid was as follows: In the cabbage house, 588: in the clover rowen house, 466. Notwithstanding the greater number of eggs laid, the average weight of fowls in the cabbage house slightly exceeded that of the fowls in the other house. The food cost per egg was decidedly less where cabbages were used. The advantage lies most decidedly with the fowls fed cabbages, also in weight of eggs. Samples of the eggs produced by the two systems of feeding were sent to two different housekeepers under numbers. Both were emphatic in the expression of their preference for the eggs from the fowls fed the clover rowen. One reports: the eggs from the clover lot are in every way superior. The other says they are superior in color, size of yolk, and flavor and it is added "they have the finest flavor of any eggs" she ever had. Analysis showed that the eggs from the fowls fed cabbages contained higher percentages of dry matter, protein and fat than the others.* The superior richness of these eggs apparently rendered them strong in flavor. In an abstract of an article in the Reliable Poultry Journal, the Experiment Station Record quotes H. E. Morse as follows: "On the basis of experience the author believes that about one-third of the mash fed poultry should be made of red clover or alfalfa."† Clover is believed to heighten the color of the egg yolk.

The writer is not prepared to fully endorse the statement just quoted, but does most decidedly advocate a rather free use of fine cut clover rowen during the winter. He is not inclined to recommend so large a proportion as one-third in the mash, but would prefer feeding a portion of the clover rowen, previously freshened by sprinkling it with hot water and leaving it a few hours in a covered receptacle, by itself at noon.

---

* We are not justified in concluding on the basis of a single experiment that the difference in composition found was due to the variation in food. It may have been accidental.

† Reliable Poultry Journal No. 11, pages 1038 and 1039. Experiment Station Record XV, page 712.

III. The Influence of the Cock on Egg Production.

At the close of one of our winter experiments, the hens used in four of the houses were matched in such a manner as to equalize previous food conditions in four lots of sixteen hens each. These were put upon the same feed and a vigorous White Leghorn cock was placed in two of the coops. The experiment was therefore carried out in duplicate. The difference in the number of eggs produced in both experiments was small. In one case the hens without a cock laid a few more eggs. In the other the difference was in the opposite direction. In view of this fact and because moreover the differences were at best slight, the experiment indicates that the presence of the cock was without influence on the number of eggs produced.

In one particular, however, there was agreement in the results of the two experiments, namely: the average weight of the eggs from the hens with which a male was kept was slightly the greater in both trials. It seems likely that this effect may be due to the fact that the eggs had been fertilized. This difference would, of course, be entirely without significance to the producer of eggs for market or for table use.

IV. Vegetable vs. Animal Albuminoids.

Two experiments to test the relative value as influencing egg production of vegetable and animal substances as a source of a considerable share of the albuminoids in a ration have been carried out. One extended from December 9th to February 12th, the other from June 1st to October 31st. The first experiment began when the fowls were pullets; the second included a considerable proportion of the time occupied in the annual molt. The material used in the first experiment to furnish the vegetable substitute for animal food was soy bean meal. This is an exceptionally rich vegetable substance containing practically the same amount of protein and about double the percentage of fat contained in meat meal. The exact composition is shown in the table.

COMPOSITION OF DRY MATTER. (PER CENT.)

	Protein.	Fat.	Carbohydrates.
Soy bean meal	34.37	16.38	45.22
Meat meal	35.98	8.31	– –

In the condition in which they were fed, the soy bean meal contained 11.61 per cent of water, the meat meal 13.68 per cent.

In the second experiment linseed and cotton seed meals in equal quantities were used as the vegetable substitute for animal foods.

In both experiments the fowls received a variety of foods, but the nutritive ratio was kept substantially the same for the two pens of fowls under comparison. In the first experiment the nutritive ratio was 1 to $4\frac{1}{2}$, in the second experiment it was 1 to 4.7. The result in both experiments was decidedly in favor of the animal food. The fowls receiving this food produced many more eggs than those receiving vegetable food and at the close of the experiment were in much better condition than the latter.

W. P. Wheeler* has carried out similar experiments and reports as follows: Rations were compared "which contained practically the same proportions of the ordinarily considered groups of nutrients, but different amounts of mineral matter," the one being wholly vegetable, and the other, with the higher ash, containing some form of animal food. "For laying hens the rations containing animal food proved superior to others in which all the organic matter was derived from vegetable sources. The vegetable food ration, supplemented by bone ash proved equally efficient for limited periods * * * * It appears also that while a cheaper vegetable food ration can sometimes be made to equal or surpass in efficiency a ration containing animal food by supplementing it with suitable mineral matter, there are plain limitations to its economical use. For laying hens, some animal food appears necessary for continued good results."

Judging from our own results and from those obtained by Wheeler, it seems safe to conclude that animal albuminoids as measured by production possess a much higher degree of efficiency than those derived from vegetable materials.

V. Animal Meal vs. Cut Bone for Egg Production.

Four of the five experiments comparing these two sources of animal food were carried out during the winter periods, one in summer. The rations fed with minor variations essential in order to secure the same nutritive ratio for the two lots of fowls compared were in general similar. The nutritive ratio varied in different experiments from 1 to 3.9, to 1 to 5. The health of the fowls receiving

* New York State Experiment Station Bulletin 171.

the animal meal was excellent in all the experiments, but in the pens of fowls receiving cut fresh bone, there were numerous cases of diarrhea and bowel trouble, eight deaths in all occurring during the course of the experiments. Five of these were undoubtedly due to the feed. But one death occurred in the pens where animal meal was used and it was not believed that this was due to the feed. The disturbances of digestion among the fowls receiving the cut fresh bone were apparently due to the fact that in spite of precautions to secure an even distribution of this highly relished article of food, some fowls occasionally secured much more than their proper share. The cut bone was in some experiments fed by itself: in others it was mixed with the mash and it appeared to be a safer feed when given in that way than when fed by itself. The weights of the fowls were taken at intervals during the course of the last two experiments and it was found that the hens fed the green cut bone averaged about half a pound heavier than the others.

Eggs were produced at the following rates per hundred fowls daily in the different experiments:

	Animal Meal	Cut Bone.
Number 1,	22.2	21.2
" 2,	18.1	21.5
" 3,	9.7	17.8
" 4,	26.0	22.0
" 5,	32.0	31.0

The summer experiment was number two. The egg product in all these experiments is relatively low. In three of the five experiments, the fowls receiving animal meal laid the greater number of eggs. Should allowance be made for the cost of labor in cutting the bone, the food cost of the eggs produced where this feed is used was considerably greater than where animal meal was used in all our experiments.

The West Virginia Experiment Station has carried out similar experiments. Messrs. Stewart and Atwood* report in substance as follows.

In the earlier of these two bulletins reporting on meat meal compared with ground fresh meat and bone, they say: "The fowls fed ground fresh meat and bone laid more and larger eggs, increased more in weight and were healthier during the experiment than the fowls receiving meat meal."

* West Virginia Agricultural Experiment Station Bulletins 71 and 82.

In the later bulletin reporting on the use of beef scraps as compared with ground fresh meat and bone and milk albumen as sources of protein for laying hens, the following summary is given: "More eggs were laid by fowls when fed beef scraps than when they received either ground fresh meat and bone or milk albumen. The health of the fowls remained uniformly good throughout the test." * * *

Stewart & Atwood† report the results of a comparison of beef scraps, ground fresh meat and bone and milk albumen as sources of protein for laying hens. There were two trials. More eggs were laid by the fowls when fed beef scraps than when they received either ground fresh meat and bone or milk albumen. In an earlier trial in the West Virginia Experiment Station, in which ground fresh meat and bone were compared with meat meal, the former gave the greater number of eggs, but the meat meal was evidently of very inferior quality. The fowls receiving it were made sick and a number died.

It will be noted that the results of the different West Virginia experiments were not in exact agreement. The same is true concerning our own experiments. Two gave results slightly favorable to the bone in number of eggs: one a similar result in favor of the animal meal and two—these having been the ones most perfectly carried out—gave results decidedly favorable to the animal meal. We found the latter, as stated, to be the safer feed. In one respect only was the animal meal apparently inferior to the bone, namely: the fowls getting it weighed less at the close of the experiment. This inferiority in weight was, however, far more than covered in our best experiments by the greater value of eggs produced. **The writer believes the following conclusion is warranted. Some form of dry animal food is likely to prove a safer and more satisfactory food for egg production and to be cheaper than cut fresh bone.**

VI. Morning vs. Evening Mash.

The object in view in these experiments, one of which was carried out in the winter and the other in the summer was to test the relative merits of feeding the mash in the ration in the morning as compared with feeding it in the evening. The feeds used in the two pens of fowls were of the same kinds and it was the object aimed at to give to each lot of fowls as much food as would be readily consumed. The

† West Virginia Agricultural Experiment Station Bulletin 83.

morning mash was always given as soon after light as possible, the evening mash just before dark. About twice a week a small cabbage was given to each lot of fowls in addition to customary grain and animal foods. The health of the fowls under both systems of feeding was in general good, although there were a few losses, two on the morning mash ; three on the evening mash. These losses were apparently not connected with the system of feeding followed. The dry grains used in these experiments included corn, wheat and millet in the winter test: corn and oats in the summer test. The mash in the winter test was made up in the proportion of about one part cut clover rowen, two parts each bran and beef scraps and three parts corn meal. In the summer test the proportions were about one part beef scraps and one and a half parts each wheat bran, middlings and corn meal. During the summer test, lawn clippings replaced the cut clover rowen and cabbages used in the winter.

Eggs were produced at the following rates per hundred hens daily :

	Morning Mash.	Evening Mash.
In the winter test,	25	24
" " summer, test,	34	33

The differences are too small to be regarded as significant. One of the most striking results of the experiments was the great difference in the relative amounts of droppings voided during the night under the two systems of feeding. The amount of droppings voided during the night by the fowls receiving the evening mash was very much greater than the amount voided by the other lot of fowls. Weights were taken on a number of different occasions with the results shown below.

DATES.	Number of Days Droppings.	Morning Mash.		Evening Mash.	
		Number of Hen Nights.	Weight of Droppings. (pounds)	Number of Hen Nights.	Weight of Droppings. (pounds)
March 3,	1	22	3.00	21	6.00
March 5,	2	44	5.25	42	11.00
March 7,	2	44	5.25	42	10.50
March 10,	1	22	2.50	21	6.25
March 21,	1	22	2.50	19	4.50

It will be noticed that the weight of droppings voided during the night by the fowls receiving evening mash during the period of nearly seven days and nights during which these weights were taken is practically double the weight of the droppings of the other fowls.

The fact thus brought out is of much interest. It furnishes conclusive evidence that the digestive process in the case of a soft food like a mash is very rapid. The fact that digestion among birds is relatively much more rapid than with most classes of animals has been frequently pointed out. Forbush in his paper in the report of the Secretary of the State Board of Agriculture for 1899 gives valuable data bearing upon this subject concerning a number of smaller birds and crows. Our experiments indicate that the ordinary domestic fowl digests soft foods with great rapidity. There has long been a general impression that it is better to give the more solid food at night, especially during the winter, since it will "stay by" the fowls better. Our experiments indicate that this impression is well founded and that the usual practice is correct, but they cannot be considered to prove these points because, of course, it may be that a period of comparative rest for the digestive organs during the night is better than the condition of more continuous work for these organs which would follow the use of solid food at night.

We have not obtained a sufficient difference in egg production to be considered significant, but it is believed that the experiment so far as it goes indicates that it is better that the mash should be fed in the morning. If given in too large quantities the fowls become inactive and remain comparatively inactive during a considerable part of the forenoon, whereas if they be given whole grain for which they are required to scratch, they are of necessity more active. The results obtained in our experiments cannot be regarded as decisive, and Stewart and Atwood of the West Virginia Experiment Station*, report similar results, the egg production under the two systems being practically the same. The writer's preference, however, is to give the mash in the morning.

VII. WIDE VS. NARROW RATION FOR EGG PRODUCTION.

During the past ten years 36 different experiments have been carried out allowing a comparison of results on combinations of feeds with relatively wide and narrow nutritive ratios. The leading idea in these experiments has been to throw light upon the general question as to the extent to which corn may wisely and safely be used as the principal grain for laying hens. The rations into which corn has entered largely have had a relatively wide nutritive ratio. The grain most largely used in comparison with the corn has been wheat

* West Virginia Agricultural Experiment Station Bulletin 83.

and the rations into which wheat has largely entered have had relatively narrow nutritive ratios. In the 36 different experiments, the so-called narrow nutritive ratios, (wheat rations) have varied from 1 to 3.44 to 1 to 5.30 and have averaged 1 to 4.41; the so-called wide ratios have varied from 1 to 4.15 to 1 to 6.69 and have averaged 1 to 5.97. Corn is usually much lower in price in the grain markets of Massachusetts than wheat. Corn, moreover, is a grain which can easily be raised upon the farm. It is well suited to our soils and climates. Wheat, on the other hand, does not do very well in most parts of this state. The comparisons above referred to, therefore, seem to be likely to prove of much interest to poultry keepers in this section.

The grains above referred to have been used in our different experiments in a wide number of different combinations. In some of our experiments the only whole grains used have been corn and wheat. In the majority of the experiments, however, other grains have been used, but in all cases, the ration with a wide nutritive ratio has included a large proportion of corn and corn meal and the rations with a narrow nutritive ratio have always included a large proportion of wheat and wheat by-products such as bran and middlings. In the different experiments various forms of animal food have been used and in quite widely different proportions. The animal foods employed have been milk albumen, beef scraps and animal meal. In one set of experiments both beef scraps and milk albumen have been used in the proportion of four parts of the former to three of the latter. One half of the experiments have been carried out in the winter, the other half in summer.

The results have not been uniformly in favor either of the wide or narrow nutritive ratio. Indeed, the number of experiments favorable to each has been nearly equal. These results may be summarized as follows:

1. With animal meal as the source of animal food, 12 experiments: eight favorable to the wide nutritive ratio in number of eggs produced; one with number of eggs equal on the two rations: three in favor of the narrow nutritive ratio.

2. With beef scraps as a source of animal food, 7 experiments: one favorable to the wide nutritive ratio: six favorable to the narrow.

3. With beef scraps as a source of animal food and with corn oil mixed with the meals in the two rations in such quantities as to equalize the amount of fat furnished by each, 6 experiments: five favorable to the wide nutritive ratio: one to the narrow nutritive ratio.

4. With milk albumen as the source of animal food, 2 experiments: both favorable to the wide nutritive ratio.

5. With milk albumen as the source of the animal food and with corn oil added to the meals used in the mash in moderate quantities, 3 experiments: one favorable to the wide nutritive ratio; two favorable to the narrow.

6. With beef scraps and milk albumen both, in the proportion of four to three, as animal food, 6 experiments: one favorable to the wide nutritive ratio; five favorable to the narrow nutritive ratio.

Summing up these results, we find the wide nutritive ratio has given the greater number of eggs in eighteen out of the thirty-six experiments, an equal number in one. The narrow nutritive ratio has given the greater number of eggs in seventeen experiments.

Number of Eggs Per 100 Hens.

The number of eggs produced daily has been at the following rates per 100 hens:

1. For the narrow nutritive ratio, from 11 to 60, the average being $35\frac{1}{3}$.

2. For the wide nutritive ratio, from 18 to 54, the average being $36\frac{3}{4}$.

Food Cost of the Eggs.

For the narrow nutritive ratio the food cost per egg has been from .6 to 2.4 cents, the average being 1.05 cents: for the wide nutritive ratio, from .39 to 1.4 cents, the average being .83 cents.

Cost of Feeding Hens.

The cost of the food per single hen daily has been as follows: for the narrow nutritive ratio, from .22 to .47 cents, average of 36 experiments, .32 cents; for the wide nutritive ratio, .16 to .43 cents, average of 36 experiments, .27 cents.

Effect of the Rations on Health.

The health of the fowls used in these experiments has been in general good, although in one of the experiments, the one with the smallest egg yield shown, there was considerable trouble from roup. As is always the case, there have been some losses by death. The total numbers thus lost have been; on the wide nutritive ratio, 24; on the narrow nutritive ratio, 20. In some cases it was quite apparent that the death of the fowls was due to digestive disturbances, but that it was due to such causes was by no means certain in all cases.

These results do not indicate any considerable difference in the safety of the two systems of feeding. It has been noticed, however, throughout the continuance of these experiments that the ration with large proportion of corn must be handled with greater care not to over-feed than was necessary with the other ration. Corn is the heavier and heartier feed and the fowls receiving the rations with a large amount of corn more frequently suffered from temporary loss of appetite than the others.

Effect of the Rations on the Weight of the Fowls.

In the great majority of experiments, the fowls receiving the rations rich in corn weighed more throughout the entire period of the experiments and at the close than those receiving the rations richer in wheat. This excess in weight usually amounted to from about 1/3 to 1/2 pound per fowl. In a number of instances, the fowls were dressed at the conclusion of the experiment and the judgment of an expert obtained. The fowls receiving the corn were as a rule pronounced to be superior to the others. They were not only fatter, but had better color.

Molt.

In a considerable number of our experiments, careful observations were taken on the molt. In the majority of instances, where such observations were made, it was found that the fowls receiving more corn molted somewhat earlier than the others. This difference would of course be important only in those cases where the fowls were to be kept a second year. It has not been our policy to follow that course.

Amount of Fat in the Ration Apparently Influences the Results.

It is by no means clear why the results in these experiments have not been more uniformly favorable either to the wide or to the narrow nutritive ratio, but these results make it apparent that the proportion of fat in the combination of foods used exercises a considerable influence on the results. While there are exceptions, it has usually been found that if the proportion of fat in the ration was relatively high and equalized for the two under comparison, the wide nutritive ratio has given the greater number of eggs.

Summary.

It cannot be claimed that these experiments demonstrate superiority either of the wide (corn) or the narrow nutritive ratio (wheat).* The rations containing the more corn, however, surpass those containing the more wheat in each of the following particulars:

*Dr. J. B. Lindsey, to whom the writer is under obligations for a number of valuable suggestions and criticisms, expresses the belief that the results would have been more decisive had the differences in the nutritive ratios compared been made greater.

1. The corn rations have given the greater number of eggs in more than one-half the experiments.

2. The average number of eggs per hundred hens daily has been for the wheat rations, 35 1/3, for the corn rations, 36 3/4.

3. The food cost per egg as the average of 36 experiments has been for the wheat rations, 1.05 cents, for the corn rations, .83 cents.

4. The average cost of feeding 100 hens daily has been for the wheat rations, 32 cents, for the corn rations, 27 cents.

5. Fowls receiving corn rations have attained and maintained a higher average weight. Their market value at the conclusion of the experiments, therefore, has been greater than that of the fowls fed on the wheat rations.

6. Fowls receiving the corn rations have on the average molted somewhat earlier and better than those receiving the wheat rations.

Results of Other Investigators.

Wheeler* in comparing a corn meal ration with a nitrogenous ration reports the following results: "The product of eggs from the hens having the corn meal ration was over 28 per cent more in number, and in weight over 24 per cent greater than from those having the more nitrogenous ration. With fowls of the smaller breeds which are considerably better layers, the number of eggs was over 57 per cent higher, and the weight about 49 per cent greater from those fed the less nitrogenous ration." He reports that the health of the fowls was rather better on the more nitrogenous ration.

Rice† summarizes results obtained in comparing a nitrogenous (narrow) with a carbonaceous (wide) ration as follows: "It will be seen that while both lots of hens lost weight during the experiment, the loss was slightly greater with those fed nitrogenous food, but these produced by far the most eggs. The chickens fed nitrogenous food just about doubled in weight while those fed carbonaceous food only added about one-third to their weight." The rations above compared had nutritive ratios of 1 to 3.1 and 1 to 7.8 respectively, the latter consisting almost entirely of corn meal. This experiment was carried on with but two pens of five fowls each, for the test of egg production. The number of chickens compared was the same. The feeds used in the above experiment were as follows: for the narrow ration, one-third wheat bran, one-third wheat shorts, one-third cotten seed meal, two parts skim milk; for the wide ration, cracked corn and corn meal dough.

*New York Station Bulletin 129. New Series.
†New York Cornell Station Bulletin No. 25.

Stewart & Atwood* report results comparing a ration made up of a mixture of grains with one in which corn meal was the principal constituent. The fowls fed the nitrogenous (narrow) ration produced 79 per cent more eggs of a value 64 per cent greater than the other lot. In these experiments the fowls receiving the nitrogenous ration received ground fresh meat and bone, while the other fowls had no animal food. A second test gave results in accord with the first.

Dryden† in comparing wheat with corn reports results in favor of the wheat ration both in number of eggs produced and in cost. In these experiments, dried blood was used as animal food, but not in equal quantities for the two lots of fowls under comparison.

Taylor‡ reports a trial of narrow, medium and wide rations for laying fowls, showing the egg production to be larger in proportion as the ratio is narrow. The highest egg yield was obtained upon a narrow ration, while the medium ration ranked next. In these trials the amount of animal food given was greater the narrower the ration.

In view of the frequently demonstrated superiority of animal substances over vegetable substances as a source of protein, the writer is not surprised that in the experiments at Cornell, in West Virginia and in Utah, the fowls receiving a narrow ration produced the more eggs, for in all these cases these fowls received a generous supply of animal food, while the fowls on the wider ration either received no animal food or received it in smaller quantity than the other fowls.

Conclusion. The writer believes that the results of his experiments justify the conclusion that corn and corn meal may safely and wisely be made very prominent in the rations of laying hens. It is necessary, however, to use in connection with these feeds a liberal amount of animal food of some sort. The results obtained in the other stations above referred to are sufficiently accounted for by the fact that the corn ration was not supplemented with animal food. With a suitable quantity of animal food, it is possible to produce very satisfactory yields of eggs where corn and corn meal comprise the greater part of the grain fed. One of the most satisfactory rations used was made up as follows:

*West Virginia Station Bulletin No. 60.
†Utah Experiment Station Bulletin No. 67.
‡Rhode Island Agricultural Experiment Station Report 1901.

Corn	50	pounds
Barley	10	"
Alfalfa meal	4.	"
Corn meal	28	"
Flour middlings	2	"
Beef scraps	7	"
Hominy	10	"

VIII. BUCKWHEAT VS. CORN FOR EGG PRODUCTION.

Four experiments comparing rations in which respectively buckwheat and corn was prominent have been carried out, two in winter and two in summer. In these experiments animal meal was used in fairly liberal amounts as a source of animal food. in two of the experiments, and milk albumen in similar amounts in two. The nutritive ratio was in all cases about 1 to 6.

The number of eggs produced in the different experiments was at the following rates per hundred hens daily:

No.	1,	buckwheat	23;	corn	18.
"	2,	"	26;	"	42.
"	3,	"	18;	"	28.
"	4,	"	27;	"	30.

At the close of the experiments, it was found that the corn fed fowls were decidedly heavier than those which had received buckwheat. The average difference the first year was about .6 pounds per fowl, the second year one-half pound. When dressed by a local marketmen, the corn fed fowls were declared to be worth a cent a pound more than the others.

The cost of feeding the fowls was less on the rations containing corn except in one instance and the cost of food per egg was less in every case. The advantages, therefore, are decidedly with the corn ration. It seems not unlikely in view of the results of other experiments which will be considered, that the inferiority of the buckwheat is due to the fact that it contains more fibre than the corn.

IX. THE EFFECT OF FIBRE IN THE RATION ON EGG PRODUCTION.

The experiments comparing a relatively narrow with a wider nutritive ratio, as will be noted from the report concerning them, have not been entirely consistent in results. In these experiments the relative proportions of fibre in the two rations which were greatly varied in make-up, as has been stated, was not always the same and a close study of the results led to the belief that the presence of large amounts of crude fibre in a ration was distinctly unfavorable to egg production. This conclusion seemed the more reasonable in view of the fact that other investigators have found that fowls have little capacity to digest fibre.

W. von Knieriem* reports coefficients of digestibility for crude fibre by fowls to be as follows: for rye, 2.4 per cent; oats, .5 per cent; barley, .2 per cent. (Experiment Station Record XIII, p. 179).

I. Kalugine† in reporting on the digestibility of certain foods by hens states that these fowls digest crude fibre less completely than either horses or swine and reports the following percentages: (Experiment Station Record VIII, p. 915).

Peas,	13.74
Buckwheat,	2.02
Wheat,	29.95

F. Lehmann‡ reporting on experiments in feeding peas and wheat to poultry states that they digest no crude fibre.

Wheeler** makes the following comment on Lehmann's results:

"It will be observed that fibre proved indigestible. Should further experiments fully substantiate the practical indigestibility of fibre by poultry, the percentage of it contained in feeding stuffs may be considered immaterial so far as nutritive value is concerned."

The Station has carried through eleven experiments comparing rations having respectively relatively high and low proportions of fibre. In six of these experiments, the nutritive ratio has been practically identical in the two rations compared, about 1 to 6. In three of the rations, the high fibre combination of foods had a nutritive ratio of about 1 to 4.3, the low fibre combination of foods a nutritive ratio of about 1 to 6.3. In most of these experiments barley and oats have been used freely in the high fibre rations. Buckwheat and millet have also been used in some of them. In the low fibre rations, corn and broken rice have been employed. In five of these experiments milk albumen has been the source of animal food: in six beef scraps.

On the high fibre rations the egg production has been as follows per hundred hens daily: lowest number in any experiment, 18; highest 42; average 32.1. On the low fibre ration, the egg production has been as follows per hundred hens daily: lowest number in any experiment 29; highest 46; average 37.4. The results have

* Landw. Jahrb., 29, (1900), No. 3. pp. 483-523.

† Zapiski Novo-Aleksandriiskago instituta Selvskago Khozyaistva i Lyesovodstva, 9 (1896), III, pp. 217-257.

‡ Landw. Vers. Sta. 21, p. 411.

** R. I. Station Bulletin 84, p. 156.

been decidedly favorable to the low fibre ration in every experiment except one, in which the egg production per hundred hens daily was for the high fibre 31, for the low fibre 30, or substantially equal production.

The broken rice used in these experiments commands too high a price to make its use as a poultry food economically advisable. It was employed in these experiments because it contained a lower percentage of fibre than any other obtainable grain.

The writer believes that the results of these experiments justify the conclusion that it is a mistake to use grains or foods exceptionally rich in fibre, especially if the fibre is of a tough texture, in combinations of foods for poultry and he would accordingly advise against any considerable proportion of such grains as oats, barley or buckwheat in feeding laying fowls.

Summary of Conclusions.

Apparently Justified by Results of Station Experiments.

1. The regular use of Condition Powder as advised by manufacturers means money practically thrown away. Such use will not be likely to increase the egg product and is unnecessary as a means of insuring health.

2. Cabbages given in moderation are superior to cut clover rowen as winter food. Their use means more eggs, but if the amount given is large, the flavor of the eggs is injuriously affected.

3. The number of eggs produced is not affected by the presence of the male: but the average weight of the egg is increased.

4. Animal substances are much more valuable as sources of protein in feeding fowls than vegetable substances, even though the latter contain equal percentages of that nutrient. Concentrated vegetable foods such as soy bean meal, linseed meal, gluten meals, etc. should not be used to replace all or even a very large part of animal foods, such as meat or animal meals, beef scraps, cut bone and meat, etc.

5. The dry, prepared animal foods such as beef scraps and animal or meat meals if of good quality are cheaper and safer feeds than cut fresh meat and bone and can be so used as to produce an equal egg yield.

6. Feeding the mash in the morning, with care not to give too large a quantity, is preferable to feeding it at night. The differences in egg yield on the two systems are small, but giving the mash at night especially in winter must mean empty crops and gizzards long before morning.

7. Corn may safely be largely used in rations for laying hens, but its use requires unusual care not to over-feed for best results, and it must be supplemented by a liberal proportion of animal food. With such care and so supplemented, the use chiefly of corn, whole or cracked, and corn meal rather than much wheat and wheat or corn by-products is attended with the following advantages: lower food cost both per day and per egg, rather more eggs, higher average weight of fowls and better market quality when dressed and an earlier and better molt.

8. Buckwheat in any large proportion is a less desirable food for laying fowls than corn.

9. It is not best to use largely grains or meals carrying hard tough fibre in large proportion. Under otherwise similar conditions the less such fibre in the ration, the better will be the egg product. Oats, barley, buckwheat and by-products containing the husks of these grains should be sparingly used.

Feeding for Eggs.

The following combinations of feeds are suggested as likely to produce satisfactory egg yields if judiciously handled. These suggestions are based upon results of some of our most satisfactory feeding experiments. Each combination will supply approximately the amount of food which will be needed by a flock of twenty-two fowls for one month. As has been pointed out, the Station has not experimented to any extent with the dry meal method of feeding. The foods in the combinations which follow which are connected by the bracket have been mixed when weighed out and have been made into a slightly moist crumbly mash in the quantity needed from day to day. It has been our practice also to mix 1½ to 2 pounds of powdered charcoal with the other materials which enter into the mash.

1.

50 lbs. corn,
14 lbs. oats or barley,
10 lbs. wheat bran,
5 lbs. middlings,
25 lbs. corn meal,
8 lbs. beef scraps,
10 lbs. cut clover.

2.

50 lbs. corn,
14 lbs. oats or barley,
10 lbs. wheat bran,
4 lbs. flour middlings,
28 lbs. corn meal,
7 lbs. animal meal,
10 lbs. cut clover.

3.

50 lbs. corn,
10 lbs. wheat,
28 lbs. corn meal,
2 lbs. flour middlings,
10 lbs. hominy,
7 lbs. beef scraps,
10 lbs. cut clover.

4.

50 lbs. corn,
10 lbs. wheat,
25 lbs. corn meal,
10 lbs. wheat bran,
5 lbs. middlings,
4 lbs. alfalfa meal,
7 lbs. beef scraps.

Method of Handling these Feeds. It is the writer's preference to feed the mash in the morning and it should be given in such quantity as the fowls will completely consume within from about 20 to 30 minutes. At the time of mixing the mash is usually slightly salted. At noon about one half the total quantity of dry grain is fed. The writer now prefers to feed cut clover when that is used at the same time. This is prepared for use by dampening slightly with hot water and leaving in a covered vessel for a few hours. The other half of the grain is fed about an hour before sunset. The amount of grain furnished by these combinations is expected to be sufficient so that there is likely always to be some scattered grain in the litter. The fowls if fed properly under these conditions begin scratching for grain within a short time after receiving the morning mash. Artificial grit, oyster shells and dry cracked bone should be kept before the fowls all the time and a supply of charcoal in granular form may also be useful as a corrective. Pure water is of course supplied in abundance.

In addition to the foods furnished by these combinations, it will be wise to supply vegetable food in moderate quantity. Loose heads of cabbage, mangolds, or table beets which are too coarse for market are suitable. The condition of the fowls, however, must be closely observed as all these vegetables are laxative and if too freely given will cause diarrhea. In place of such vegetables it is good practice during the summer season to feed fine grass or clover or Dwarf Essex rape which is highly relished. Lawn clippings are also good. Care must be taken in feeding rape as in the case of cabbages and mangolds and for the same reason.* It should be the object in feeding a flock of laying hens to supply all the food in considerable variety which they will consume with good appetite. At the first evidence that the appetite is flagging, the quantity of food should be reduced.

The results obtained in the Maine Experiment Station in feeding for eggs have certainly been highly satisfactory and the writer is glad to present a description of the method of feeding now followed*. There is abundant evidence to show that very satisfactory egg yields can be obtained by the dry system of feeding. The method certainly reduces the labor of caring for the fowls greatly. There is evidence

* In the Maine station alfalfa and clover are found the most satisfactory green feeds for summer. The free use of rape is believed to make the yolks of the eggs greenish when boiled.

* Maine Experiment Station Bulletin 144.

which indicates that the dry feed is not equally as palatable as the properly mixed moist mash and some parties who have compared the two methods have reported the fowls lay rather more eggs when receiving the mash, but such parties have at the same time indicated their belief in the dry meal system on account of the reduced labor. The two systems are now under comparison in the Experiment Station at Amherst, but the experiment is not sufficiently advanced to justify comment based upon our results.

Maine Method of Feeding.

"Early in the morning for each 100 hens, 4 quarts of screened cracked corn* are scattered on the litter, which is 6 or 8 inches deep on the floor. This is not mixed into the litter, for the straw is dry and light and enough of the grain is hidden so the birds commence scratching for it almost immediately. At 10 o'clock they are fed in the same way, 2 quarts of wheat and 2 quarts of oats. This is all of the regular feeding that is done.

Along one side of the room is the feed trough, with its slatted front. In it is kept a supply of dry meals mixed together. This dry meal mixture is composed of the following materials. 200 pounds good wheat bran, 100 pounds corn meal, 100 pounds middlings, 100 pounds gluten meal or brewers' grain, 100 pounds linseed meal, and 100 pounds beef scrap. * * * About 5 pounds of clover hay cut into ½-inch lengths is fed dry daily to each 100 birds in winter." * *

"The average amounts of the materials eaten by each hen during the last year are about as follows:

Grain and the meal mixture,	90.0 pounds.
Oyster shell,	4.0 pounds.
Dry cracked bone,	2.4 pounds.
Grit,	2.0 pounds.
Charcoal,	2.4 pounds.
Clover,	10.0 pounds.

These materials cost about $1.45.

The hens averaged laying 144 eggs each."

* "Whole corn will be used hereafter at the Station. See comparison of whole corn and cracked corn on pages 180 and following."

General Care.

Cleanliness and Care of Droppings. Poultry houses must be kept clean if the best results are to be obtained. The dropping board beneath the roost seems desirable both because it facilitates keeping the house clean and because the droppings, which constitute a valuable fertilizer, can be better saved than in its absence. The droppings should be frequently removed. In summer daily removal or at the very least semi-weekly removal is important. In winter when fermentation and heating are not likely to follow, the droppings may safely be allowed to accumulate for a week.* In order that the droppings may not deteriorate in fertilizer value, they should be kept under cover and loss is most effectively prevented if with each addition of new material it be sprinkled with a chemical preservative such as kainit or acid phosphate. It is the writer's preference to cover the dropping boards when cleaned with dry dust-like earth. This being mixed with the droppings when they are removed helps to prevent loss of valuable elements and to maintain a desirable physical condition. The Maine Experiment Station reports good results from the use of dry sawdust in connection with a chemical preservative.

The Litter. The floor of the poultry house whenever the fowls are kept in close confinement should be kept covered with dry litter some seven or eight inches in depth. For this purpose bright well cured straw either of oats or the Japanese Barnyard millet will be found particularly satisfactory, although other kinds of straw may be used. Such straw should be cut into six to eight inch lengths. As the hens live on the straw and scratch it over, it is of course soiled and gradually broken up. About once a week the portion which is still coarse and clean should be moved to one side and the finer portion underneath removed. At the same time fresh straw should be added to make good the loss.

The Dust Bath. Of great value in enabling the fowls to rid themselves of vermin is a suitable dust bath. To hold the material required for such a bath a shallow box or a depression in the floor so placed that the sun will

* This advice is intended for open front houses. For closed houses the droppings should be removed daily in order to avoid foul air.

shine upon it during some part of the forenoon is desirable. Fine dust-like earth as dry as possible is fairly satisfactory material, but its efficacy is undoubtedly somewhat enhanced by mixing with it a moderate amount of some such material as land plaster or acid phosphate. To prevent the material in the dust bath being covered with straw and thus rendered inaccessible, it should be protected by a board about a foot in height. The fowls will readily learn to fly over this board into the bath when it is needed.

Vermin.

In spite of every precaution to prevent, there is usually some trouble with lice of different kinds. Some of these multiply on the woodwork of the house, roosts, walls, etc. To destroy these, it is advisable to use kerosene or kerosene emulsion rather freely. The roosts should be wiped over with kerosene at intervals of not less than a week in summer. Somewhat less frequent applications will answer in winter. Two or three times per year it will pay to make thorough application of kerosene or crude petroleum to the wood work in the vicinity of the roosts and once a year at least, preferably in the fall, the house should be given a most thorough cleansing. At this time it is advisable to thoroughly spray all the woodwork of the interior with a disinfectant. Creolin has been used with satisfactory results. If the house can be closed it may in addition be wise to fumigate thoroughly with burning sulphur. In addition to the above measures, a good insect powder such as Lambert's Death to Lice may with advantage be thoroughly dusted into the feathers of the fowls two or three times during the summer. A dredging box is convenient for use in the application of such powders which should be sprinkled as thoroughly as possible into the feathers of the fowls.

BULLETIN No. 123. APRIL, 1908.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION.

FUNGICIDES, INSECTICIDES, AND SPRAYING DIRECTIONS.

BY

GEORGE E. STONE AND HENRY T. FERNALD.

This bulletin gives formulas for the preparation of fungicides and insecticides, with directions for preventing and controlling fungous diseases and insects.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

STATION STAFF:

CHARLES A. GOESSMANN, PH.D., LL.D.	*Honorary Director and Consulting Chemical Expert.*
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
JOSEPH B. LINDSEY, PH. D.,	*Chemist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. S.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
EDWARD B. HOLLAND, M. S.,	*Associate Chemist* (Research Div.).
HENRI D. HASKINS, B. SC.,	*Chemist in Charge* (Fertilizer Div.).
PHILIP H. SMITH, B. SC.,	*Chemist in Charge* (Feed and Dairy Div.).
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist.*
ROBERT D. MACLAURIN, PH. D.,	*Assistant Chemist* (Research Div.).
LEWELL S. WALKER, B. SC.,	*Ass't Chemist* (Feed and Dairy Div.)
PHILIP V. GOLDSMITH, B. SC.	*Assistant Chemist.*
JAMES C. REED, B. SC.	*Assistant Chemist.*
GEORGE H. CHAPMAN, B. SC.,	*Assistant Botanist.*
CARL S. POMEROY, PH. B.,	*Assistant Horticulturist.*
E. A. WHITE, B. SC.,	*Florist.*
WILLIAM K. HEPBURN,	*Inspector.*
ROY F. GASKILL,	*Assistant in Animal Nutrition.*
JOHN N. SUMMERS, B. SC.,	*Assistant in Entomology.*
T. A. BARRY,	*Observer.*

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

Fungicides, Insecticides and Spraying Directions

By George E. Stone and Henry T. Fernald.

The time has come when insects and fungi are so abundant that no crops can be neglected if profitable returns are to be expected. More care in cultivation and the production of healthy, vigorous plants is necessary, accompanied by spraying or special treatments for special cases, and it is the purpose of this bulletin to offer suggestions along these lines.

It is now recognized that if plants are healthy, vigorous and in good condition, they can better resist the attacks of injurious insects and fungi than if in poor condition. Every effort should accordingly be made to get the soil into good condition; to have it supplied with the proper fertilizers for the crop; to cultivate well and to use every means for the production of strong plants, which can resist attack and bring better results to the owner.

This plan alone will do much good, but if supplemented by spraying or other treatments, made in the right way and at the right times, the results will become far more satisfactory, and any farmer who now neglects such an important part of his business as properly caring for his crops has only himself to blame for poor results.

The more important fungi and insects on the different crops are listed below, with the treatment for each, and these treatments will also protect from the less important foes. The number of applications suggested is given for cases where the enemies are abundant, and where these are present only in small numbers the later treatments may frequently be omitted. In any case prevention is better and cheaper than cure.

See that all spraying apparatus is in shape for immediate use before the season opens. Have connections tight, the hose in good condition, the packing in the pumps perfect, and everything ready. The insects and diseases are ready; the farmer must also be ready if he is to keep them under control.

Learn to know the insects and diseases by their appearance and their work, so as to apply the right treatment, for treatments differ for different foes and there is no one material which is effective for all insects and diseases any more than there is any one medicine good for every kind of illness with man.

"There is no one best pump or nozzle." Almost any spray pump now on the market will do at least fair work. For Bordeaux mixture use a Bordeaux nozzle. For most insects use a Vermorel nozzle. There are many varieties of this, but in all the spray enters the chamber behind the outlet hole from one side and whirls around the chamber before escaping, and a nozzle made on this plan, whatever its name, should do the work. The smaller the outlet hole the better, unless it clogs, in which case use a cap with a slightly larger hole. The spray should be a fine mist or fog.

One THOROUGH spraying at the right time is worth ten careless treatments. Most people who have given up spraying have done so either because they were not thorough enough and were disappointed in the results, or because they were lazy, and this country will soon have no place for the lazy farmer who thinks that planting, cultivating and harvesting are the only things necessary to obtain a crop.

This bulletin contains a compilation of formulas for fungicides and insecticides taken from various sources, and the usual spraying directions. The treatments recommended are similar to those given in other Station bulletins of the same nature, but are based upon the personal observations of the authors covering a period of years. Many of these mixtures can be bought already prepared from reliable dealers, which saves much time and trouble in mixing them. The following precautions should be taken into consideration:

1. Care should be taken to keep all substances employed in spraying where they cannot be used by mistake. All substances should be correctly labeled.

2. Solutions and mixtures containing copper sulfate, corrosive sublimate, and arsenate of lead, should be made in wood, glass or earthern vessels.

3. Arsenical sprays should not be applied to fruits, etc., within two weeks of the time they are to be used as food.

4. Trees should not be sprayed when they are in blossom unless one wishes to reduce the crop.

Directions for making and applying the different treatments follow.

FUNGICIDES.

1 ## BORDEAUX MIXTURE.

Copper sulfate, (blue vitriol), 4 pounds.
Lime, (unslaked), 4 pounds.
Water, 25 to 50 gallons.

Dissolve the copper in hot or cold water, using a wood or earthern vessel. Slake the lime in a tub, adding the water cautiously and only in sufficient amount to insure thorough slaking. After thoroughly slaking, more water can be added and stirred in until it has the consistency of thick cream. When both are cold, dilute each to the required strength and pour both together in a separate receptacle and thoroughly mix. Before using, strain through a fine mesh sieve or a gunny cloth.

The mixture is then ready for use. Considerable trouble has frequently been experienced in preparing the Bordeaux mixture. Care should be taken that the lime is of good quality and well burned and has not been air slaked. Lumps are far superior to the fine lime and are selected by masons for preparing finishing coats. Where small amounts of lime are slaked it is advisable to use hot water. The lime should not be allowed to become dry in slaking, neither should it become entirely submerged in water. Lime slakes best when supplied with just enough water to develop a large amount of heat, which renders the process active. If the amount of lime in the Bordeaux mixture is insufficient, there is danger of burning tender foliage. In order to obviate this the mixture can be tested with a knife blade or with ferro-cyanide of potassium (1 oz. to 5 or 6 oz. of water). If the amount of lime is insufficient, copper will be deposited on the knife blade, while a deep brownish-red color will be imparted to the mixture when ferro-cyanide of potassium is added. Lime should be added until neither reaction occurs. A slight excess of lime, however, is desirable, and it is seldom one has to apply these tests.

The standard mixtures are :

(a). 25 gallons (full strength mixture, or 4—4—25 formula), that is, 4 lbs. copper sulfate, 4 lbs. lime and 25 gallons water.

(b). 50 gallons (half strength mixture, or 4—4—50 formula).

(c). 6—4—50 formula.

(d). 3—6—50 formula.

(e). 2—2—50 formula.

(f). 3—9—50 formula.

d, e and f are suitable for peach and plum foliage, which are susceptible to burn when full strength mixtures are used.

2 SODA BORDEAUX MIXTURE.

Copper sulfate, 4 pounds.
Water, 50 gallons.

Add enough soda lye to make the mixture alkaline to test paper.

3 AMMONIACAL COPPER CARBONATE.

Copper carbonate, 5 ounces.
Ammonia (26° Beaumé.), 3 pints.
Water, 50 gallons.

Dissolve the copper carbonate in ammonia. This may be kept any length of time in a glass stoppered bottle, and can be diluted to the required strength. The solution loses strength on standing.

4 COPPER SULFATE SOLUTION.

(*Strong Solution.*)

Copper sulfate, 1 pound.
Water, 25 gallons.

Applied only on trees without foliage.

5 COPPER SULFATE SOLUTION.

(*Weak Solution.*)

Copper sulfate, 2 to 4 ounces.
Water, 50 gallons.

For trees in foliage.

6 POTASSIUM SULFID.

Potassium sulfid, 3 ounces.
Water, 10 gallons.

Valuable for gooseberry mildews, etc.

7 CORROSIVE SUBLIMATE.

(*For Potato Scab.*)

Corrosive sublimate, 2 ounces.
Water, 15 gallons.

Dissolve the corrosive sublimate in 2 gallons of hot water, then dilute to 15 gallons, allowing the same to stand 5 or 6 hours, during which time thoroughly agitate the solution several times. Place the seed potatoes in a sack and immerse in the solution for 1½ hours. Dry before planting.

Corrosive sublimate is very poisonous, consequently care should be taken in handling it, and the treated potatoes should not be kept within reach of stock. The solution should not be made in metallic vessels.

8 FORMALIN.

(*For Potato Scab.*)

Formalin (40 per cent solution), 8 ounces.
Water, 15 gallons.

Used for the same purpose as corrosive sublimate, but not poisonous. Immerse the seed potatoes for 2 hours and spread out to dry before planting.

INSECTICIDES.

STOMACH POISONS.

9 PARIS GREEN.—DRY.

Paris green, 1 pound.
Flour, 20 to 50 pounds.

Mix thoroughly and apply evenly; preferably when dew is on the plants.

10 PARIS GREEN.—WET.

Paris green, 1 pound.
Quicklime, 1 to 2 pounds.
Water, 200 gallons.

Slake the lime in part of the water, sprinkling in the Paris green gradually, then add the rest of the water. For the peach and other tender leaved plants use 300 gallons of water. Keep well stirred while spraying.

11 ARSENITE OF LIME.

White arsenic, 2 pounds.
Sal-soda, 8 pounds.
Water, 2 gallons.

Boil till the arsenic all dissolves,—about 45 minutes. Make up the water lost by boiling and place in an earthern dish. For use take one pint of this stock, 2 pounds freshly slaked lime and 45 gallons water, and spray.

12 ARSENATE OF LEAD.

Arsenate of soda (50% strength), 4 ounces.
Acetate of lead, 11 ounces.
Water, 100 gallons.

Put the arsenate of soda in 2 quarts of water in a wooden pail, and the acetate of lead in four quarts of water in another wooden pail. When both are dissolved, mix with the rest of the water. Warm water in the pails will hasten the process. For the elm-leaf beetle use 10 instead of 100 gallons of water.

A number of ready-made arsenates of lead are now on the market, and except when very large amounts are needed it will probably prove cheaper to buy the prepared material than to make it. With this ready-made material take 3 pounds to 50 gallons of water for codling moth, and 5 pounds to 50 gallons for the elm-leaf beetle and on potatoes.

CONTACT POISONS.

13 a WHALE OIL SOAP.

Potash whale oil soap, 2 pounds.
Hot water, 1 gallon.

For winter use only.

13 b

Potash whale oil soap, 1 pound.
Hot water, 6 gallons.

For summer use.

14 KEROSENE EMULSION.

Hard soap, shaved fine, ½ pound.
Water, 1 gallon.
Kerosene, 2 gallons.

Dissolve the soap in the water, which should be boiling; remove from the fire and pour it into the kerosene while hot. Churn this with a spray pump till it changes to a creamy, then to a soft butter-like mass. Keep this as a stock, using one part in nine of water for soft bodied insects such as plant lice, or stronger in certain cases.

15 RESIN-LIME MIXTURE.

Pulverized resin, 5 pounds.
Concentrated lye, 1 pound.
Fish or other animal oil, 1 pint.
Water, 5 gallons.

Place the oil, resin and 1 gallon of hot water in an iron kettle and heat till the resin softens; then add the lye and stir thoroughly; now add 4 gallons of hot water and boil till a little will mix with cold water and give a clear, amber colored liquid; add water to make up 5 gallons. Keep this as a stock solution. For use, take

Stock solution, 1 gallon.
Water, 16 gallons.
Milk of lime, 3 gallons.
Paris green, ¼ pound.

The object of this preparation is to obtain an adhesive material which will cause the poison to adhere to smooth leaves. It has been highly recommended by the New York State (Geneva) Experiment Station.

The stock solution No. 15 can also be used in making the resin-Bordeaux mixture by taking two gallons and adding it to 10 gallons of water. This is mixed with 40 gallons of Bordeaux.

16 LIME-SULFUR WASH.

Fresh stone lime, 20 to 22 pounds.
Flowers of sulfur or sulfur flour, 18 to 20 pounds.
Water, 45 to 50 gallons.

Slake the lime with some of the water in a large iron kettle, sprinkling in the sulfur gradually. Start a fire under the kettle to continue the heat begun by the slaking lime, and boil till the mixture becomes dark orange in color, adding water till 35 or 40 gallons are in the kettle. Boiling should probably take from 40 minutes to an hour. Stir frequently and a successfully prepared lot should have little sediment on the bottom when the boiling is finished. Strain through a fine meshed strainer into the spray pump, adding the rest of the water, and spray while warm. It is generally better to use only the freshly prepared wash, though good results have sometimes been obtained with it when it has stood over night. This should not be applied to trees after the leaves have opened.

17 CARBOLIC ACID EMULSION.

Hard soap shaved fine, 1 pound.
Water, 1 gallon.
Crude carbolic acid, 1 pint.

Dissolve the soap in boiling water; add the carbolic acid and churn as for kerosene emulsion. Use one part of this with 30 parts of water.

18 HELLEBORE.

Hellebore, 1 ounce.
Water, 1 to 2 gallons.

Steep the hellebore in a pint of water and gradually add the rest of the water. Hellebore may also be dusted over the plants, either pure or mixed with flour or plaster.

19 INSECT POWDER. PYRETHRUM.

Mix with half its bulk of flour and keep in a tight can for 24 hours; then dust over the plants. Or,

Insect powder, 100 grains.
Water, 2 gallons.

Mix together and spray.

COMBINED FUNGICIDES AND INSECTICIDES.

20 BORDEAUX MIXTURE AND PARIS GREEN.

Paris green if pure, 6 ounces; more if necessary.
Bordeaux mixture, 50 gallons.

21 BORDEAUX MIXTURE AND ARSENATE OF LEAD.

Prepare the arsenate of lead as directed above, but instead of adding the arsenate of soda and acetate of lead to the water when dissolved, mix them together and then add to 50 gallons of Bordeaux mixture. On potatoes, use 20 ounces of arsenate of soda and 55 ounces of acetate of lead to 50 gallons of Bordeaux mixture. With ready prepared arsenate of lead use 5 pounds to 50 gallons of Bordeaux.

22 BORDEAUX MIXTURE AND ARSENITE OF LIME.

Arsenite of lime (made by formula No. 11), 1½ quarts.
Bordeaux mixture, 50 gallons.

23 IVORY SOAP.

Ivory soap (10 cent size), 1 bar.
Water, 15 gallons.

Apply warm as it thickens on cooling.
Recommended for rose mildew, plant lice, etc.

FUMIGANTS.

24 CARBON BISULFID.

Evaporate one pound of carbon bisulfid to every thousand cubic feet of space. This is done by pouring the bisulfid into shallow dishes placed in the upper part of the place to be fumigated, and closing everything tightly and leaving 24 hours. Then open, air for ten minutes before entering or using anything which has been fumigated. This treatment is effective for infested grain, weevily seed, clothes moths, carpet beetles, etc., in closets, trunks, tight boxes or wherever these substances are kept or in which they may be placed for treatment. **Caution : Do not use carbon bisulfid near a fire, or where there is much heat, as it takes fire easily, even from a lighted pipe or cigar.**

25 HYDROCYANIC ACID.

For Nursery Stock.

Potassic cyanid (98 or 99%).
Sulfuric acid (1.83 sp. gr. commercial).
Water.

Multiply the number of cubic feet to be fumigated, by .2 or .25, giving the number of grams of cyanid needed for the house or box ; divide the answer by 28.35, giving the weight of the cyanid in ounces. Take twice as many fluid ounces of acid and four times as many fluid ounces of water as was taken in ounces by weight of the cyanid. Mix the water and acid in an earthern or granite-ware jar, then by loose bag and string drop in the cyanid after tightly closing the place to be fumigated. Leave closed 40 minutes, then open from the outside and air for at least ten minutes before entering.

26 HYDROCYANIC ACID.

For Empty Houses.

Potassic cyanid (98 or 99%) 1 oz. per 100 cu. ft.
Sulfuric acid (1.83 sp. gr. commercial), 2 fluid oz. per 100 cu. ft.
Water, 4 fluid oz. per 100 cu. ft.

Mix as directed under Number 25.

27 SULFUR.

For Empty Houses.

Close the house tightly and burn 200 grams (about 6 oz.) to 1000 cu. ft. of space. Keep the house closed at least twelve hours.

28 SULFUR.

For Houses with Growing Plants.

Evaporate a small quantity in a kettle over a kerosene stove, taking care that it does not catch fire. Or, better, paint some of the heating pipes occasionally with a mixture of sulfur and oil.

TREATMENT OF GREENHOUSE PLANTS.

On general principles the practice of spraying greenhouse plants cannot be recommended, since the control of their diseases is possible to a large extent by maintaining favorable or hygienic conditions. This requires skill obtained from long experience in greenhouse management. When greenhouses are about to be emptied or before replanting, fumigation can be practised to advantage with Nos. 26 and 27.

Red Spiders and Mites.

Drench the plants with 2 ounces of common salt in a pailful of water. No really satisfactory treatment for these pests has yet been found.

Plant Lice : Aphids.

Burn tobacco stems ; when the house is empty, fumigate by any fumigant, such as Nos. 26 or 27.

Thrips.

Nikoteen 4 cc. (1/7 oz.)
Water 150 cc. (5 fl. oz.) } Per 1000 cubic feet.

Mix and vaporize in the house at night ; will kill most of the thrips.

White Fly.

Fumigate as for Nursery Stock above, No. 25, except that instead of using .2 or .25 gram of cyanid per cubic foot, use .007 to .01

gram according to how tight the house is. Use the corresponding proportions of sulfuric acid and water, fumigate at night for three hours, and then ventilate. Repeat the fumigation two weeks later and a third time two weeks later. This treatment must be used with caution, as tender plants may under exceptional conditions be somewhat injured.

Eel Worms.

For eel worms on cucumbers, melons, violets, tomatoes, roses, etc. change the soil, or freeze or sterilize it. Excess of water in soil or drenching it for a few days has a marked repressive effect on eelworms. Avoid manure containing greenhouse refuse or that contaminated with eel worms.

Mildews and Leaf Spots.

Mildews and leaf spots can be controlled by paying careful attention to details of heat, light, ventilation and moisture. Powdery mildew of cucumbers is brought on by lack of light and too much moisture in the atmosphere during the short days in winter. Downy mildew of cucumbers is a summer trouble and does not survive the winter in the greenhouse. It affects both out-door and indoor crops about the middle of August in this State. In order to avoid downy mildew in the greenhouse, crops should not be planted until September or October, and what holds true of downy mildew on cucumbers is also applicable to outbreaks of bacterial wilt on greenhouse cucumbers. Anthracnose occurs usually about the middle of March on greenhouse cucumbers and is induced by too much moisture in the atmosphere and lack of light and ventilation. If cucumbers are affected with anthracnose, apply sulfur and oil to the pipes.

Leaf blight of tomatoes (scab) is caused by a too moist atmosphere and lack of light. The leaf spot of the tomato (Cylindrosporium) results from crowding and shading. To prevent the leaf blight, avoid excessive moisture, and give sufficient light and ventilation. If present, paint the pipes with sulfur. For the leaf spot, (Cylindrosporium), prevent crowding of the plants and allow access of air and sunshine. For chrysanthemum leaf spots, (Cylindrosporium), give the same treatment as for tomato leaf spot. For rose mildew evaporate sulfur or paint the pipes occasionally with a mixture of sulfur and oil.

Rots.

For blossom end rot of tomatoes (bacterial, Fusarium, etc.), give the plants plenty of water when the fruit is forming. Keep the atmosphere of the house fairly moist, although not enough so to induce scab. In general a house should not be kept too moist during the night, as infection is likely to result. The foliage of greenhouse plants should be watered only on bright, sunshiny mornings, when it will dry off quickly. For chrysanthemum stem rot prevent overcrowding and give sufficient light and air. For carnation dry rot (Fusarium), select healthy cuttings and avoid planting in infected soil, extreme forcing and adverse conditions in general. Outdoor culture seems to be more favorable for dry rot than greenhouse culture. For lettuce rot (Sclerotinia) and Rhizoctonia of lettuce, radishes, and carnations (wet rot), and timber rot of tomatoes and cucumbers (Sclerotinia) sterilize the soil.

Rusts.

For chrysanthemum rust select healthy stock and pick off all rusted leaves. In outdoor culture avoid exposure to dews and excessive moisture on the foliage. Carnation rust is best avoided by selecting rust-free stock and avoiding excessive moisture on the foliage during periods when there is no sunshine. The application of lime to the foliage and sub-irrigation have proved successful in checking the rust.

Burns, Wilts, Etc.

For lettuce top-burn maintain low temperatures on cloudy and succeeding days. The principal feature in lettuce growing is maintaining low night temperatures, when the plants are making their most rapid growth, and avoiding too high day temperatures. The night temperature for lettuce may range from 35° to 45°, depending upon conditions. On cloudy days it should not exceed 65°, but during periods of bright sunshine, the temperature may run higher in the daytime.

Extreme cases of cucumber wilt are caused by insufficient light, too high temperatures and lack of air. Leaf burns are often brought about by an excess of certain chemical constituents in the soil. To prevent leaf curl, stem curl, contorted leaves and various other malformations occasionally seen in greenhouses, avoid too concentrated manure. Unless one has an extended knowledge of soil fertility, it is best to avoid the use of all commercial fertilizers in greenhouse culture. Greenhouse soils are as a rule provided with so much plant food that the addition of fertilizers is not absolutely necessary, and the formulas given for out door crops cannot be followed. If it is desired to use fertilizers on greenhouse crops, consult station authorities familiar with the subject of soil fertility.

TREATMENT OF OUTDOOR PLANTS.

APPLE.

Leaf Spots, Sooty Mold, Scab.

These can be controlled by spraying with Bordeaux mixture.

Canker.

Remove diseased twigs. Early spraying before the leaves appear with lime and sulfur wash or strong copper sulfate solution (No. 4) is most effective for this trouble. Allow no rotten fruit to remain on the ground. (See apple maggot.)

Crown=Gall.

This is becoming more common. Buy nursery stock free from the disease, and if the young stock is affected, destroy it.

Apple Maggot or Railroad Worm.

Gather and destroy all fallen fruit once every day, or let fowls or hogs run under the trees. They eat the maggots both in the fruit and on the ground.

Bud Moth.

Spray with a stomach poison (No. 10, 11 or 12) when the buds first open. Repeat just after the blossoms fall.

Canker Worms.

Band the trunks with tree tanglefoot: Oct. 1st for the fall canker worm; band on the first warm day in March for the spring canker worm; or, spray as soon as the leaves open with a stomach poison (No. 10 or 12).

Codling Moth (Apple Worm.)

Spray with a stomach poison (No. 12) just before the blossoms open. Repeat as soon as they fall. Repeat in two weeks.

Oyster-Shell Scale.

Spray trunk, branches and twigs thoroughly about June 5 in average seasons with No. 13a or 14, varying the date according to the season. Repeat two weeks later. Old scales may remain all summer after successful treatment.

Plum Curculio.

Eats leaves in early spring and punctures small apples, causing hard spots with woody places inside them. Spray with a stomach poison (No. 12) just before the blossoms open. Beginning about ten days after the blossoms fall, jar the trees about sunset and early in the morning, spreading a white cloth beneath and killing the insects which fall.

Round-Headed Borer.

Look for "sawdust" at the base of the trunk in October and from this find and cut out the borers. Make a cone of wire mosquito netting, fitting the trunk about two feet from the ground and setting the other end in the ground, keeping the borers off. This will also protect from mice in winter.

San Jose Scale.

Spray during the winter with lime-sulfur wash (No. 16) covering every part of the tree thoroughly. If this treatment is impossible for lack of facilities for making, or the number of trees to treat is very small, use "Scalecide" 1 part, water 14 parts. In either case use a nozzle giving a very fine, misty spray and apply very thoroughly. The lime-sulfur wash has given better results than "Scalecide" at this Station. Home-made "soluble oils" are still in an experimental stage, in the opinion of the writer, and are not recommended for that reason.

Woolly Aphis.

White, woolly places on limbs in fall with lice beneath ; they may also be present on the roots. Remove the soil to the top roots two feet each way from the trunk, and if lice are present, apply 15% kerosene emulsion liberally, then replace the earth. For those on the limbs spray with the emulsion.

The apple is comparatively free from diseases in Massachusetts and in well-kept and thoroughly cultivated orchards one spraying in the spring with the lime-sulfur wash for the scale before the leaves appear, followed by one or two sprayings for codling moth, is usually sufficient. If sooty mold or scab is troublesome, midsummer spraying with Bordeaux is advisable. The lime-sulfur treatment has proved the most successful of any for fungous diseases of the apple.

ASPARAGUS.

Rust, summer stage.

Avoid planting new beds on too dry soil, and in preparing a bed incorporate considerable organic matter, occasionally applying stable manure. Maintain the highest degree of fertility possible and during dry seasons cultivate thoroughly.

Asparagus Beetle.

Keep cutting beds closely cropped, leaving a few stalks for the beetles to lay their eggs on. Destroy these once a week and take others for the purpose. Spray the fruit stems thoroughly with arsenate of lead about once a month during the summer. Let fowls run in the beds.

Asparagus Miner.

A maggot mining in and often girdling the stems near or below the surface of the ground. Leave a few plants in spring for the fly to lay eggs on, destroying these by pulling up and burning about the end of June.

BEAN.

Anthracnose.

Select clean seed. Spray with Bordeaux mixture when the leaves first expand, and repeat two or three times if occasion demands. Some varieties are more susceptible to anthracnose than others.

Weevils in Seed.

Place the seed in a tight box on gathering, and add a teaspoonful of carbon bisulfid for every cubic foot of space in the box. Keep closed 24 hours; then store for the winter. **During treatment keep the box away from any fire.**

BEET.

Leaf Spot.

This is not as a rule troublesome in Massachusetts, but if so, apply Bordeaux mixture when four or five leaves are formed, and repeat, if necessary, at intervals of 10 to 14 days.

Flea Beetle.

Spray with Bordeaux mixture as needed.

BLACKBERRY AND RASPBERRY.

Anthracnose.

Cut out badly infested canes. The Bordeaux spray may be used at intervals after growth has commenced.

Rust.

In bad cases of rust remove and destroy infected plants. Both anthracnose and rust are difficult to control by spraying. The intelligent application of fertilizers and frequent cultivation are the best treatment for raspberries and blackberries.

Rose Scale. See Rose.

CABBAGE AND CAULIFLOWER.

Clubfoot.

Start seedlings in uninfected soil, and for planting select land free from clubfoot if possible. If the soil is infected, use lime, 50 to 75 bushels per acre.

Black Rot.

Treat seeds with formalin, one pound to 20 gallons of water for 15 minutes. Avoid infected soil.

Cutworms.

If noticed while preparing the ground for the crop, finish preparation, then cut some clover and sprinkle it heavily with a stomach poison (No. 10), and scatter the clover over the ground for the cutworms to feed on. If they appear after the cabbages are set, make a mash of 60 pounds of bran or middlings, 1 pound of Paris green, water to make a dough and molasses enough to sweeten. Place a little of this at the base of each plant, and keep fowls away. The cutworms will eat the sweet, poisoned mash in preference to the plants.

Root Maggot.

Apply disks of tarred paper to the stems of the plants when setting them. Powdered hellebore placed at the base of each plant about once a week is often a successful treatment.

Cabbage Worm.

Spray with a stomach poison (No. 10 or 12) till the heads form, then dust with hellebore as needed.

CELERY.

Blights.

Start seedlings in soil free from infection. If spraying is necessary, use Bordeaux mixture on young plants and continue its use at intervals throughout the season.

CHERRY.

Brown Rot, Etc. See Plum and Peach.

Curculio. See Apple.

Plant Lice.

Spray with kerosene emulsion (No. 14) when the lice first appear, before the leaves curl. Repeat as needed.

Slug.

Spray with a stomach poison (No. 10 or 12) when the slugs appear.

CORN.

Wireworms.

Fall plowing and thorough pulverizing of the soil for several years. Rotation of crops. Trapping in early summer with freshly cut clover dipped in Paris green water and placed under boards in the field. This is a very difficult pest to control.

CRANBERRY.

Rots, etc.

Consult Bulletin 110, Bureau of Plant Industry, Washington, D. C.

Cranberry Insects.

Send for Bulletin No. 115, Massachusetts Agricultural Experiment Station.

CURRANT AND GOOSEBERRY.

Leaf Blights.

Spray with Bordeaux before the leaves start, and continue to spray if the disease is troublesome after the leaves have formed.

Currant Worm.

Apply a stomach poison (No. 10) either wet or dry, or hellebore, FREQUENTLY, as new lots of the worms may appear shortly after a treatment.

Imported Currant Borer.

Works along the centers of the stems. Cut off and burn all injured stems.

San Jose Scale. See Apple.

CUCUMBER, MELON, SQUASH.

Bacterial Wilt.

Occasionally present in Massachusetts. Destroy cucumber beetle, which is largely responsible for the distribution of the disease.

Downy Mildew.

Appears about August 15th. It is controlled by spraying with Bordeaux mixture every ten days or two weeks, commencing about August 10th.

Alternaria.

Occasionally more or less troublesome. Partly controlled by spraying.

Anthracnose.

Spraying is practically useless.

For further advice in reference to these diseases, write this Experiment Station.

Striped Cucumber Beetle.

Keep under netting till well started. Apply a stomach poison (No. 10 or 12), wood ashes or air-slaked lime thoroughly and frequently. Burn plants as soon as crop is gathered.

Squash Bugs.

Keep under netting till well started. Pick and destroy bugs and eggs. Burn plants as soon as crop is gathered.

Squash-vine Borer.

Plant summer squash early to attract this insect. Keep main crop under netting till well started. Cover stems with earth at the joints to start roots at these places. Cut out borers, splitting the stem lengthwise. Harrow lightly in fall and plow at least six inches deep the following spring.

GRAPE.

Anthracnose, Black Rot, Downy Mildew and Powdery Mildew.

Spraying with Bordeaux is successful in the treatment of these diseases.

Flea Beetle.

Spray with a stomach poison and repeat if necessary.

Rose Bug or Rose Chafer.

Hand picking; spray with arsenate of lead 5 lbs., water 50 gallons. A very difficult pest to control.

For the control of fungous and insect pests of the grape, the following treatment is recommended: Before the buds unfold in the spring, spray with copper sulfate (No. 4). After the leaves have expanded, spray with Bordeaux (No. 1 b). When the fruit has set, spray with Bordeaux (No. 1 b) and repeat this once or twice until the fruit is mature. If insects are troublesome, use a combined fungicide and insecticide (No. 21).

MELON. See CUCUMBER.

ONION.

Smut.

Infects young seedlings but not transplanted onions, or sets. 100 pounds sulfur thoroughly mixed with 50 pounds lime per acre, applied with a seeder in drills, has proved beneficial; also ground lime drilled in with a fertilizer drill at the rate of 75 to 125 bushels per acre, is helpful. The best results have been obtained with the use of formalin, 1 pound (pint) to 30 gallons of water (1-240) or 1 ounce to 1 gallon of water (1-128), thoroughly sprinkled over the seeds before covering them. A drip attachment on the seeder, treating two rows at once, is a cheap and efficient method of applying formalin. One gallon of formalin solution will treat about 400 feet of drill.

Maggot.

Apply carbolic acid emulsion around the base of the plants, when these first appear, using enough to wet the ground well on all sides of the stems; repeat three or four times at weekly intervals.

Thrips. (Blight.)

Spray very thoroughly with kerosene emulsion when the insects first appear; repeat as needed.

OATS.

Smut.

Place the seed in a sack and immerse in formalin, 1 pound (1 pt.) to 36 gallons of water, for ten minutes, after which spread out and dry for two or three days. This has proved very successful in preventing oat smut.

PEA.

Pea Weevil. See Bean Weevil.

PEACH.

Peach Leaf Curl, Twig Blight, (Cladosporium and Monilia.)

If the lime-sulfur wash for the San Jose scale has not been applied, spray in March or April before the buds swell with strong Bordeaux (No. 1a), or the copper sulfate solution (No. 4.)

Shot-Hole Fungus.

Thorough spraying in the spring with the lime-sulfur wash is very beneficial. If Bordeaux mixture is used when the tree is in foliage, use formula (No. 1d, e or f.)

Brown Rot.

In this region brown rot is seldom troublesome in well-kept peach orchards except when the fruit is ripening. Allow no over-mature fruit to remain on the trees. If the season is muggy and damp, spray with ammoniacal copper carbonate before the fruit is mature and repeat if necessary. The lime-sulfur wash applied in the early spring has proved the best remedy for all fungous troubles of the peach.

Peach Yellows and Rosette.

Remove all diseased trees.

Plant Lice. See Cherry.

Peach Borer.

Cut out borers in the tree as early in the spring as they can be found. Mound up earth about 18 inches high around the trunks the last of June and leave till in September.

Plum Curculio. See Apple.

San Jose Scale. See Apple.

The use of the lime-sulfur wash on peach trees has proved of the greatest value. It is remarkable for its control of peach leaf curl and twig blights caused by Monilia and Cladosporium, which are very common on peaches. In well-kept orchards no other spray is as a rule necessary except occasional treatment for brown rot.

PEAR.

Blight.

Remove all affected branches. Early spring spraying before the buds swell with the lime-sulfur wash, copper sulfate (No. 4), or Bordeaux is beneficial.

Leaf Blights and Fruit Spots.

Spray with Bordeaux at intervals.

Sooty Mold of Twigs.

When the pear psylla is abundant, sooty mold is often very troublesome. For prevention see pear psylla.

Pear Psylla.

Spray with kerosene emulsion as soon as the blossoms have fallen. Repeat twice more at intervals of a week. Winter treatment with the lime sulfur wash, or whale oil soap, 1 pound; water, 1 gallon, is helpful.

Pear Slug. See Cherry.

San Jose Scale, Scurfy Scale, Codling Moth. See Apple.

The pear in general can be treated like the apple.

PLUM.

Brown Rot, Leaf Curl, and Shot-Hole Fungus. See Peach.

Black-Knot.

Early spring spraying with copper sulfate (No. 4) or the lime-sulfur wash has proved beneficial in holding the knot in check. When knots are present they should be removed. In the young stage they may be dug out and painted, which will check their development.

Curculio, San Jose Scale. See Apple.

Peach Borer. See Peach.

For general treatment of the plum see peach.

POTATO.

Early Blight.

Spray with Bordeaux mixture when the potatoes are five or six inches high, about June 20th, or preferably with Bordeaux and Paris green or arsenate of lead, (Nos. 20 or 21). Repeat application every two weeks.

Late Blight.

A continuation of the treatment recommended for early blight answers for this blight. To prevent the rotting of tubers, avoid poorly drained soil.

Scab.

To destroy germs on seed potatoes soak one and one-half hours in corrosive sublimate, (No. 7) or two hours in formalin (No. 8.). Dry the potatoes after soaking in formalin or corrosive sublimate. Avoid fertilizers containing stable manure, and as scab develops freely in alkaline soils do not use fertilizers containing free lime. The tendency to produce scabby potatoes may be lessened by the use of such fertilizers as acid phosphate and sulfate of ammonia.

Cf. Wheeler et al. in R. I. Bulletins Nos. 26, 33 and 40.

Potato Beetle.

Spray with a strong stomach poison (Nos. 9, 10, 11 or 12); repeat as needed.

Flea Beetle.

Spray with Bordeaux mixture and Paris green or arsenate of lead.

For the control of blights and insects on potatoes it is best to use a combined fungicide and insecticide, (either No. 20 or 21) as potato beetles are usually troublesome. Paris green acts more quickly on the potato beetle than arsenate of lead, but the latter is more adhesive than Paris green, and many growers are using formula No 21 in preference to No. 20.

QUINCE.

Leaf Blight.

Spray with Bordeaux when the blossom buds appear, and repeat at intervals, if necessary.

Rust.

Remove all affected fruit, etc., from the tree.

Borer, San Jose Scale. See Apple.

ROSE.

Leaf Hoppers, Plant Lice.

Kerosene emulsion, whale oil soap or tobacco water applied thoroughly and frequently.

Red Spider.

See under Treatment of Greenhouse Plants.

Rose Scale.

Cut out badly infested stems, spray with whale oil soap 1 pound, water 1 gallon late in the fall or during the winter; also spray the following April with whale oil soap 1 pound, water two gallons. During the summer whale oil soap 1 pound, water five gallons about every three weeks may be used.

SQUASH.

See Cucumber.

STRAWBERRIES.

Leaf Blight.

Attention to cultivation and fertility is much more important than spraying for the development of healthy plants. Mulch thoroughly to prevent winter killing.

White Grub.

Rotation of crops or destruction by hand. Salty fertilizers may be of some value.

TOMATOES.

Leaf Blight and Fruit Rots.

Leaf blights and fruit rots are only partially controlled by spraying. The blossom end rot is more common upon dry soil and during dry seasons than wet, and some varieties are more susceptible than others. Irrigation has proved successful during the time of fruit ripening.

Flea Beetle. See Potato.

Cutworms. See Cabbage.

TOBACCO.

Root Rot.

Plant seeds in beds sterilized with steam or treated with formalin, one pound to 12 or 15 gallons of water, using about a gallon for each square foot of surface treated. Cover the soil for 24 hours to hold the formalin vapors, then remove cover and allow to air afterwards.

Cut Worms. See Cabbage.

Tobacco Worm.

Hand picking, or spraying with a stomach poison (No. 12.)

SHADE TREES.

Shade trees have to contend with various difficulties,* many of which can be prevented if proper treatment can be given in time.

Elm-Leaf Beetle.

Spray about the middle of June with arsenate of lead 5 pounds, water 50 gallons.

Leaf Eating Insects, Caterpillars, etc.

Spray as necessary with a stomach poison.

---

*There are many substances applied to shade trees which have proved very injurious, much injury having been caused by the use of banding substances,—gas oil, kerosene and water, etc. Only those substances which have been thoroughly tested and proved to be reliable should be used.

Gypsy and Brown-tail Moths.

For advice in regard to these pests address the Superintendent of the Gypsy Moth Commission, 6 Beacon Street, Boston, Mass.

Spruce Gall Louse.

Swellings at the bases of the smaller twigs, fresh and soft in May. Pick off and burn. Spray thoroughly with kerosene emulsion in April.

Woolly Aphis on Maple.

Spray with kerosene emulsion.

Leaf Spots.

There are many leaf spots more or less common to shade trees, viz: the linden leaf spot (Cercospora), the sycamore blight (Gloeosporium), oak blight (Gloeosporium,) horse chestnut blight (Phyllosticta) and the English hawthorne leaf spot (Entomosporium), which can undoubtedly be controlled to a large extent by spraying with any good fungicide, but the question of treatment depends upon whether the tree is valuable enough to warrant it.

Sun Scorch.

Some shade trees are subject annually to sunscorch and wilts which are the result of strong, warm winds when the soil moisture supply is low. Trees growing on lawns in rich soil seldom suffer from these troubles, as the conditions are unfavorable for their development. When soil is very dry water may be applied by means of a sub-irrigation system installed near the feeding roots.

Wounds.

By far the greatest amount of injury to trees from fungi is due to lack of antiseptic treatment of wounds caused by poor pruning and mechanical injuries. When large pieces of bark are removed from the trunk of the tree an old European method of treatment is sometimes used, consisting of carefully scraping the wound and covering it with a mixture of one part lime, two parts cow-manure and 2 parts clay, which is securely bandaged with burlap. Whatever other virtue it has, this mixture probably assists in keeping the parts moist, which would help in the process of healing.

Pruning.

Attention should be given to the removal of all dead limbs on shade trees and all wounds should be antiseptically treated with a thick coat of paint or coal tar.

Cavities.

If there are cavities formed by decay in a tree which is of value they should be carefully dug out, scraped and treated first with creosote, and then with tar. If it is necessary to fill the cavity, Portland cement should be used, for the rough work employing grouting, —one part cement to five of sand and gravel,—and for the surface one part cement to two of sand. It is essential that the cavity should be thoroughly treated and filled and all moisture prevented from entering. If it is not desired to fill the cavity, it can remain open or be closed over with tin. In no case of filling should the cement extend beyond the wood.

Chaining and Bolting.

When trees show a tendency to split, they may be strengthened by bolts and chains, but whichever are used, care should be taken to have the work done thoroughly to prevent infection from fungi. When bolts are put through the tree, they may be treated with tar and the washers and nuts imbedded in tar and elastic cement, flush with the wood. An extension bit is valuable for this purpose.

Wires.

To prevent injuries from electric wires, wooden or porcelain insulators should be used to protect the trees. Wires should not be allowed around trees in any form which would cause girdling.

TREATMENT OF WEEDS.

Lawns.

Plants like chickweed, moneywort and other running weeds can be largely eradicated from lawns by treatment with nitrate of soda, which should be used strong enough to kill the weeds. This may also kill the grass, but a good growth of grass will come in again to the exclusion of the weeds.

Dandelions on lawns can be sprayed with iron sulphate at the rate of 1½ to 2 pounds to 1 gallon of water. Mechanical devices are also used for injecting acids and chemicals into the crowns of plants like the dandelion and plantain. The midsummer application of lawn fertilizers is beneficial in maintaining a strong growth of grass and keeping certain fall weeds out.

Mowings and Cultivated Fields.

Golden hawkweed in mowings has been more or less successfully treated by the application of 3,000 pounds of salt per acre. For wild mustard, smartweed, pigweed, cocklebur and ragweed in oat fields or mowings, spray with sulphate of iron at the rate of 100 pounds to 52 gallons of water. The sulphate of iron application is said to cost 20 or 25 cents per acre, 52 gallons being sufficient for 1 acre. Special spraying appliances are used for this work. Lime and wood ashes are valuable for sorrel, mosses, ferns, etc. which grow in acid soil.

Tennis Courts, Walks, Etc.

The weeds on tennis courts, gravel walks, drives, etc. can be successfully removed by treatment with arsenate of soda at the rate of 2 pounds to 10 gallons of water. This amount will cover about one square rod and can be applied with a watering can or spraying machine. On tennis courts in use it is generally sufficient to treat only 6 or 8 feet of the edges. It can also be applied to railroad beds where grass and troublesome weeds interfere with traffic. By treating a strip of grass 4 to 6 inches wide close to the foundation of buildings with arsenate of soda much hand trimming may be obviated. Arsenate of soda is poisonous and care should be used in handling it. It should not be applied too freely near valuable trees.

There are many proprietary compounds on the market known as "Herbicide", "Weedicide," etc. which are effectual weed killers.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

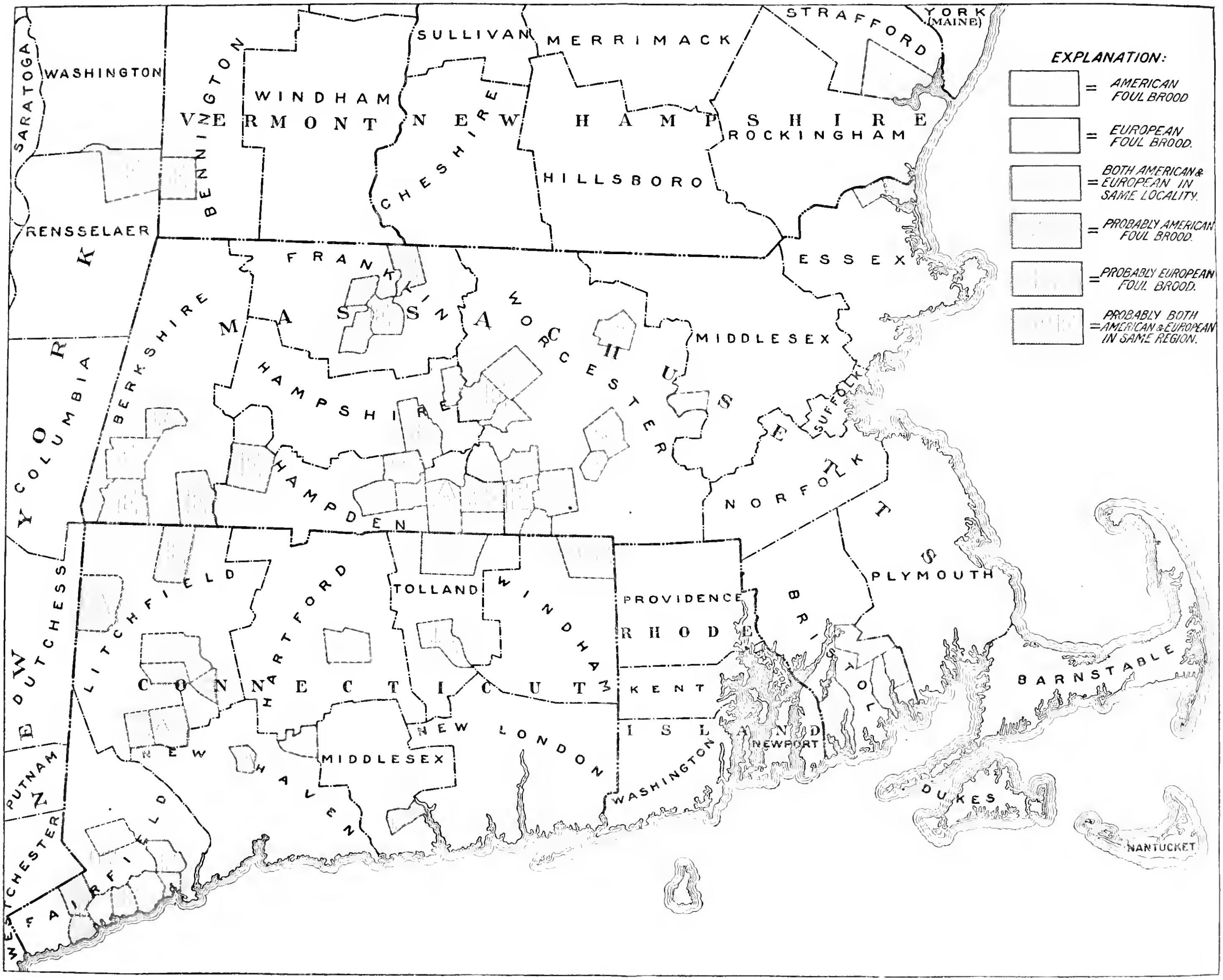
AMHERST, MASS.,

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

CONTENTS

ILLUSTRATION.



Map Showing Distribution of Bee Diseases in Massachusetts and Possible Sources of Infection from Neighboring States.

MISCELLANEOUS PAPERS ON APICULTURE.

BEE DISEASES IN MASSACHUSETTS.

By Burton N. Gates,
Expert in Apiculture.

INTRODUCTION.

In Massachusetts bee keeping is not an industry conducted by a few, as in the Hawaiian Islands, where four corporations harvested 600 tons of honey last year; but there are more than 2,100 men who derive some profit from their bees and who have interests at stake. There is besides, a vast, concentrated, and steadily increasing population which, fortunately for bee keepers, provides an almost unlimited home market. In order to point out the status of the industry, the writer estimated in 1904,[a] that two tablespoonfuls of honey per person as a year's ration is all that is now consumed, and of this less than one-fourth is produced in Massachusetts. Theoretically it is possible for Massachusetts to support approximately 40,000 colonies of bees, which could more than equal in amount Hawaii's honey crop for last year. There is reason to believe, however, that bee keeping, if it is not actually decreasing, is not progressing along with the steadily increasing population of the State. This is borne out by the general feeling among the country people that to-day there are fewer bees kept on the farms than there were fifty years ago.

One of the fundamental reasons for this condition may be found in the presence of brood diseases of bees, which exist in practically every quarter of Massachusetts and Connecticut, as well as in the other New England States, and which from time to time have doubtless killed out the bees in many localities. There is undeniable proof of this; furthermore, from evidence of former outbreaks it must be concluded

---

[a] Bee Keeping: How to Meet its Dangers and Difficulties. By Burton N. Gates, with suggestions by Prof. C. F. Hodge. Fifty-second Ann. Rept. Sec. Mass. St. Bd. Agric., pp. 411–426, Boston, 1905. Massachusetts Crop Report, Vol. 17, No. 6, October, 1904, pp. 30–40. Boston, 1904.

that their introduction is not recent. This evidence is not merely the result of bee keepers' reports or of more or less semiauthoritative and indefinite rumors, but it is based upon results of bacteriological findings in numerous samples of brood comb sent to this Bureau by the bee keepers in the State during the past year and a half. Under these conditions bee keeping can not be brought to the high degree of perfection which is possible. No factor in bee keeping tends to limit the industry as do epidemics of such diseases; they cause bee keepers to become discouraged by "bad luck" and to lose interest in their bees. The "luck" must change; the bee keepers must learn the nature of the diseases, where they exist, and how to combat them; otherwise the industry will decrease even more.

THE TWO KNOWN BEE DISEASES.

Two contagious brood diseases of bees are now known. These attack the developing brood and so reduce it that the colony soon dwindles from lack of young bees to replace the old. They are known, respectively, as American foul brood and European foul brood.

AMERICAN FOUL BROOD.

The cause of this disease is definitely known to be an organism, *Bacillus larvæ* White. It is what has been heretofore frequently designated simply as "foul brood." The nature of the disease is described by Dr. E. F. Phillips, in charge of apicultural investigations in this Bureau,[a] as follows:

When the larvæ are first affected they turn to a light chocolate color, and in the advanced stages of decay become darker, resembling roasted coffee in color. Usually the larvæ are attacked at about the time of capping, and most of the cells containing infected larvæ are capped. As decay proceeds these cappings become sunken and perforated, and, as the healthy brood emerges, the comb shows the scattered cells containing larvæ which have died of disease, still capped. The most noticeable characteristic of this infection is the fact that when a small stick is inserted in a larva which has died of the disease, and slowly removed, the broken-down tissues adhere to it and will often stretch out for several inches before breaking. When the larva dries it forms a tightly adhering scale [of characteristic and diagnostic shape and] of very dark brown color, which can best be observed when the comb is held so that a bright light strikes the lower side wall [of the cell]. Decaying larvæ which have died of this disease have a very characteristic odor which resembles a poor quality of glue. This disease seldom attacks drone or queen larvæ.

EUROPEAN FOUL BROOD.

This is the disease which appears to be most prevalent in Massachusetts, probably having swept in from New York State, where it

---

[a] The brood diseases of bees. By E. F. Phillips, Ph. D. Circular 79, Bureau of Entomology, U. S. Department of Agriculture, pp. 1–2, 1906.

was formerly known as "black brood." Its presence is less easily diagnosed by superficial examination than is American foul brood. It is described by Doctor Phillips [a] as follows:

This disease attacks larvæ earlier than does American foul brood, and a comparatively small percentage of the diseased brood is ever capped. The diseased larvæ which are capped over have sunken and perforated cappings. The larvæ when first attacked show a small yellow spot on the body near the head and move uneasily in the cell. When death occurs they turn yellow, then brown, and finally almost black. Decaying larvæ which have died of this disease do not usually stretch out in a long thread when a small stick is inserted and slowly removed. Occasionally there is a very slight "ropiness," but this is never very marked. The thoroughly dried larvæ form irregular scales which are not strongly adherent to the lower side wall of the cell. There is very little odor from decaying larvæ which have died from this disease, and when an odor is noticeable it is not the "glue-pot" odor of the American foul brood, but more nearly resembles that of soured dead brood. This disease attacks drone and queen larvæ very soon after the colony is infected. It is as a rule much more infectious than American foul brood and spreads more rapidly. On the other hand, it sometimes happens that the disease will disappear of its own accord, a thing which the author never knew to occur in a genuine case of American foul brood. European foul brood is most destructive during the spring and early summer, often almost disappearing in late summer and autumn.

DAMAGE FROM BEE DISEASES.

The damage from an epidemic of bee disease is as difficult to estimate as is the damage from an epidemic of smallpox, of typhoid fever, or of malaria in a human community. The loss of colonies is but one small item; there is the resulting loss of crop, the resulting lack of increase in the number of colonies of bees, and that demoralizing effect on the industry which tends to cause bee keepers to go out of business. Besides this there is a crippling of commercial queen rearing, a check on the trade in bees, and a decisive effect on the manufacture and sale of bee keepers' supplies. All these factors must be considered in an estimate; and, what is more, the damage is accumulative. It can not be calculated by the year and then totaled; the progressive loss must be figured.

In New York State, where European foul brood has been combated for nearly a decade, and where it is now well suppressed, it has been estimated that the damage from loss of bees alone, in a very limited area, in 1899 and 1900, was at least $45,000.

In Ventura County, Cal., where American foul brood flourishes, a thriftless bee keeper had 151 colonies which, from neglect, were reduced to 14 colonies in a little over twelve months' time. One hundred and thirty-seven colonies had died or were nearly dead. But there are many more and even sadder cases, were there space to relate them.

---

[a] The brood diseases of bees. By E. F. Phillips, Ph. D. Circular 79, Bureau of Entomology, U. S. Department of Agriculture, p. 2.

PRESENT EXTENT OF BEE DISEASES IN MASSACHUSETTS.

The extent of bee diseases in Massachusetts may be readily seen on the map. The towns in which they are positively known to occur are listed below in black-faced type. Towns in which they probably exist are listed in lighter-faced type.

Table showing the towns in which the bee diseases respectively occur.

[**Black-faced type** indicates where disease is positively known to exist. Light-faced type indicates that disease is probably present.]

American foul brood.		European foul brood.	
Bristol County:	*Worcester County:*	*Berkshire County:*	*Hampshire County:*
Acushnet.	Brookfield.	**Great Barrington.**	Belchertown.
Freetown.	Charlton.	Lee.	**Greenwich.**
New Bedford.	**Leominster.**	Sandisfield.	*Worcester County:*
Westport.	Sturbridge.	Sheffield.	**Auburn.**
Essex County:	Southbridge.	*Franklin County:*	Barre.
Amesbury.	Warren.	Deerfield.	Brookfield.
Salisbury.	**Worcester.**	Greenfield.	Charlton.
Hampden County:		Montague.	Hardwick.
Brimfield.		Northfield.	New Braintree.
Ludlow.		*Hampden County:*	Southbridge.
Monson.		Blandford.	Sturbridge.
Springfield.		Brimfield.	Warren.
Wilbraham.		**Ludlow.**	**Worcester.**
Hampshire County:		Monson.	
Belchertown.		Springfield.	
Middlesex County:		Wilbraham.	
Marlboro.			

The distribution of these diseases is based, as is explained, on bacteriological findings in numerous samples of suspected brood, submitted by the bee keepers during the past year and a half. The examinations were made by Dr. G. Franklin White, expert in bacteriology, of this Bureau. In plotting the regions where disease is thus definitely known to exist a solid red color has been used. Index letters, A for American foul brood and E for European foul brood, show which disease is present in each locality.

Besides these definite data there are in the Bureau of Entomology a great number of reports from bee keepers throughout Massachusetts, which, without the definite knowledge from the bacteriological examinations, would be of slight significance and importance, but which, in conjunction with these findings, are of the greatest value. They indicate regions of probable infection, which are shown on the map in lighter tone.

As an illustration, a bee keeper who lives in Acushnet reports, "I lost all my bees, thirty swarms, at once." This bare statement is of slight import; but taken together with the fact that American foul brood occurs in Freetown, it would indicate that American foul brood is distributed throughout southern Bristol County. Another illustration is found in Worcester County. Bacteriological examination shows that in Auburn and Worcester both European foul brood and American foul brood exist. A bee keeper from Barre reports that in the year 1902 or 1903 he lost forty-five colonies of bees. From East Brookfield and Charlton, from New Braintree, Sturbridge, and Warren, all located around and adjoining Worcester and Auburn, reports of heavy loss of bees, not alone by one bee keeper in a town but by several, are at hand. A bee keeper in Warren says, "Bees all died about five years ago; I had nine colonies which I lost; Mr. —— lost about five colonies also, as did others, so that at the present day only three to four colonies remain in town." Similar reports come from across the county and Connecticut State lines adjoining this section of Worcester County. It is highly probable, then, considering the positive knowledge of foul brood in Worcester and Auburn and considering collectively the widespread and yet individual reports from the country about these two towns, that these diseases are present throughout this section of Massachusetts and Connecticut. In other parts of the State similar conclusions are obvious.

Considering the distribution as a whole, it is apparent that European foul brood has swept in from New York State, where the disease has existed for years. Moreover, were the bees in western Massachusetts systematically examined, this portion of the State would doubtless be found thickly infected with European foul brood. American foul brood in Connecticut has apparently invaded Litchfield County in the western half of the State. In Massachusetts, on the other hand, and in one small area in New Hampshire, where there is less thorough information, American foul brood is largely confined to the eastern half of the State. Ultimately, when more information is at hand, if decisive and immediate steps to suppress these diseases are not taken, Massachusetts, as well as the rest of New England, will undoubtedly reveal a mass of infection.

EVIDENCE THAT BEE DISEASES WERE NOT RECENTLY INTRODUCED INTO MASSACHUSETTS.

In 1828 Dr. James Thatcher wrote (p. 4):[a]

> The destructive ravages of the bee-moth have in many places almost annihilated our bee establishments and discouraged all attempts to renewed trials. No less than a hundred hives have, the past season, been entirely destroyed by that enemy within the towns of the county of Plymouth, and in places where a single hive has yielded one hundred pounds of honey.

At first reading this might appear, so far as bee diseases are concerned, of slight import. General experience shows, however, that strong, healthy colonies of bees are seldom if ever destroyed by wax moths, the presence of the latter being secondary as a result of a weakened condition of the colony from loss of its queen, disease, or the like. Consequently, wherever there is extensive complaint of damage from moths, there the presence of disease is to be suspected.

[a] A Practical Treatise on the Management of Bees. * * * By James Thacher, M. D., Boston, 1829.

In 1831, again, Dr. Jerome V. C. Smith[a] says (p. 41):

> Great lamentations are heard about the bee-moth, * * * whose devastations in the New England States have been described as something frightful.

More specifically he says (p. 43):

> In the interior of Massachusetts, New Hampshire, and Connecticut the farmers have become heartily discouraged in their attempts at cultivation, and lamentably appear to have abandoned them entirely.

Such reports strongly suggest that some unknown agent, as disease, depleted the bees and made them subjects for the devastations of bee moths. Even at that early date Doctor Smith intimates (p. 41) that all the damage "attributed to it [the bee moth] . . . admits of some doubt." Without being conclusive, such evidence must be accepted as strongly indicative of the existence of disease, probably of American foul brood, in Massachusetts.

About 1896 the writer saw in Worcester a hive in which the bees had died from some affection of the brood. It was diagnosed then as a disease which is now designated as American foul brood. Only one hive out of several was affected.

European foul brood, on the other hand, is of more recent introduction in the State. It was first recognized in New York State in 1895, where it is thought to have been introduced in importations of bees from the south. As the map shows, this disease has probably spread into Massachusetts from New York.

The late Mr. James F. Wood, of North Dana, noticed in the Connecticut and Swift River valleys of Massachusetts a brood disease of bees which made its appearance in that region about 1901. It did much damage, destroying all the bees in the yards where it appeared; but, as it was apparently not American foul brood, Mr. Wood regarded it as a new disease. From a description made in an address before the Worcester County Bee Keepers' Association by Dr. James B. Paige,[b] of Massachusetts Agricultural College, who was closely associated with Mr. Wood and who made a study of the disease, it would appear to have been European foul brood. Being first observed in Massachusetts in 1901, it would have had ample time to have spread from New York State.

With so little recorded data, it is difficult to draw positive conclusions regarding the distribution of these diseases in years gone by. It is far more important, however, to realize that they have existed in the State for a considerable time, that they have been and are a decided check on the progress of bee keeping, but that they can now be counteracted.

---

[a] An Essay on the Practicability of Cultivation of the Honey bee * * *. By Jerome V. C. Smith, M. D., Boston, 1831.

[b] Wood's Bee Disease. American Bee Keeper, Vol. 16, pp. 69–70, 1906.

THE SPREAD OF BEE DISEASES.

Both types of foul brood are highly infectious; the way in which they are spread might be compared to the spread of typhoid fever in human communities. Honey is the common carrier of this infection, just as milk and water are the agents which frequently spread typhoid fever.

In diseased colonies of bees, practically every part of the hive becomes contaminated with the germs of the disease. Consequently, when disease is found in the bee yard, every precaution must be taken that bees from healthy colonies do not come in contact with any part of the diseased colonies or hives. Honey, being so irresistible to the bees, is of course the main thing to be guarded. Since diseased colonies soon become weakened, from the lack of young bees to replace those dying from old age, they are less likely to maintain guard against robbers, which are a great source of danger in the spread of infection. Immediately on discovery, diseased colonies should be treated.

FEEDING HONEY.

In these days of widespread bee disease it is dangerous to feed any honey to bees; it is far preferable and less dangerous to supply them, if they need stores, with a sirup of sugar and water, half and half. It is safe to feed honey to bees only when it has been vigorously boiled for at least a half hour, and, as Doctor Phillips has recently stated,[a] in order to avoid risk, "it is better to make this an hour" (p. 12). In boiling, the honey should always be diluted with equal parts of water in order to prevent scorching.

DISINFECTION OF TOOLS AND HANDS.

All tools used in manipulating diseased bees, as well as the operator's hands, should be thoroughly disinfected before opening a healthy colony.

DEPLETED HIVES FROM GREENHOUSES A SOURCE OF DANGER.

In Massachusetts particularly there is another source of infection which is difficult of control. Each year several hundred colonies of bees are placed in greenhouses by those who grow cucumbers under glass. In the adverse conditions of the cucumber house the hive soon becomes depleted and is promptly thrown on the rubbish pile. If the hive originally came from a foul-brood region—which is not

[a] The production and care of extracted honey. By E. F. Phillips, Ph. D. Bul. 75, Pt. I, Bur. Ent., U. S. Dept. Agric., 1907. Price 5c, from Superintendent of Documents, Washington, D. C.

improbable, inasmuch as the greenhouse men buy their bees wherever they can get them—all the bees within a radius of several miles of the rubbish pile are exposed. More than once the writer has seen from two to a half dozen such hives cast out on the rubbish heap. While there is no intention of endangering neighbors' bees, it is as criminal to throw out of doors any hive in which bees have died as it is to shake the bedding or throw the waste of the sick room from the window. Discarded hives and their contents, if the cucumber grower does not wish to render the wax, should be thrown under the boiler.

PURCHASING BEES AND QUEENS.

In purchasing bees the buyer should be as certain that he is getting stock free from disease as is the farmer, who purchases cows, that these have no tuberculosis. A region where the disease is not found or where it has been successfully suppressed can be reinfected by one careless purchase. For instance, speaking of New York State, Mr. Charles Stewart says: [a]

> Just as we [the inspectors] were feeling that we had nearly stamped it [the disease] out and were masters of the situation we discovered that at least one if not two fresh importations had been made in a section of the State where no trouble of this kind [European foul brood] formerly existed (p. 55).

To some degree this applies to purchasing queen bees. It is usually safe, however, to introduce a queen if she is removed from the cage in which she is mailed and is introduced unaccompanied by her escort of workers. The candy which is shipped with queens should never be put into a hive.

STRAY BEES.

There is one agent over which the bee keeper has no control and which should cause him no anxiety if a considerable territory is freed of the diseases. It is a well-known fact that under certain conditions, as, for instance, in storms and heavy winds, bees enter hives other than their own. Obviously, then, such bees in their interchange of hives may spread the infection. This only emphasizes the urgency of cleaning the disease out of a whole State, or, better, out of a block of States, as New England. Cooperation is the key to the situation.

BROOD DISEASES CAN BE CONTROLLED.

Enumeration of the methods by which disease is spread should not convey the idea that these diseases can not be combated, for it has been thoroughly demonstrated that by judicious and persistent manipulation both of them can be successfully controlled and sup-

---

[a] Report of the Meeting of the Inspectors of Apiaries, San Antonio, Tex., November 12, 1906. Bul. 70, Bur. Ent., U. S. Dept. Agric., 1907.

pressed. The rapidity with which they spread, however, makes cooperation of bee keepers throughout the State or States essential. Sixteen States and Territories[a] now have legislation and inspectors designed to protect the bee keepers from the spread of these infectious diseases. The State nearest to Massachusetts is New York, where the annual loss of bees alone is shown in the following figures:[b]

Previous to 1899, in a limited area, the loss of bees alone is estimated at	$39,383
In 1899, when concentrated effort to suppress bee disease was begun, it amounted to	25,420
In 1900	20,289
In 1902	10,853
In 1903 the loss of the previous year was halved, making it	5,860
In 1903 it was	4,741
In 1904 it was again divided by two, being	2,220
In 1905 there was again a reduction of nearly 50 per cent	1,725
Total loss of bees, covering about ten years	110,491

In other States the encouraging results of inspection and persistent effort to suppress the inroads of disease are similar.

INSPECTION.

Inspectors are not alone police officers. They are educators, up-to-date bee keepers giving instructions in modern methods of bee keeping, thoroughly experienced in treating foul brood, and a great stimulus to progress. They are necessarily exacting and thorough; but they are not out to seize and condemn; their aim is to help the bee keepers, to assist them in a cooperative effort to eradicate disease, and to promote bee keeping. Of course the individual can do much for himself by keeping his own yard clean and free from infection; but he is in constant danger of reinfection from his neighbors, if they fail to cooperate with him.

A BRIEF ACCOUNT OF TREATMENT FOR BROOD DISEASES.

Those who are most experienced in the suppression of brood diseases are agreed that "shaking,"[c] which is practically "shook swarming," and modifications of this process are the only successful methods.

[a] The legislation empowering this inspection in twelve of these States and Territories is reprinted from Bul. 61, Bur. Ent., issued November 5, 1906, and entitled "The Laws in Force Against Injurious Insects and Foul Brood in the United States," compiled by L. O. Howard and A. F. Burgess.

[b] These figures are afforded by a compilation made in 1905 by Mr. Charles Stewart from the records of the commissioner of agriculture of New York State.

[c] The various treatments are described by Dr. E. F. Phillips in Circular 79, of this Bureau, mentioned above.

SHAKING.

Shaking is briefly this: As soon as a colony is discovered diseased, and at a time when there would be no robbing, it is shaken on the old stand into a hive containing new frames with narrow strips of foundation. In this way none of the contaminated honey is deposited in the new cells. Should the disease reappear, which is sometimes the case, the operation must be repeated. In order to prevent the bees from swarming out, the queen may be caged in the hive for a few days or the entrance closed with a piece of queen-excluding zinc. Care should be taken not to scatter parts of the contaminated hive, particularly the honey, where bees can get at them.

DISINFECTION OF HIVE MATERIALS.

Honey, unless it has been boiled as above described, should never be fed back to bees. Wax, however, after being rendered and manufactured into foundation, is commonly used without apparent danger. It is customary in the East to put bees back into hives which have formerly contained diseased colonies, after they have been thoroughly cleaned of all bits of wax and honey. In the West, however, the hives are either burned out with oil, with a blue-flamed torch, or are disinfected with strong chemical disinfectants. All frames should be burned, since it does not pay to clean them.

O

BULLETIN No. 125. OCTOBER 1, 1908.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION.

SHADE TREES

BY

E. A. Start, G. E. Stone and H. T. Fernald.

The Massachusetts Forestry Association has co-operated with the station in the preparation and publication of this bulletin. For valuable suggestions and the sections on Shade Trees and the Law, The Tree Warden's Outfit and Duties, and Tree Guards, we are indebted to Mr. E. A. Start, the secretary of the association. The cost has been equally divided between the association and station. Besides the subjects mentioned above, the bulletin discusses the characteristics and value of the more important species of shade trees and their suitability for different environments; it gives brief directions for transplanting and pruning; describes the best methods of tree surgery, and includes chapters on the injurious effects of gas and electricity and the best methods of prevention. The more important insect enemies are described and the best known methods of treatment are given. The bulletin will prove of value to all who are interested in the planting and care of shade trees.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

CONTENTS.

SHADE TREES.

G. E. STONE, E. A. START and H. T. FERNALD.

The general interest in shade trees, particularly in the eastern states, well illustrated by the amount of money expended upon them and the many questions asked concerning their welfare, has created a demand for a brief practical manual covering the various questions relative to shade trees and their management. The Massachusetts Agricultural Experiment Station and the Massachusetts Forestry Association, having both had occasion to realize this need in their work, have united in the publication of this bulletin.

Shade trees add greatly to the desirability of a community as a place of residence, and their aesthetic value cannot be estimated in dollars and cents, but it is no exaggeration to say that the complete destruction of all the trees and shrubbery would reduce the valuation of some cities and towns fifty per cent.

Trees also possess a utilitarian value which is recognized by the courts, and for the careless destruction of street trees the abutter is entitled to compensation. A street tree adds value to real estate in the same way that a sidewalk or curbing does, but while the sidewalk and curbing may deteriorate a tree for many years increases in value.

Too much emphasis cannot be laid upon the care of shade trees. They, as well as crops, give the best results under cultivation, but unfortunately proper conditions do not always exist. Trees grow fairly well on lawns, however, especially when the lawn is occasionally fertilized, but mowings devoted to the production of hay are not at all suitable to the development of certain species, such as the elm. Many of the elms on our village greens, where no attention is given to their care, are unhealthy and sadly in need of better treatment. In many places they have been growing in sod for years where no fertilizer has been applied, and a hay crop removed annually, and in such cases one year's use of a plow and harrow, together with manuring and some kind of cropping, would work wonders. The leaves of elm trees under cultivation will change their color and double their size very quickly.

A tree in perfect health should make a vigorous growth and have large, dark green leaves, and the bark should be healthy in hue. If the conditions are otherwise the tree is not perfectly healthy and is more likely to fall a prey to certain diseases.

In applying remedies to trees it is well to be on the conservative side, since it is a very easy matter to cause them serious injury. The different spraying mixtures and banding substances recommended for trees are not always to be depended upon, and many trees are injured by their use, hence a word of caution is not out of place. Unfortunately at the present time it is necessary to be on the watch for bogus "tree doctors" and their stock of patent hypodermic injections guaranteed to rid trees and vegetation in general of insect and fungous pests, and other nostrums of a "sure-cure" nature. The tree warden should be, and often is, a man of intelligence and common sense and one to be called upon for advice pertaining to trees. There are also competent firms and professional men who are capable of giving advice in regard to the proper treatment of trees.

See "Woodland and Roadside," Vol. V, No. 3, June, 1906, and the Ann. Rept. of the Hatch Experiment Station for 1906.

THE LAW OF SHADE TREES.

E. A. START.

THE OFFICE OF TREE WARDEN.

For several years prior to 1899 there was a provision in the Massachusetts statutes that towns might elect tree wardens. By the act of that year it was provided that every town must elect a tree warden and the duties and powers of the office were defined. The tree warden law of 1899, with certain amendments in details, remains in force today and regulates the care of shade trees in every town in the commonwealth. It does not apply to cities.

The tree warden is an elective officer, with very complete powers in his own jurisdiction. He is responsible only to the body of citizens that elects him, although in the matters of making regulations and of locating trees to be planted he must act in conjunction with the selectmen. The warden's success in administering his office depends in a great measure upon the interest of the people of his town in their trees and the support which they give him. An intelligent, capable tree warden, well supported by his constituents, may be a power for good in maintaining and improving the trees of his town. The reverse of this proposition is equally true.

The tree warden holds a responsible position which carries with it a duty to his town. The trees that are put in his care are one of the chief resources for maintaining the beauty and health of the place. His duty is not merely the negative one of preventing cutting and disfigurement. He should plan systematically to maintain all existing trees at their maximum of attractiveness by careful, well-advised pruning, not careless cutting; by protecting with guards all promising young growth and all older trees that are liable to disfigurement by horses or otherwise; by preventing companies running wires above ground and pipes below ground from injuring the branch or root systems; and by planting or encouraging planting along roadsides. He should be an active apostle of the cause of the trees in his town, leading public sentiment and creating a better understanding of the value of good trees in the community.

The tree warden is elected at the annual town meeting,[1] and his compensation may be determined by the town, or in default thereof by the selectmen. He has the care and control of all public shade trees in the town, except those in such public parks, open places or roads as may be under the jurisdiction of park commissioners or state highway commissioners.[2] In some towns which have park commissioners, the tree warden is given the care of shade trees in the parks by the commissioners. The latter may, of course, entrust this work to the tree warden as well as to anyone else but such an arrangement does not relieve the commissioners of ultimate responsibility for the park trees.

PUBLIC SHADE TREES AND THEIR PROTECTION.

Public shade trees are defined by the law as "all shade trees within the limits of a public way."[1] It may be assumed in the absence of a court decision on the point, that not only mature trees, but any young tree that is within the limits of a public way, and that now or in the future will add to the beauty and comfort of the highway, is protected by the law and within the warden's control.

The setting out and maintenance of public shade trees and the expenditure of money appropriated therefor is a part of the tree warden's duties; and no trees may be planted by individuals without the approval of the tree warden, and after a location has been obtained from the selectmen, or road commissioners where authority has been vested in them.[1]

Regulations for the care and preservation of public shade trees may be made by the tree warden, with the approval of the selectmen, and when so made and approved shall be posted in two or more public places, and shall have the force and effect of town bylaws. Such regulations may impose fines of not more than twenty dollars in any one case.[1]

Public shade trees may not be cut or removed, in whole or in part, except by the tree warden, his deputy, or a person licensed by the tree warden to so cut or remove said tree; and a tree may be removed only after a public hearing, at a suitable time and place, due notice thereof having been posted in two or more public places in

[1] R. L., ch. 11, s. 334.
[2] R. L., ch. 53, s. 12, amended by Acts of 1908, ch. 296.
[3] R. L., ch. 53, s. 12, amended by Acts of 1908, ch. 296.

the town, and upon the tree.[1] The hearing having been duly held, the tree warden may exercise his discretion in granting or refusing the removal permit. The hearing gives an opportunity for an expression of public sentiment. The warden is not subject to any action taken by citizens at the hearing, but it is presumed that he will pay due regard to the amount of interest shown, the representative character of the attendance, and the weight of testimony as to the benefit of removal or retention.

The laws expressly prohibit the mutilation, injury or disfigurement of trees, and in the case of public shade trees[2] it is the duty of the tree warden, under his general care of the trees, to see that these provisions are enforced. No one may wilfully and maliciously injure, deface or destroy an ornamental or shade tree in a public way or place, or negligently or wilfully suffer an animal driven by him or belonging to him to injure, deface or destroy such tree. No one may affix to a tree in a public way or place a playbill, picture, announcement, notice, advertisement or other thing, or cut, paint or mark such tree, except for the purpose of protecting it and under a written permit from the tree warden, or in a city from the officer having charge of said trees.[3] The penalty for violation of this statute is a fine of not less than five nor more than one hundred dollars, and a vigorous enforcement of its provisions, with the levying of fines in a few cases, will generally result in a very respectful attitude toward its provisions on the part of the public. It will, however, be found in most cases that a courteous warning, with information as to the exact purport of the law, will be sufficient to secure its enforcement.

The municipality has absolute control of trees within public ways as regards care, trimming, retention and removal, if public necessity requires, but when a tree is cut the wood is the property of the abutting owner.

The tree warden should at all times see that trees are so trimmed as not to obstruct in any way the proper use of the highway, or endanger travelers thereon. When locations have been granted to public service companies for wire, poles and equipment necessary to the proper conduct of their business, it becomes the duty of the tree

---

1 R. L. ch. 53, s. 13, amended by Acts of 1908, ch. 296.

2 R. L. ch. 185, s. 7. and ch. 208, s. 100, 101, 102.

3 R. L. ch. 208, s. 100, 101, 102, 104 (amended by Acts of 1905), ch. 279. s. 2.

warden to see that the trees are protected and given full opportunity for healthful and beautiful growth, but he should remember, at the same time, that the corporation should have a fair opportunity to carry on its business. This raises some delicate questions. The location of poles and running of wires on roads and streets lined with shade trees, without serious injury to the trees, often involves careful and intelligent study. It will generally be found possible to meet the conditions in a fairly satisfactory manner. If properly approached the companies will usually meet reasonable requirements without opposition. In case of trouble with linemen or foremen it is best to make a temperate statement of the case to the most accessible official of the company, when satisfactory orders to the men will usually be forthcoming. It should be borne in mind that the men at the heads of these companies are good citizens, law-abiding, and with an interest in maintaining the beauty of the state. Sometimes they are unwisely approached as public enemies.

The tree warden has no jurisdiction over trees on private land, but if such trees grow beyond the boundary of such private land and the branches interfere with any public use, that part which projects into the public way may be treated by the warden as if it were a public shade tree. Conversely, if a public shade tree projects over private property, so that it becomes a nuisance, as when the branches interfere with the windows of a house, the property owner may cut such limbs as overhang his line if the tree warden declines to do so.[1]

Tree wardens and owners of trees may obtain advice and assistance through the Massachusetts Agricultural Experiment Station at Amherst and the Massachusetts Forestry Association, No. 4 Joy St., Boston. The State Forester, at the State House in Boston, deals with all questions relating to trees in larger growths, as woodlots and forests. The bulletin of the Massachusetts Forestry Association, *Woodland and Roadside*, is published nine times a year, and is sent to every tree warden. It gives information as to methods of work, legislation in the state, legal cases involving tree law and other matters which the wardens should know.

[1] Holmes case (Lexington), decided by Judge Bond in the Superior Court, Oct. 1, 1907, an appeal from the District Court, Concord.

WOODLOTS AND HIGHWAY TREES.

In our country towns one of the most difficult questions arises from the cutting of woodlots having frontage on a public way. Often it is desirable that a fringe of trees or at least a row of selected shade trees within the highway be preserved, while the lot owner in too many cases wishes to cut them, and often does make a clean sweep to the roadway, in defiance of law. After the cutting is done, the only remedy is by a prosecution or an action at law. If the warden knows what is going on he can prohibit the cutting of any trees within the highway lines, and should enforce his prohibition. In either case his first step must be to determine the location of the highway lines, and this is the most difficult part of the case. It is most important that every town in Massachusetts should have its public ways surveyed and their lines determined. At present these are very vague, depending upon ancient layouts which perhaps were never accurately surveyed.

SHADE TREES ON STATE HIGHWAYS.

State highways form an exception to the jurisdiction of the tree warden, as heretofore stated. The exclusive care and control of all trees, shrubs and growths within the limits of state highways is given to the state highway commission, which has authority over all planting, trimming, cutting or removal on such highways.[1] The provisions in regard to defacement, injury or disfigurement are to be enforced by the tree warden, however, but should he fail to act in the case of a state highway within thirty days after the receipt of a complaint in writing from the Massachusetts highway commission, the commission may proceed through its own agents to enforce these provisions also.[2]

SHADE TREES IN CITIES.[3]

The law relating to city shade trees differs somewhat from that in towns. There is no tree officer specifically required by law. The mayor and aldermen, street commissioner and park commissioners

[1] Acts of 1905, ch. 279, amended by Acts of 1908, ch. 297.
[2] R. L. ch. 208, s. 104, amended by Acts of 1905, ch. 279, s. 2.
[3] R. L. ch. 53, s. 6 (amended by Acts of 1908, ch. 296), and s. 7, 8, 9, 10, 11,

are the officials generally charged with responsibility for the trees. Springfield has a city forester, Newburyport and Fall River have tree wardens. The general law requires the authorization of the mayor and aldermen, or some city officer having the care of the public ways, for any planting of trees therein. Such trees are the property of the abutting owners, but may be removed by the mayor and aldermen if public necessity requires.

No one may cut or remove an ornamental shade tree standing in a public way in a city except after giving notice of his intention to the mayor and aldermen and receiving their consent.

The mayor and aldermen of a city are required during the last four months of each year to designate for preservation ornamental and shade trees, not otherwise protected, selecting at least one tree in every thirty-three feet where such trees are growing and are of a diameter of one inch or more. Such trees are to be marked by a nail having the letter M plainly impressed on its head, driven into the tree at a point between four and six feet from the ground on the side toward the centre of the highway. These nails are to be furnished by the secretary of the state board of agriculture. There is a fine of not less than five nor more than one hundred dollars for injuring, defacing or destroying trees so marked, or the nails affixed to them.

The use of M nails was formerly provided for in towns, but the present law placed all the public shade trees in towns under the protection of the tree warden, and the nails ceased to be needed.

The general penalties for injuring trees (chaps. 185 and 208, *Revised Laws*) apply alike to cities and towns.

TREES ON PRIVATE PROPERTY.

For injury to trees upon private property by persons other than the owner the law provides punishment by imprisonment not exceeding six months, and triple damages may be assessed for wilful injury of another's trees.[1]

[1] R. L., ch. 208, s. 100, and ch. 185, s. 7.

SELECTION, PLANTING AND CARE.

G. E. STONE.

SUITABLE TREES FOR STREETS AND ROADSIDES.

As a rule, those trees should be planted which are known to thrive well in the particular environment under consideration. Because a tree does not grow naturally in one locality is no evidence that it will not thrive in some other, and it is well known that the species of tree peculiar to wet places will grow in those inclined to be dry, but there is a limit to the adaptability of trees as regards their best growth, which should be taken into consideration. The nature of soils and other considerations, therefore, enter very largely into the problem of selection and planting of shade trees.

The following list* is taken from the report of Mr. W. F. Fox, Superintendent of State Forests, New York. It should be stated that there is considerable difference of opinion in regard to what are the best trees to plant; moreover, some of these trees might thrive in one location and in another be entire failures. Perfection is no more common to trees than to the human race, and since all trees have their defects the important question is to find those possessing the least. Some of the trees given in this list are not especially suited to Massachusetts, although in other states they would prove to be of value as street trees:

WIDE STREETS.	NARROW STREETS.
American or White Elm.	Norway Maple.
Hard or Sugar Maple.	White or Silver Maple.
Tulip Tree.	Red Maple.
Basswood (Linden).	Ailanthus.
Horse Chestnut.	Cucumber Tree.
Sweet Gum.	Ginkgo.
Sycamore.	Bay Willow.
White Ash.	Pin Oak.
Scarlet Oak.	Red Flowering Horse Chestnut.
Red Oak.	Black or Yellow Locust.
White Oak.	Hackberry.
Honey Locust.	Hardy Catalpa (speciosa).
American Chestnut.	Lombardy Poplar.

* Seventh Report of the Forest, Fish and Game Commission of the State of New York, 1903.

The **American elm** is one of the most widely planted trees in New England, and the best developed types are grand, majestic and more beautiful than any other tree known. It is difficult to make the elm thrive on dry, gravelly soil, and when growing in such situations it is inclined to be lanky. It is best suited to a fertile, more or less moist soil, and is well adapted to lawns and roadsides, but not at all to mowings. The high branching habits of this tree render it the best type we have for streets on which there are numerous wires. In recent years it has become infested with the elm leaf beetle, which has been the means of discouraging its planting. Olmsted Bros., landscape gardeners, say in one of their reports :

" We believe, however, that notwithstanding this objection (which, of course, can be more or less remedied by destroying the insects), there is no other sort of tree which so well gives the effect of a lofty, overarching canopy of foliage, which observation of village greens leads us to believe is the effect mostly to be desired."

The elm has a habit of shedding its leaves and its twigs, and is occasionally affected to some extent with a leaf fungus (Dothidella).

The **rock maple,** like the elm, has been extensively planted, and is comparatively free from fungous diseases. It is one of our handsomest trees, and will thrive on drier and poorer soil than the elm, but is susceptible to sun scorch.

The **tulip tree** is another excellent tree for roadsides, although not very much planted, and is probably better suited to lawns and country streets than to the hard usage it might receive on city streets. It is indigenous to different parts of Massachusetts, but it is not an easy tree to transplant and make live.

The **basswood, or American linden,** is a native of Massachusetts, but is seldom planted on streets, although it could be used to advantage. It is a beautiful tree, with bright green foliage and graceful and symmetrical when young.

The **European linden** is much planted and makes a fine avenue. The tree is not, as a rule, long-lived, however, and is often subject to frost cracks.

The **horse chestnut** was introduced from Europe, and is often planted on streets. It is not a long-lived tree, and is generally affected with a leaf-spot fungus (Phyllosticta), sometimes losing much of its foliage on this account, and often many of the twigs are winter killed and affected with Nectria. The red flowering horse chestnut is occasionally planted and is preferred by many.

The **sweet gum** is a native further south, Massachusetts appearing to be a little too far north for its best development, as it is often subject to winter killing and frost cracks.

Fine specimens of our **native sycamore** may often be seen on lawns and near roadsides, but it is seldom planted as a street tree with us. It is severely affected with a leaf-spot fungus (Glœosporium), which sometimes defoliates two-thirds of the tree. The younger twigs have been known to winter kill badly, but the tree will stand a great deal of hard usage and neglect.

The **white ash** grows fairly rapidly and often makes fine avenues. In poor, dry soil, however, it is likely to be attacked by borers and scale insects, and has suffered of late years from extremes of weather.

Fig. 1. Showing ideal tree-belt.

The **scarlet oak** is one of our most beautiful shade trees. It grows rather slowly under ordinary conditions, but is being planted more extensively than formerly. The beautiful scarlet foliage in the fall is much admired. As a native it is confined largely to dry soil, being associated generally with the yellow or black oak. It is, however, a difficult tree to transplant successfully. In many cases it has been effectively alternated with some tree of rapid growth, like the Carolina poplar, the poplars being removed when the oak has reached a fair size. On country streets and roadsides it should be more commonly planted.

The **red oak** is a common tree by roadsides, but is seldom planted on streets. This is a tree of fairly rapid growth, and may be used to excellent advantage as a roadside tree. Mr. John A. Pettigrew, Superintendent of Parks, Boston, speaks highly of the red oak, and states that no better trees can be planted than the red and scarlet oaks.

The **white oak** is seldom planted as a street tree, but makes magnificent individual specimens for lawns and roadsides. It is occasionally affected with a leaf spot fungus (Glœosporium).

The **honey locust** is not native with us, but may occasionally be seen growing along roadsides. City Forester W. F. Gale, of Springfield, states that he finds it easily broken by winds and susceptible to borers.

The **American chestnut** is seldom used for a street tree, although seedlings will make ornamental specimens of fairly rapid growth. They are regarded as dirty trees and are easily broken by winds, and when old require considerable pruning to dispose of the dead wood.

The **Norway maple** is a wide, spreading tree, with large leaves which give a dense shade. It is well suited for lawn planting and highly recommended for streets and roadsides.

The **white or silver maple** is not equal to the sugar maple, since it is more easily broken down by ice and winds. It grows very rapidly, and in Connecticut, where magnificent specimens may be occasionally seen, it attains a great size. It is planted to some extent on avenues. It is affected by a leaf spot fungus (Rhytisma), which, however, does little harm.

The **red maple** branches low and its foliage is inferior to that of the rock maple. During the past four years these trees have rapidly deteriorated in Massachusetts, owing to winter killing, and are dying in large numbers,

The **Ailanthus** may be termed a "scavenger tree," as it will grow anywhere and will stand harder conditions than any other tree. It is frequently found growing along railroad embankments, and often grows out of the side of a stone wall and on dumps, etc.; in fact, no conditions seem to be too severe for it. It is little used as a street tree, but excellent individual specimens may be seen here and there. If used as a street tree the fertile form should be selected, owing to the disagreeable odors arising from the sterile trees.

The **cucumber tree, or magnolia,** has been highly spoken of by many authorities as a roadside tree. Mr. Fox says that it fulfills all the requirements of a desirable shade tree.

The **Ginkgo, a Japanese species,** is occasionally seen on lawns, and forms a handsome avenue on the Agricultural grounds, Washington, D. C. It grows fairly well in Massachusetts, but better further south. We have seen large specimens of this tree in Providence, R. I., and it may be used under favorable conditions as a street tree, and is certainly worth trying.

The **pin oak** is native in Massachusetts only in the Connecticut valley, and when young is one of our most graceful trees. Its lower branches have a tendency to droop, consequently it is difficult to prune and maintain its characteristic beauty. It is well suited to lawns and narrow streets, where high pruning is not necessary.

The **black or yellow locust** is found growing spontaneously in many localities in this State. The old trees are often ugly in appearance and are very susceptible to attacks from borers.

The **hackberry,** which is closely related to our elm, is found occasionally in some of our river valleys and requires a good soil for development. City Forester W. F. Gale, of Springfield, advises planting this tree instead of the elm, as it is less susceptible to insects, and it is favorably spoken of by others.

The **hardy catalpa (speciosa)** is more at home in the west, although used here as an ornamental tree. With us it does not sustain its western reputation for growth, and there is at the present time some doubt as to its value as a tree for this locality, although some good authorities do not hesitate to recommend it.

The **Lombardy poplar** was formerly cultivated around dwellings, but owing to its habit of growth it gives little shade. It is used in parkways, and is occasionally planted for screens about dwellings. It is more or less susceptible to borers, but some good authorities recommend it for narrow streets.

Among other trees which might be mentioned is the **Carolina poplar,** which because of its rapid growth is extensively planted at the present time. Good avenues of these trees may be seen about Boston in the Metropolitan Park System, where they have been cut back to form a compact head. It is, however, subject to various troubles.

The **Italian poplar,** which grows even more rapidly than the Carolina, is occasionally used, but it is affected by a rust (Melampsora).

The **white poplar** is occasionally seen on streets, and makes exceptionally rapid growth.

The **yellow and swamp white oak** are handsome trees, and the latter might be used to advantage along country roadsides where the soil is moist.

Occasionally excellent effects are secured on roadsides by the use of **white pines, willows, Scotch larches and Norway spruces,** the latter sometimes being alternated with decidious trees.

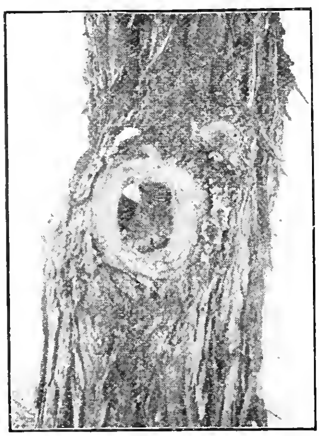


Fig. 2. Showing entrance to cavity in tree caused by the removal of large limb and wound not properly cared for.

Many exotic species have recently been introduced, which may prove to be excellent shade trees. Among these may be mentioned the **Japanese elm,** which is a handsome tree of rapid growth.

The large and unrivalled collection of trees to be seen in the Arnold Arboretum furnishes good examples for consideration, and undoubtedly Prof. Sargent would recommend others worthy of trial. This list of trees was submitted to different persons familiar with the subject of shade trees and their care, in order to obtain their opinions in regard to it. Mr. E. W. Breed, Forester of the Massachusetts Highway Commission, who has had considerable experience in planting roadside trees, states that the first question in determining the varieties of trees to be used should be the soil conditions, and the next the width of the street, its kind, whether straight, curved, level or hilly, and the obstructions, such as electric wires, poles, etc. He mentions the following trees as being suitable for city and country streets:

For wide streets, the elm, rock maple and white maple, basswood, red oak and white ash ; and for narrow streets, the Norway maple, English elm, scarlet oak, ginkgo, red maple, bay willow. For country roadsides he recommends the tulip tree, chestnut, white willow, honey locust, white oak, pin oak, sweet gum, horse chestnut, cucumber tree, catalpa (speciosa), American larch and Ailanthus. He lays great emphasis on selecting the right tree for the right place.

Superintendent Pettigrew mentions favorably the following trees as being adapted to more or less severe conditions, and best suited to city planting: English elm, horse chestnut, linden, Ailanthus; while the rock, red, silver and Norway maples, the ginkgo, basswood, tulip, red and scarlet oaks, cucumber tree and hackberry are better suited to suburban planting. He recommends the Lombardy poplar as an excellent tree for narrow streets, but does not recommend the black or yellow locust, catalpa (speciosa) and sweet gum because they are not hardy in this region; the chestnut he does not recommend because it is subject to fungous disease.

Mr. Christopher Clark, the veteran city forester of Northampton, values highly the rock maple, tulip, all the oaks and the elms for wide streets; and for narrow streets he recommends the Norway, red and white maples, pin oak, red flowering horse chestnut, hardy catalpa, Lombardy poplar and bay willow.

City Forester W. F. Gale, of Springfield, recommends for wide streets the elm, hackberry, rock maple, tulip, white, scarlet and red oaks, linden and the sycamore; for narrow streets, the pin oak, Norway, red and silver maples, sweet gum, cucumber tree, catalpa (speciosa), ginkgo and red flowering horse chestnut.

Some mention should be made of the different kinds of shrubs growing along roadsides which greatly add to the attractiveness of country drives, and among these may be mentioned alders, viburnums, andromedas, clethra, cornels, New Jersey tea, sumach, spiraeas, shadbush, crataegus, witch hazel, etc. The duty of the tree warden is to see that these growths are maintained and not ruthlessly destroyed by highway surveyors who have charge of the roadbeds only.

The aesthetic value of these natural growths, constituting as they do the most charming landscape effects, is many times the economic value of the land upon which they grow.

RAPIDITY OF GROWTH OF TREES.

The variation in the growth of trees, due to the influence of many different factors, is very great, and even when trees of the same age are growing side by side great difference in the size and development are noticeable. A chestnut tree will, under certain conditions, attain a diameter of three feet in fifty-six years, while another may require one hundred and fifty years to reach a diameter of eighteen inches. The average diameter of twenty ash trees measured by us was sixteen inches in twenty years, and Italian poplars will occasionally grow twenty-six inches in the same period. On the other hand, many instances might be mentioned where trees have made very slow growth. To obtain the approximate growth of trees in any particular locality would require measurements of a very large number of specimens.

The following list, showing the average growth of trees, is taken from Supt. Fox's report, and represents approximately what a three-inch sapling will develop into in twenty years:

White maple,	21 in.	Yellow locust,	14 in.
American elm,	19 in.	Hard maple,	13 in.
Sycamore,	18 in.	Horse chestnut,	13 in.
Tulip tree,	18 in.	Honey locust,	13 in.
Basswood,	17 in.	Red oak,	13 in.
Catalpa (speciosa),	16 in.	Pin oak,	13 in.
Red maple,	16 in.	Scarlet oak,	13 in.
Ailanthus,	16 in.	White ash,	12 in.
Cucumber tree,	15 in.	White oak,	11 in.
Chestnut,	14 in.	Hackberry,	10 in.

TRANSPLANTING.

Too little attention is given to the details of transplanting. It is quite essential that attention should be paid to the soil and moisture conditions suitable for growth. Landscape gardeners recommend planting a few trees well rather than many poorly, and when one recalls the large amount of poor planting seen around dwellings and the weak-looking, half-fed, diseased specimens of trees and shrubs this advice will appear pertinent.

The funds of towns will not always allow the appropriation of a large sum of money for transplanting trees, and one must do the best he can with the conditions under which he has to labor. Special attention, therefore, should be given to the adaptability of certain species to conditions, since the cost of preparing suitable conditions is too often beyond the funds allowed for this purpose in most towns. Mr. John A. Pettigrew, Superintendent of the Boston parks, says that it is safe to say that if one has twenty dollars to spend on planting a street tree, nine-tenths of it should be spent on the preparation of the ground.

Olmsted Bros., landscape gardeners, in one of their reports to an association with limited funds, says in regard to the planting of elms :

"It would be better to prepare tree beds two to three feet deep and twenty to thirty feet square, filled with good loamy soil where the present ground is dry and sandy gravel, even if the expense of doing so would be so great that only one tree a year could be planted." Few trees, however, outside of those planted in the Arnold Arboretum and on a few private estates receive any such treatment, but it is hoped that much more attention will be given to good planting in the future. The majority of street trees which are planted are not supplied with loam or placed in holes over three feet wide and fifteen inches deep. A hole six feet wide by twenty inches deep in any case should be the smallest used, and it should be as much larger as can be afforded.

When digging up young trees the roots should be preserved as much as possible and the more earth that can be taken up with the roots the better. The roots should not be exposed to the sun and wind, and if possible they should be kept covered and moist, for which purpose damp straw, bagging or sphagnum moss may be used.

It is usually the practice to place the best side of the tree toward the north and the poorest toward the south, since the light conditions on the south side are better and naturally better growth results. It is also advisable to lean a tree toward the direction of the prevailing winds, and if these are strong enough to interfere with the growth of the tree it should be fastened to a strong stake.

When the ground is prepared for planting the injured roots should be pruned so that healing may take place, and before being covered they should be properly arranged in the soil. According to good authorities trees should never be planted more than two or three inches deeper than they originally grew. It is more convenient for two men to set out a tree than one, as one can hold the tree in its proper position while the other is filling the soil in around the roots.

The top soil, if of good quality, may be used, but it is better to discard the poorer subsoil and replace it with loam. Manure should be sparingly used and thoroughly incorporated with the loam, care being taken not to bring it in too close contact with the roots. Towns and cities which do much transplanting might make good use of composted street cleanings, and if land were available for a small nursery it could be used to good advantage by tree wardens and foresters.

When a tree is being set out the soil about the roots should be well tamped. Most people apply water to the roots at the time of transplanting, and if the season is an unusually dry one the watering may be repeated occasionally, but persistent watering is injurious and many young trees have been killed in this way. If trees are kept well tamped when set it is not essential that water should be applied at all, and it may even be injurious by washing the soil from the roots and leaving air spaces. One of the most essential features in transplanting is to secure as nearly as possible normal conditions of the soil about the roots.

Watering large trees near their trunks is not a wise practice, since the feeding roots are quite a distance from the tree, and one might suppose that an elementary knowledge of tree growth would discourage anyone from doing this.

After the tree is set, a mulching of hay, straw or horse manure containing much straw may be used to help to conserve the moisture in the soil and keep down the grass and weeds which rob the soil of its moisture and food.

Transplanted trees require a certain amount of pruning to accommodate the leaf and root systems to one another, and it is generally necessary to cut back the branches to meet these requirements. (See Pruning.)

There are differences of opinion in regard to the transplanting of trees, and undoubtedly more than one method may be followed. Opinions also differ in regard to the best time of year for transplanting, but it may be said that most people prefer the spring to the fall. We are of the opinion that it is not advisable to plant too small trees, preferring elms and maples 2½ to 4 or 6 inches in diameter, since they take hold of the soil better.

At the present day many very large trees and shrubs are being transplanted successfully, and special machines have been designed for use in this work. The Hicks tree mover, designed by Mr. Isaac Hicks of Westbury Station, Nassau county, N. Y., is extensively used, and Mr. Hicks has achieved remarkable results in handling very large specimens of trees and shrubs; but these tree movers are expensive, and for trees 6 to 10 inches in diameter a pair of high, heavy truck wheels, with some simple improvised arrangement, may be adapted. At the present time many individuals are willing to pay a good price for large trees, and for these tree movers are admirably adapted and should be more extensively employed.

Most street trees are planted too closely for their best development. For the larger trees 70 to 100 feet would not be too much to allow, although trees may be planted 30 to 40 feet apart and every other one cut out when necessary. The courage to do this is, unfortunately, often lacking. The limbs of very large maple trees would touch if planted 55 or 60 feet apart.

On modern streets a space, or tree-belt as it is called, should be set apart for trees, but if this is not available it is best to plant the trees inside the sidewalk, as there they are much less likely to be injured by horses.

PRUNING.*

Besides the necessary pruning at the time of transplanting, the removal of dangerous dead wood and branches every two or three years is essential, and in the case of street trees the lower branches should be cut. When limbs are so close as to interfere it is best to remove them, and this should be done when the trees are young, in order that a better crown may be ultimately obtained. Mr. W. F. Gale, City Forester of Springfield, makes a practice of thinning and shaping his trees when young, thus obviating the necessity for too much thinning when the tree reaches maturity. The amount of dead wood annually found in trees is frequently quite large, and it costs about as much to dispose of it as it does to prune it.

In towns a distance of 10 or 12 feet or more may be left between the roadway and the lowest limbs, but in cities the nature and amount of traffic necessitates higher pruning. When trees are growing

* The reader may consult "The Pruning Book," by L. H. Bailey, Macmillan & Co.; also "A Treatise on Pruning Forest and Ornamental Trees," by A. Des Carr, translated by Prof. C. S. Sargent, and published by Mass. Society for the Promotion of Agriculture.

thickly on streets it is often necessary to prune them high to let in sufficient sunlight, and when different types of trees are planted together, such as maples and elms, high pruning is often resorted to in order that the high canopy or Gothic arch effect formed by the elm trees may not be destroyed, and if a more or less conventional type is desired in individual specimens the removal of certain limbs often changes the contour of the trees, much to the advantage of the surroundings. We do not believe it is desirable to prune the feathery growths often found on the trunks of elms, as they are apparently protective in nature ; moreover, in our estimation they add to the

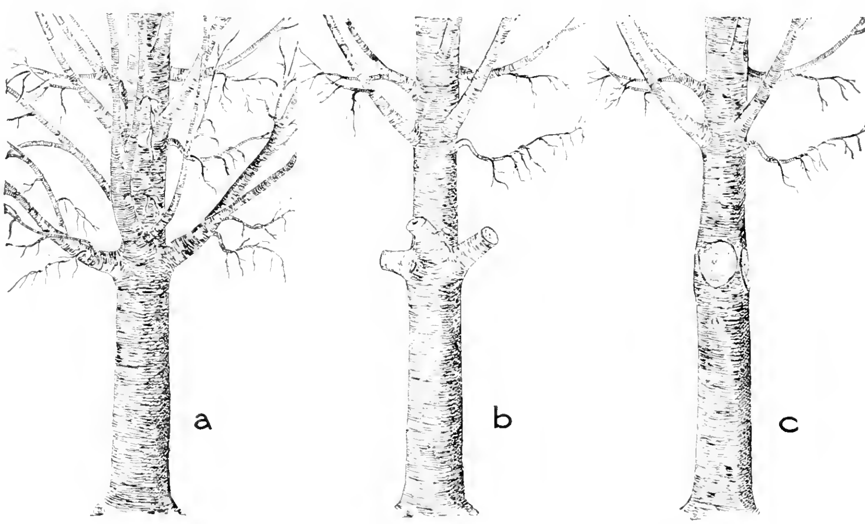


Fig. 3. Showing the proper method of pruning large limbs. a, tree before planting, b, showing relative distance of first cut from the tree trunk. c, the same with limbs cut close and the scars finished with a mallet and chisel.

beauty of the tree, taking away much of its conventional appearance.

As a rule the limbs on vigorous maple trees will droop about one foot or more a year owing to their increased weight, and it is only a short time before they become too low. Limbs over a sidewalk may be left lower than over roadways. During rain and sleet storms limbs are heavily weighted and often give trouble when too near the ground.

On country roadsides pruning should be high enough so that the limbs will not interfere with the hay and wood traffic which is common on suburban roads. All limbs should be cut as close as possible to the tree, and cuts over 1½ to 2 inches in diameter should be painted with thick lead, tar, shellac or some such substance to prevent decay. Strictly horizontal cuts should never be left, since they retain water and rot is likely to result, and the cleaner the cut the better it will heal. There is, moreover, less chance for subsequent rotting.

Many of the cavities in trees are caused by leaving long stubs on the trunk of the tree, which become disintegrated and fall off, and the decay follows back into the heart of the tree. (See Fig. 2.) It is therefore essential that close pruning and antiseptic treatment of the wounds should be practiced in order to prevent this decay. The plastic materials in a tree will not follow up a long stump and form a callus unless there are some branches left upon it which bear leaves, and even then healing will take place only close to the living branch on the stump.

Two cuts should be made in pruning practically all limbs to prevent peeling, and on limbs of any size it is necessary to make the incision on the under side for the same reason. (See Figs. 3 and 4.) After removing the limbs with a saw, a mallet and chisel may be used to smooth up the cut surface. This induces a better callus growth. It is well to prune carefully at the time of transplanting, when all street trees should be trimmed up 8 or 10 feet or more. It is also often necessary to cut back some of the branches in order to balance the root system, and when this is done some of the less desirable branches may be sacrificed, and those remaining may be cut back to some extent.

The practice of topping trees is injurious and should never be resorted to except in special cases. All of the reserve material in the tree is stored in the roots, stem and branches, and in a transplanted tree this is sufficient to develop the foliage. It is necessary that a tree should have a certain amount of foliage for growth and development, since the rapidity of growth is dependent upon leaf development.

The type of trees termed "bean poles," or trees with the tops cut away to such an extent that there are no limbs left, is not suited, therefore, to transplanting. Such trees as the willow will survive any amount of mutilation, but elms, maples and others must be handled more carefully to obtain the best results. Pruning the branches of trees directs the energies of growth to the trunk, whereas topping or the destruction of the leader has the reverse effect. Continual pruning of the lower branches induces the tree to grow taller than it otherwise would, and in some locations is advantageous to the tree. Topping is destructive to the formation of typical crowns in such trees as the elm, hornbeam, etc., whereas in other trees, like the Carolina poplar, topping or pollarding has a tendency to thicken

Fig. 4. Showing too common method of pruning limbs, resulting in the disfiguration of the tree. a, tree before pruning. b, limb cut too close, resulting in the peeling of the bark. c, unsightly wound caused by this method of pruning.

them up and make them more desirable shade trees. The configuration of the crowns of maple trees is modified to some extent by topping them when they are young, and this modification is manifested by the branches assuming more of a vertical direction.

The cutting back of old trees is usually followed by disappointment in the results obtained, and it is often a question as to whether this is worth while, although old trees, if not too far gone, may be restored to a more or less vigorous condition by judicious pruning. When elm branches a foot or more in diameter are topped nothing but a bushy growth results. By removing all but a single sprout much better growth may be obtained.

There is a difference of opinion as to the best time to prune, some authorities advocating spring and others preferring the fall of the year. Many people prune when the tree is in foliage; for example, in May or later. There are advantages in pruning in either season. Since trees occasionally bleed when pruned in early summer the painting of wounds is not always so successfully accomplished under these conditions; while, on the other hand, scars on vigorous trees are likely to heal somewhat during the summer if the pruning is done early.

THE TREE WARDEN'S OUTFIT.

E. A. START.

In some towns the tree warden has the actual work on the trees done by contract. When this plan is followed care should be taken to have a contractor who is competent and responsible. Tree butchers are plenty. Expert tree workers are very few. When the work is done by men employed by the town, under the supervision of the warden or his deputies, it is necessary to have a serviceable equipment. The following list is suggested for a beginner. More of some of the articles will be needed when much work is to be done.

	Approximate Cost.
1 30 foot extension ladder (to be kept well painted),	$6.00
2 pairs climbing irons (medium length leg iron and straps, Only to be used where ladders are impossible, and never to be trusted to irresponsible men without supervision.	4.30
3 16-foot Waters or Standard pruning hooks,	3.75
1 one-man cross-cut saw,	1.90
2 narrow blade carpenter's hand-saws, coarse,	2.00
2 half-inch augers and handle (for bolt work),	1.50
1 1¼ in. gouge (for cleaning cavities),	.75
1 1¼ in. framing chisel (for cavities),	.75
1 axe,	1.00
1 pole saw, bracket form, and six extra blades,	2.00
1 pole for above, 15 feet,	.25
1 framing mallet,	.45

1 carpenter's hammer (medium weight),	.40
1 machinist's hammer (for driving bolts),	.75
1 10-inch monkey wrench (for screwing up bolts),	.65
1 spade,	1.00
1 pair heavy tinsmith's shears (for cutting wire guards),	1.50
1 pair linemen's pliers (for putting up guards),	.90
1 50-foot hemp clothes-line (for hoisting tools, etc., into trees),	.25
1 100-foot ¾ in. hemp rope (for lowering large limbs, etc.),	3.15
1 stencil brush (for applying coal tar to cuts),	.25

In addition to these tools most towns need a spraying outfit in these days. When much work is to be done, the complete power outfits are the most serviceable and economical. They will cost $250 to $300. Smaller hand pump outfits can be obtained at from $25 up to $125, which latter figure is as low a price as will secure a really practical equipment for shade tree work.

TREE GUARDS.

E. A. START.

There are many tree guards on the market. A few are good, some are unhandsome and themselves disfigure the tree, and some are so attached that they cramp the tree and interfere with its health and growth. A tree guard should protect the tree to a height of about six feet, should be as light and inconspicuous as is consistent with strength and protection, and should allow the tree ample opportunity for growth. A neat and inexpensive guard used in Brookline is made as follows: Use No. 16 one-inch mesh wire, 32 inches wide. Cut a strip six and a half feet long. Cut through the mesh at the top of one of the twisted parts. This will leave one edge like A in Fig. 5, which is to form the top of the guard, and the other like B, which will be the bottom. Roll the wire in the opposite direction from that in which it comes to you. That is, lengthwise with the selvedge edge and fold the upper edge over close to the netting at the next twist. (See dotted line A, Fig. 5.) This must be on the outside, leaving a perfectly smooth surface on the inner side, so that there will be no danger of the tree being marred

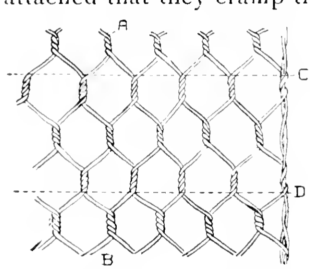


Fig. 5. Wire for tree guard.

by the cut ends in a high wind. The bottom edge can be unturned as it is to rest on the grass or soft earth. If it is to rest on a hard surface it looks better to finish at the bottom by turning the Λ shaped edges inward at the second row of twists. (See dotted line D, Fig. 5.) The upper edge can be curved a little outward (See Fig. 6), giving a more finished appearance to the guard. To fasten the vertical edges of the guard together when it is placed around a tree use No. 16 copper wire. Lap the guard to make it as small as is desired. Tie the guard at the top to the tree with stout soft twine in opposite directions to hold it in place. If this guard is made and set up in a workmanlike manner the result will be satisfactory and the expense moderate. Three men, one to cut and two to roll and bend the wire, can make and fit one hundred guards in a day.

A very cheap and efficient tree guard is used to quite an extent in some places, and is known as the "Clinton Tree Guard." This guard is made of No. 15 galvanized wire with a mesh ¾ inch in diameter, all the wire contacts being soldered. This wire can be bought in strips of various widths from 24 to 48 inches, and cut off any length desired, 6 and 6½ feet being the more desired lengths. Strips 12 inches wide or more are well suited for small trees. These are rolled up in cylindrical form of the desired diameter and tied together by one or two pieces of copper wire to prevent the top of the guard from chafing the tree. This may be made of pieces of rope or heavily insulated electric wire passed through the guard in such a way as to prevent the guard from coming into contact with the tree.

Fig. 6. The Brookline tree guard.

The great advantage of this guard is its cheapness, and since it is made of heavy wire and firmly put together it answers the requirements well. This wire is made by the Clinton Wire Co., Clinton, Mass., and costs about 4½ cents per sq. foot.

TREE SURGERY.

G. E. STONE.

The term "tree surgery" is a legitimate one to use in describing modern methods of treating trees, as they are similar to those used in human and animal surgery; that is, the treatment of trees is based upon aseptic and antiseptic methods. In the same manner that modern surgery is successful in correcting deformities, performing operations, etc., so a young and vigorous, although often imperfect tree, may be improved and rendered more valuable by the use of the same methods. While old and decrepit trees are often treated to extend their period of usefulness, it should be borne in mind that it is more desirable to care for the younger, more promising trees, and it is only too apparent that if more attention had been given to the care of old trees at the proper time, they would never be in the condition in which we often find them.

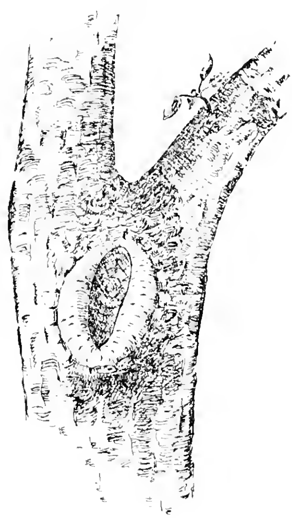


Fig. 7. Showing healing of wound. Most active healing follows most direct lines of transference of plastic materials.

Unlike the surgeon, who has no choice of subjects, the tree expert can select his individuals at the start and eliminate the imperfect specimens, although in the process of development trees need constant attention. It is desirable that antiseptic methods of treatment following pruning, mechanical injuries, etc., shall be adopted.

HEALING OF WOUNDS.

A protective feature characteristic of all plants is well illustrated in the healing of wounds. The healing tissues (callus) in a tree are the cambium and adjacent meristematic cells located between the wood and the outer bark. The plastic substances which provide the material for growth and healing are manufactured in the leaf and are transferred through certain tissues of the inner bark (phloem) adjacent to the cambium to various parts of the tree. When the tree is girdled or the bark removed no growth takes place below the girdling because the channels of transportation are destroyed.

In some young plants the pith cells possess the power to form a callus, but such cases are rare and of little importance. The younger the tissue or organ the more quickly it will heal, providing other things are favorable, and vigorous trees will form a callus much more quickly than old or weak ones. The nearer wounds are to the plastic materials the more rapidly they will heal; for example, the upper part and sides of a cut as a rule heal the most rapidly because they are in more direct contact with the channels supplying plastic materials for healing. (See Fig. 7.) Cuts made near large leafy branches are more likely to heal quickly than those near small ones, for the reason that a larger amount of the plastic materials is available.

To facilitate healing, recourse is occasionally made to cutting the bark smooth around the stumps of the removed limbs, and it is also claimed that after the callus is well started a re-cutting of the surface stimulates it to grow faster. Moisture is said to stimulate the growth of the callus, and the old practice of covering the wound with a mixture of cow-manure, clay and lime has this object in view.

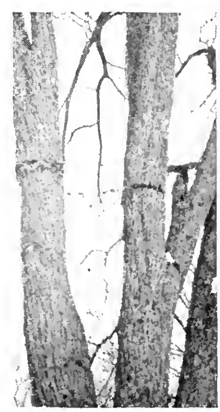


Fig. 8. Girdling by chain placed around tree.
From "Park and Cemetery."

In the pine family, whenever a wound is made it is quickly covered with pitch, one of the best substances for covering wounds, but for practical purposes coal tar is cheaper, and a thick coat of paint answers the purpose quite well.

Thick shellac dissolved in denatured alcohol has been recommended for painting wounds, and might be used to advantage. Coal tar is likely to injure delicate tissue, although this injury is not permanent. When paint and other substances are applied to limbs when they are moist and show a tendency to bleed, the results are not always satisfactory, and cases have been known of decay occurring even when coal tar has been used. The principal object in painting exposed wounds is to prevent the entrance of destructive organisms, and particular care should be exercised in doing it.

CHAINING AND BOLTING TREES.

In many instances it is necessary to render trees more secure by bolting or chaining them to prevent injury and disfiguration, and as this process is not an expensive one it should be much more largely used than it is, since many valuable trees have been rendered practically worthless by the loss of large limbs during wind storms. The elm, although a tough tree, with wood extremely difficult to work up into fuel, is very likely to split, and for this reason it is advisable to chain and bolt elm trees which show a tendency to weakness.

Fig. 9. Iron band around limbs of tree. An objectionable method. From "Park and Cemetery."

Different devices are employed for strengthening trees. Some of these are objectionable and do more harm than good; for instance, it has been common in many places to chain limbs to prevent their splitting, but as the tree develops the chain becomes imbedded in the bark, partially girdling it and disfiguring the tree to quite an extent. (See Fig. 8.)

Another equally objectionable method is placing strong bands of iron around limbs. (See Fig. 9.) Many prefer to use an iron rod rather than a chain, and although both have their place, in our estimation the chain system is the better for most purposes. If it is desired to secure rigidity by fastening the limbs near the point of forking an iron rod is preferable; but for long spaces remote from the junction of the limbs the chain method is superior, since a rod is likely to break owing to its rigidity when the tree is swayed by the wind; whereas a chain, which is flexible, will stand the strain better. Steel chains are stronger than iron rods, and for this reason are better for use in such cases, besides being easier to place than a solid rod, as less attention has to be given to boring the holes. If links are placed in the rod, as is sometimes done, this difficulty is of course obviated to some extent.

In most cases of chaining and bolting the washer and nut are placed on the outside of the bark, and often no attempt is made to cut the ends of the bolts off. The unsightliness of this method makes it objectionable. It is better to cover the nut and washer, which may be done by countersinking them into the wood of the tree, imbedding them in cement. (See Figs. 11 and 12.)

By the aid of an extension bit a hole is bored through the bark into the wood, and the washer and nut are placed in this depression. They should be well imbedded in thick paint or tar and either elastic or Portland cement used to cover them, allowing the cement to come flush with the exterior surface of the wood. By this method the end of the bolt, the washer and the nut are covered and the exposed wood treated antiseptically, with the result that no further injury to the tree takes place. The scar heals over in a short time, leaving no trace of the bolt.

Fig. 10. Chain and bolt method of supporting limbs. From "Park and Cemetery."

TREATING DECAYED CAVITIES, FILLINGS, ETC.

Decayed cavities in trees are very undesirable, since the fungi and insects which are present extend their range of activity, causing decay and shortening the tree's life. Cavities result from poor pruning of limbs, the breaking off of branches and other injuries which are not followed by proper treatment at the time.

The treatment of cavities naturally involves some expense, but if a tree is of value, if only sentimental, it is worth treating. There are many trees which to the casual observer would appear to be of little consequence, but the associations connected with them may be highly cherished. Then, again, the location is often important. The tree may furnish shade which cannot be dispensed with, and even if old and decayed it is more satisfactory to treat it than to wait for a new tree to grow.

Fig. 11. Showing tree properly bolted, washer countersunk and imbedded in cement. From "Park and Cemetery."

The rationale underlying the cleaning and filling of cavities is similar to that in dentistry, and there is reason to believe that if the work is properly done and if antiseptic conditions are maintained the length of a tree's life may be extended.

For centuries trees have been treated in one way and another, and cavities have been filled with wood, brick, stone and other substances for many years, but as a rule this work has been very crude in nature, and has probably done little or nothing toward the prevention of decay. During the past few years, however, more attention has been given to the treatment of decayed cavities in trees, and many examples may be seen, although it must be confessed that as yet the work is in an experimental stage. It is too early to say what has been accomplished by the various methods of treatment.

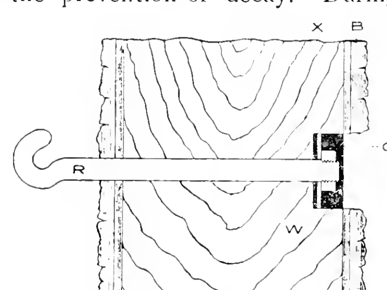


Fig. 12. Longitudinal section of limb, showing method of bolting. B, bark. X, wood. R, bolt. W, washer. C, elastic cement. From "Park and Cemetery."

The object and process of treating decayed cavities may be summarized as follows:

First, to extend the usefulness of the tree and prolong its life.

Second, to remove all decayed tissue, which is done by a thorough cleaning out of the cavities.

Third, to treat antiseptically all those exposed tissues which are susceptible to decay, preventing further disintegration.

Fourth, to fill the cavity with some substance such as cement or to cover the surface with metal or other substance, in order that the callus may grow over the cavity and form a smooth surface.

Fifth, to strengthen the tree. This may follow immediately as a result of filling, or ultimately in the processes of growth, and sometimes is not accomplished at all.

Exposed tissues in cavities are treated with creosote or other substances to serve as an effective antiseptic. The cavities are filled with grouting composed of one part of cement to five parts of sand and gravel, over which is spread a coating one-half to one inch thick of one part of cement to two parts of fine sand. The grouting should be put in very soft, and the cement coating, which is put over the surface, should be soft enough to go on easily with a trowel. The grouting is kept back an inch or so from the surface of the wood. It can be held in place while soft by boards loosely fitted to the orifice of the cavity.

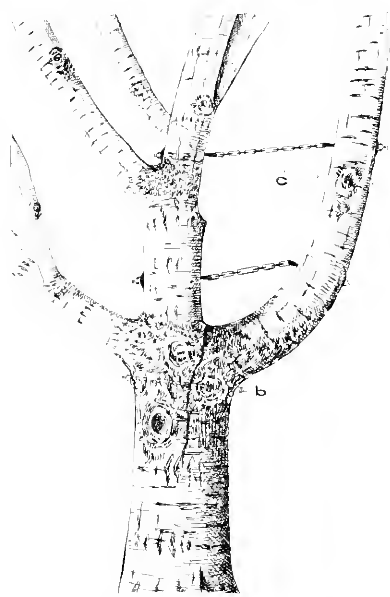


Fig. 13. Showing improper method of chaining tree. Dotted lines show more effective method. b, bolt. c, chain.

Many unsatisfactory fillings have been made by using the cement too dry, with the result that it possesses no strength. After the cement has been put in the cavity it should be well trowelled and kept moist for a few days. In all cases the cementing, when complete, should be flush with the wood and the cavity so shaped, when practicable, that it forms a wedge for the cement, thus preventing it from falling out.

Mr. John Davie, who has had large experience in filling trees with cement, in many of his fillings makes use of large iron bars. These are securely tied to the sides of the cavity for the purpose of holding the cement filling in place.

Occasionally a cavity is not entirely filled with cement, but a brick wall is constructed and the surface plastered with cement even with the wood, and in other cases the cavities are dug out, treated antiseptically, and covered with tin put on flush with the surface of the wood. Mr. H. L. Frost, of Arlington, has done some excellent work in tinning over cavities.

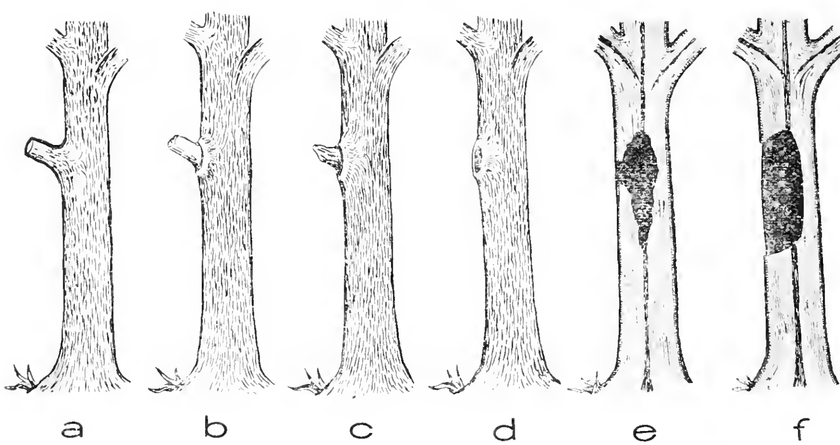


Fig. 14. Showing the evolution of a cavity and method of treating the same. a, long stub left from pruning. b, beginning of decay. c, more advanced stage. d, cavity formed in the wood. e, longitudinal section of the trunk showing cavity. f, cavity cleaned out and filled with cement.

Both the cement and tin methods have their defects. In the tinning method, changes in temperature may cause the tacks to become loosened, displacing the tin, in which case the callus grows under the tin, displacing it still more and defeating the object of the treatment. On the other hand, the cement is likely to crack on the surface and contract from the wood after drying, and in some instances adds too much weight to be supported when limbs are filled. This may be obviated by filling with some lighter substance or by tinning, and in some cases the weight has been supported in part by rods extending from the trunk into the limbs and imbedded in the cement.

The contraction of the cement from the wood leaves a space which is likely to become filled with water. In winter the space may open like a frost crack and decay set in in time, even if the wood is disinfected : therefore, we have always found it important to have the cavities painted with some thick substance of an elastic nature to fill the space caused by the contraction of the cement. In this way the water is kept away from the wood and the danger of infection lessened.

Various kinds of fillings have been tried, also different substances for disinfecting cavities, but little can be said about their relative value at the present time. The writer has experimented with a variety of cements and disinfectants and prefers an oily substance to a watery solution for disinfecting a cavity. We have used creosote more than any other substance for this purpose, since its wood preserving qualities are well known, and so far as we have seen it causes no injury when applied to cavities.

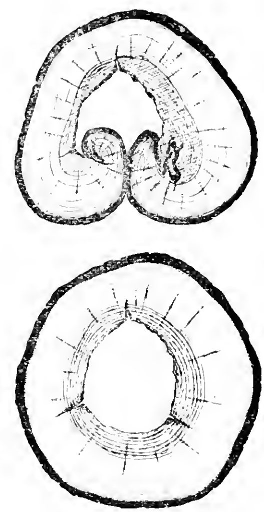


Fig. 15. Demonstrating the object of treating cavities. Upper figure showing cavity of long standing, with callus curved in, which, if it had been filled, would be as represented below.

One of the objections to the use of Portland cement in filling cavities, as previously mentioned, is its tendency to crack. Mr. John T. Withers, who has had much experience in filling trees, recommends re-inforcing the surface with wire. He has employed this method, and some of our best fillings have been re-inforced in this way.

The fillings in trees which are likely to sway considerably are sure to crack, and although the cracks formed are not often serious, this objectionable feature may be overcome by laying the cement in blocks or sections and filling in between each section with some thick elastic substance to keep out the water. Such substances as thick coal tar, coal tar and roofing tar mixed, or slaters' cement would answer this purpose.

Some attempts have been made to sculpture the surface of the cement to imitate the bark, but this is objectionable from many points of view.

The cost of filling or tinning trees need not be excessive nor beyond the reach of most individuals or towns. Considerable experimenting and careful observations, however, must be made in order

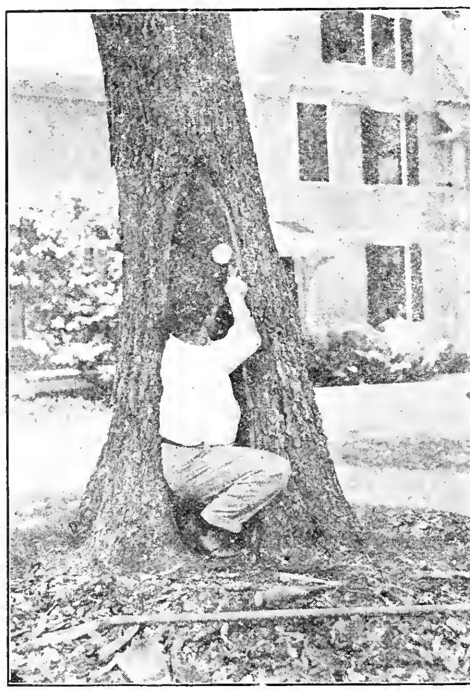


Fig. 16. Showing cavity in valuable yellow oak being prepared for filling.

to ascertain the best method of treating cavities. Most of the cleaning of the cavities at the present time is done with mallets, chisels and other tools, but a rotary cutter driven at high speed by a gasoline engine or other power would greatly facilitate this work, and we are now experimenting with such a machine.

EFFECTS OF GAS, ELECTRICITY, ETC. ON TREES.

G. E. STONE.

INFLUENCE OF ILLUMINATING GAS.

Undoubtedly a larger number of trees suffer from the effects of escaping illuminating gas in the soil than formerly. The increased

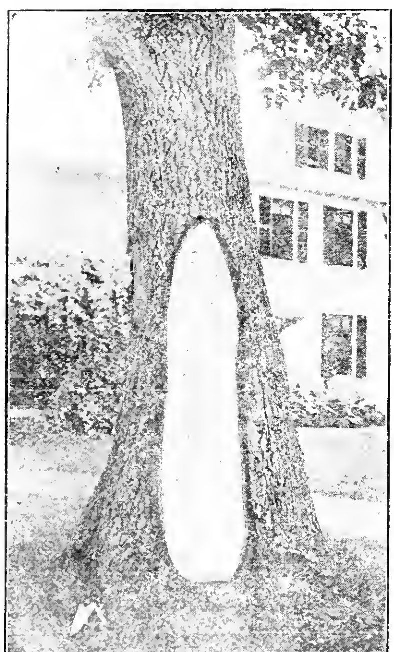


Fig. 17. The same cavity properly filled with reinforced cement.

death rate from this cause may be accounted for by the fact that gas is now more extensively used, and the larger pipes and different types of connections now in use, together with the modifications in the methods of laying and calking the joints are no doubt responsible for the increase; at any rate, it would seem that when small pipes have been in the ground for many years with thread joint connections, there is much less leakage than if larger pipes are used and the calking done with oakum and cement or lead.

The trolley, steam roller and other heavy traffic on highways are in part responsible for defective joints, and occasionally cause leakage of gas. The continual excavation and undermining of gas conduits made necessary by the construction of sewer and water lines, as well as the effects of frost in severe seasons, also cause leakage, and finally the modern network of wires, steel rails, etc., which carry electricity, are a constant source of danger to gas pipes, as is occasionally proved by cases of electrolysis.

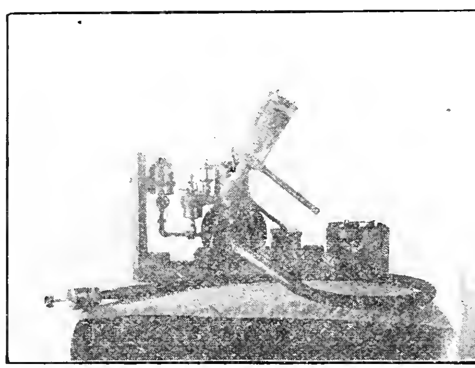


Fig. 18. Showing flexible shaft and gasoline engine arranged for cleaning cavities.

A large amount of the gas manufactured is unaccounted for. According to the twenty-first annual report of the Gas and Electric Light Commissioners of Massachusetts, the production of gas for the year 1905 in this State was 6,418,024,954 cubic feet. The amount unaccounted for during that year was 622,304,044 cubic feet; in other words, there was a loss of about 10 per cent. This loss undoubtedly represents more than mere leakage, however, since part of it may be accounted for by differences in temperature to which the gases are subjected when measured.

It should be stated, in justice to many of the larger manufacturers of gas in this State that every effort is made to prevent leakage and injury to trees, and some of our more progressive gas manufacturers spare no expense or skill in constructing and maintaining their lines. In laying the larger pipes, which are more difficult to keep calked securely, they are providing their patrons with better facilities; nevertheless, they run a greater risk from leakage.

Numerous connections are found in gas mains from which can be detected only slight leakage, perhaps only a few cubic feet a day; whereas there are others from which the leakage is extensive. The presence of small leaks, if not attended to, will injure trees in the course of time, since the soil becomes charged with gas

Fig. 19. Large elms killed by escaping illuminating gas, one and one-half years after leakage occurred. From "Park and Cemetery."

to a greater or less extent in a few years.

In the eastern states the three principal kinds of gas used are water, coal and oil gas, and so far as the effects of these various gases on trees are concerned there is apparently little or no difference, since they all contain similar elements which are poisonous to trees.

Two degrees of injury may readily be distinguished as resulting from gas poisoning; first, incipient cases, and second, pronounced cases. In the first series we have those already alluded to as resulting from small leaks, the soil in such cases not becoming saturated for any considerable distance. Such leaks may not result in killing the tree directly but cause it to be unhealthy and shorten its life, and there is likely to be an unusual amount of dead wood annually found on such trees. Occasionally a large tree may be located near a small leak, when only a single root will be affected, but those portions of the trunk of the tree in direct connection with that root will show the effects of gas poisoning. Small leaks of this description often produce only local injury but trees affected in this manner may suffer with what is termed "general debility," a term often used to conceal a vast amount of ignorance concerning diseases in general.

Fig. 20. Showing effects of illuminating gas on elm tree one and one-half years after leakage occurred. From "Park and Cemetery."

In severe cases of gas poisoning such as take place where there is a large leak the effects on a tree are very pronounced, and there is absolutely no hope of recovery for a tree which has once been severely injured. If a tree has been defoliated, or even half defoliated, from the effects of gas there is little or no hope for it. There appears to be little difference in the susceptibility of different species to gas poisoning, but trees with a large spread of roots are more likely to be affected than those with a limited spread.

The characteristic symptoms of gas poisoning are quite distinct to one familiar with them, and can generally be distinguished from other troubles which are likely to affect a tree.

One of the first effects in summer is a yellowing of the foliage, followed by a greater or less defoliation of the tree, according to the degree of poisoning. The trunk of the tree generally assumes a dark color, indicating an absence of life, but this feature is not always noticeable. The sap wood is often found to be discolored, and it has peculiar, characteristic odors which assist in diagnosis. Sometimes, however, especially when the tree is injured by gas in late summer, at which time the flow of sap is not so active as it is in the spring, the odors of the wood are not so marked. Where slow poisoning occurs this same condition of the tissue is noticeable. If only one root becomes affected with gas, that portion of the tree nearest it will show the effect first. Generally, however, the top of the tree first shows the effects by defoliation and loss of bark. The presence of fungi on trees (Schizophyllum, Polystictus, etc.) affected by gas is of common occurrence and often significant, and they frequently make their appearance shortly after a tree has been injured. Trees affected by gas disintegrate very rapidly, and should never be allowed to stand long after dying, as they become brittle and are a source of danger.

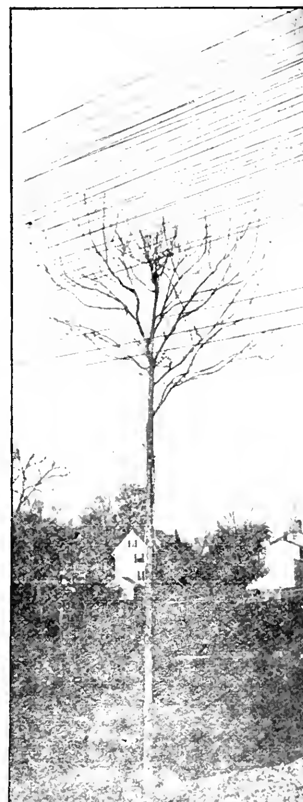


Fig. 21. Showing the destructive effect of wires on the growth of trees.

Gas escaping into the soil from a leak follows the line of least resistance. For this reason, if leakage occurs in the street in front of a house one can usually detect the odor of gas in the cellar, as the gas will follow the exterior of the pipe leading into the cellar, and it often escapes into sewers, underground conduits, hydrants, etc. There is considerable difference in the resistance of soils to gas. In gravelly soils we have known gas to travel 2,000 feet when the ground was frozen and escape into the cellar of a house, whereas in heavier soils gas is more likely to be restricted to smaller areas.

The poisonous properties of gas are undoubtedly due to coal tar products, which contain such compounds as sulfates, cyanides, etc. More or less of the gas and its constituents is absorbed by the water in the soil, and these are taken up by the roots and translocated to various parts of the tree through the sapwood, and when they come

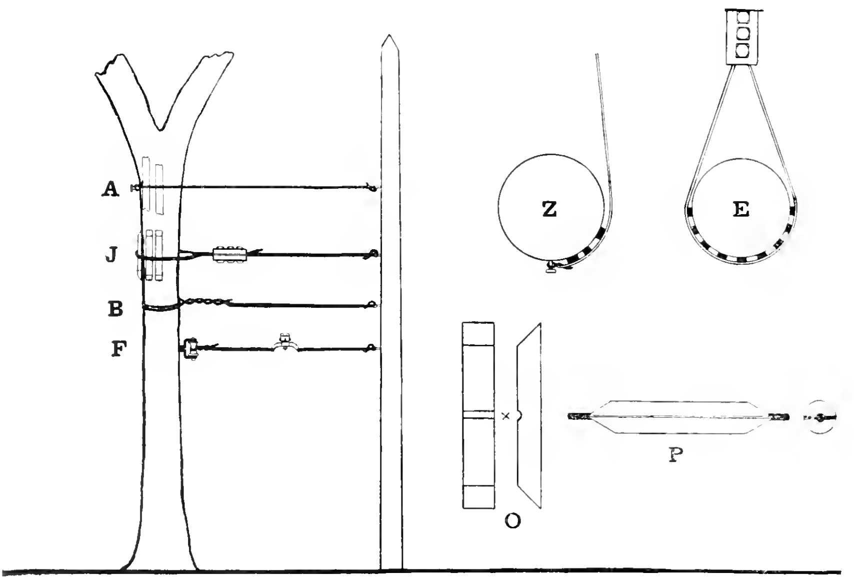


Fig. 22. Showing methods of attaching wires to trees. A, wires attached to lagbolt and protected from tree by stick. Z, section of the same. B, wire loop placed twice tightly around tree, causing girdling. J, loose wire loop fastened with clamp and separated from the tree by blocks. E, cross section of the same. O, section and surface views of blocks. x, groove for wire. F, showing attachment of trolley guy wires. P, wooden sleeve for wires to protect from burning. From "Woodland and Roadside."

into contact with living tissues destroy them. The feeding roots are naturally first affected, and in a brief period of time the larger roots and trunk near the surface of the ground will show the effects of poisoning.

About 1 or 2 per cent. of gas is absorbed by water, and the water in the soil becomes saturated to a certain extent. In the course of time, when the leakage is more or less extensive, the odor of the soil becomes extremely obnoxious. This odor disappears very quickly when the soil is aerated, and when a gas leak is repaired it is an excellent idea to leave the ditch open for a few days to get rid of the strong odors which are present in the soil. There is a certain capacity for adaptation in plants to poisons, which probably exists to some extent in the case of trees affected by gas, but this capacity is limited, and if the leakage of gas is continuous the roots are sure to be poisoned in time. It requires a considerable amount of gas to kill a large tree, but it must be borne in mind that the conditions surrounding a tree are favorable for maintaining gas in the soil for a long time. Certain devices may be employed at no great expense when installing a system of lines which will readily detect sources of leakage and prevent gas escaping into the soil, thus preventing injury to trees. There are many instances where the cutting of roots under a roadbed, which is necessitated by regrading and placing curbing, has saved trees from injury from gas poisoning, and the presence of conduits near leaks has been known to prevent injury to many trees.

Fig. 23. Showing burning caused by alternating current wire.

If symptoms of gas poisoning are discovered in only one root, and the poisoning has not extended to the tree trunk, amputation of the root is the best remedy.

EFFECTS OF WIRES ON TREES.

During the last few years a very material increase in the number of electric and telephone wires used has been the means of ruining the appearance of many beautiful streets, and of all the troubles with

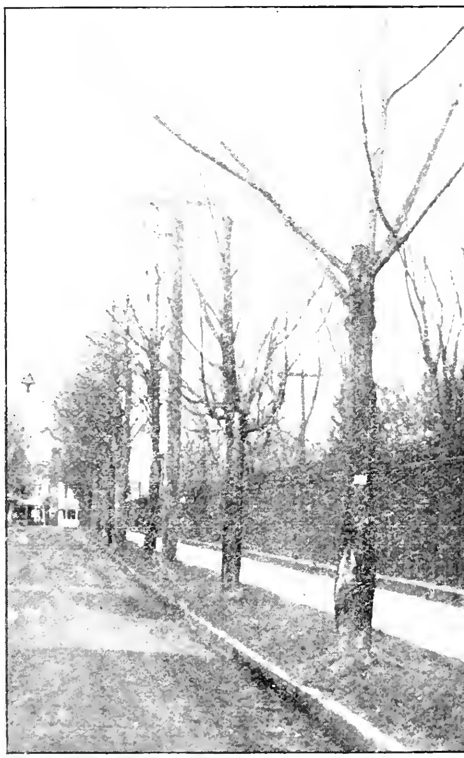


Fig. 24. Showing disfigurement of trees caused by burning from electric wires.

which tree wardens have to contend the wire problem is often regarded as the worst. Notwithstanding the strict laws which some states have adopted in regard to injuring shade trees, the agents of some public service corporations have little regard for trees or the laws protecting them.

In the case of telephone wires, the cable system may be used and much injury to trees prevented in this way. Large cables are rather expensive to install, but what is called the "ring construction" system may be used to advantage in many instances, particularly in the suburbs. In this way it is possible to run a line through avenues of fine trees in the country districts without necessitating pruning or disfiguration. In cities and larger towns the proper solution of this problem consists in burying the wires in conduits, and although this is somewhat expensive it is being done more and more each year. It is often quite useless to start an avenue of trees under a mass of wires with the expectation of making them thrive. In many cases permission has been given to install poles and wires on private property, and in this case it is necessary for the abutter to give the company right of way for an indefinite period of time.

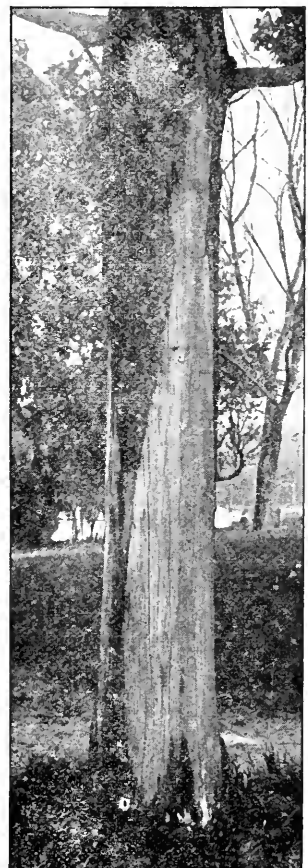


Fig. 25. Showing maple tree killed by direct current from trolley system.

So far as trolley wires are concerned, the conduit system is out of the question in the smaller towns at present on account of cost, but electric lighting wires may often be run over private property in the rear of houses, or buried in conduits, much to the advantage of the trees and streets in general.

In cities high poles are occasionally used, the wires being placed as far above the streets as possible, which prevents considerable damage, particularly to young and middle aged trees.

On general principles it is not wise to allow wires to be attached to trees, although this is often done. Trolley and electric light wires are frequently guyed to trees, but they are a source of danger,

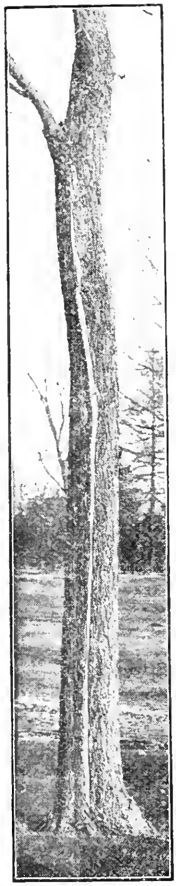


Fig. 26. Showing ridge on tree, caused by feeble lightning discharge.

since by the crossing of the wires injury is likely to occur, and lightning discharges occasionally pass from the wires to the tree, causing damage. It is, however, often better to allow the wires to be attached to trees than to endure the addition of ugly poles, but if wires are to be attached to trees they should be properly insulated, although ordinary insulators have little effect on lightning discharges. The lagbolt system in common use (see Fig. 22, A and Z) for guying wires to trees is not the best method of attachment, since sooner or later the wire and bolt become imbedded in the tree and cause injury. The block system (J and E) is better, although it may not be in all cases free from objections. In no case should a wire be allowed to pass tightly around a tree (B), as it will girdle it in time. When live wires come into contact with limbs some type of insulator should be employed similar to that shown in P. The porcelain and dowel insulator gives good satisfaction.

Wires often accidentally come in contact with trees by the displacement of poles, particularly on curves, where the strain is very great, but much of this injury may be prevented by imbedding the poles in Portland cement, and it should be pointed out that the necessity for guying poles to trees may be obviated in this way.

ELECTRICAL INJURIES.

Alternating Currents.

Electrical injuries, such as are caused by burning, are common to trees, and occasion tree wardens a great deal of vexation. There are many instances of large limbs being burned off, and in some cases the burning is so extensive that the whole top of the tree is injured. There are, however, no authentic cases of an alternating current completely killing a tree, and the injuries caused by this current occur only during periods of moisture, when there is a grounding. Owing to the high resistance of trees it would require an exceptionally high potential to furnish sufficient curent to kill a tree even if wires were inserted into limbs and roots and the current allowed to pass through the tree. In all cases, so far as has been observed, the injury resulting from alternating currents is due to burning.

When grounding takes place leakage occurs, causing burning and steaming which, if the contact continues, will cause a blaze and burn a deep hole in the limb. Sometimes a tree may be injured a few feet above and below this burning, but it never extends to the base of the tree. Occasionally the grounding is so marked that it is dangerous for one to come into contact with a tree, and a person standing on the ground and touching his fingers to the leaves would receive quite a severe shock.

During periods of damp weather neither rubber nor porcelain insulators prevent leakage in high tension wires; consequently, when even insulated wires are brought into close contact with trees some escape of the current takes place. Injuries to trees often occur when alternating current wires during storms accidentally come in contact with other wires attached to trees. For this reason there is always risk, as has already been pointed out, in allowing any wires to be attached to trees.

Direct Currents.

Direct currents of electricity are chiefly employed by electric railways, although occasionally used for lighting purposes. A direct current appears to have a different physiological effect upon, and is more disastrous to protoplasm than an alternating current, since it causes disintegration of the cells, and there is reason to believe that a direct current is capable of killing a tree even if the strength of current is not sufficient to cause burning.

The direct current, like the alternating, causes injury to trees by burning, and there are instances known where it has killed trees. In some instances the base of a tree has been girdled to a distance of ten feet or more from the effects of direct currents from trolley lines, and in such cases the trees have died from electrocution.

LIGHTNING.

Lightning affects trees in different ways, the most common effect upon vegetation being a shattering of the tissues. It is surmised that some trees are more susceptible to lightning strokes than others, but little is known about the subject.

A stroke of lightning is frequently dispersed in such a way as to travel over more or less of the cambium zone of the tree, thus girdling it and causing its death, and trees have been observed which were killed instantly by a lightning stroke but which showed no fracturing whatsoever, in which case the lightning, although not powerful enough to dislocate any of the bark, had destroyed a considerable portion of the vital layer of the tree.

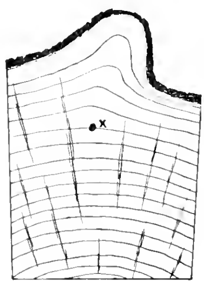


Fig. 27. Cross section of a piece of wood taken from a tree struck by lightning, showing the formation of ridge on the outside of the bark. x, small dead area corresponding to path of lightning discharge.

More frequently, however, trees receive only a slight discharge, which burns out a very small hole near the cambium, and the result of such a discharge will not be noticeable until two or three years afterward. In such cases a ridge forms on the bark, revealing the path of discharge. An examination of the tissue will disclose a small hole, usually not larger than the head of a pin, running down near the cambium layer. A wound of even this size acts as a stimulus and induces a marked growth of the cambium. These cases are very common but often overlooked.

Less common, are earth discharges, which originate in the soil and discharge from the limbs, but there are enough authentic cases to prove they occur, and they occasionally cause injury. It is known that a great difference frequently exists between the electrical potential of the earth and air during thunder storms, and that the electrical conditions of the clouds and earth may change instantly from negative to positive. It is then that earth discharges may take place.

INSECT ENEMIES OF SHADE TREES.

H. T. FERNALD.

It is impossible to adequately consider in detail even the more important pests of shade trees within the limits here assigned. Over five hundred different insects feed on various kinds of oaks; the elm, maple, evergreens and other important trees each have many enemies; and a few general remarks and a more detailed consideration of the most important insects is all which can be given.

Two fundamental principles underlie methods of treatment. For insects such as caterpillars and others which feed on the leaves, spraying with arsenate of lead is usually a success, though if the feeding is not noticed until the insects have nearly finished their work, the results will hardly be satisfactory. Where the insects are feeding in clusters, it is often cheaper and easier to gather the clusters by hand and destroy them than to spray; and there are some leaf feeders whose habits are such that neither hand picking nor spraying is the best method of control, and special treatment for each case is necessary.

For insects which do not feed on the leaves, but suck the juices, arsenate of lead is useless, as such forms get none of the poison into their bodies. Accordingly, something which kills every insect it touches, and which is called a contact poison, is used instead. Kerosene and soap are most often used in this way, and directions for making a few of the most successful sprays are given at the end of this article.

In general then, if caterpillars, grubs or insects in any stage are eating the leaves, spray with arsenate of lead if they are scattered, or pick them off if they are in clusters; for sucking insects, like plant lice, scales, etc., spray with a contact poison.

Failure to observe three points is responsible for nine-tenths of the poor results from spraying. These are: 1. Be sure the spray material is properly made. 2. Apply thoroughly. 3. Apply at the right time.

THE ELM-LEAF BEETLE.

(*Galerucella luteola* Müll.)

A European insect which reached this country about seventy-five years ago. It is generally distributed over Massachusetts, though it may perhaps rarely prove to be a serious pest in certain of the higher and colder portions of the state. It passes the winter as the adult beetle in attics, unused chimneys, outhouses, barns, etc., and about the time the elm leaves develop in spring, leaves its winter

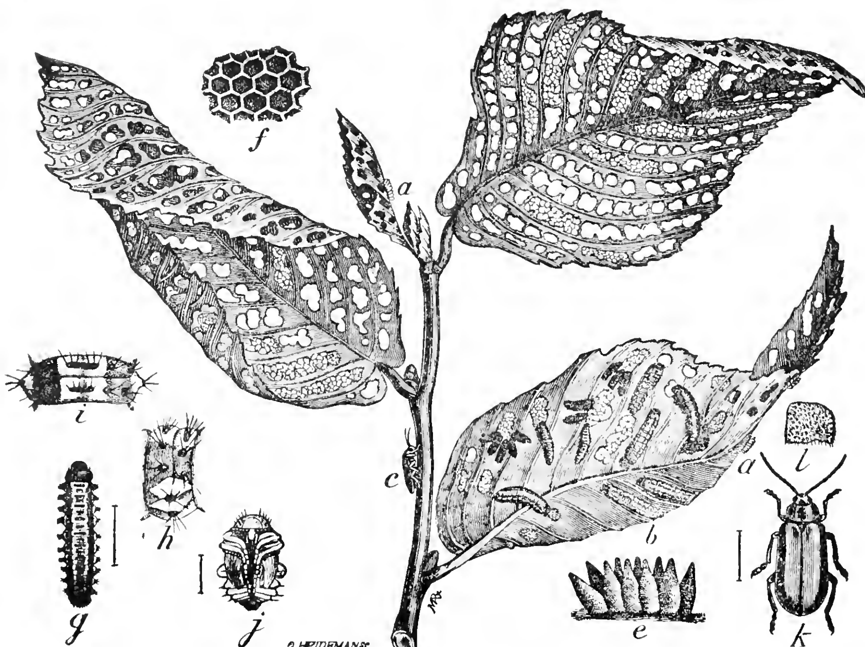


Fig. 1. Elm-Leaf Beetle. a, eggs; b, larvæ; c, adult; e, eggs; g, larva; j, pupa; k beetle; a, b and c, natural size; e, g, j and k, much enlarged. From U. S. Department of Agriculture.

quarters for the trees. At such times, the beetles often gather on the windows of houses mutely pleading to be let out, and causing housekeepers to fear that they will have an army of carpet beetles, or some other household pest, to fight. Flying to the trees, the beetles eat irregular holes entirely through the leaves and lay their eggs in clusters of a dozen to about thirty, on the underside of the leaves, feeding and occasionally depositing eggs in this way for several weeks. The grubs which hatch from the eggs feed on the leaves, but leave the upper surface entire, and become full grown in from fifteen to twenty days. They then go to the trunk, and most of them crawl to the lower part or to the ground at the foot of the tree, where they change to the adult beetles, about a week being required for this purpose.

In most seasons these beetles pass the winter before laying the eggs for the next generation, but in some cases a new brood, which feeds during the late summer, is met with. Fortunately, this is not usually the case in Massachusetts.

To keep this pest in check, spraying the trees thoroughly with arsenate of lead when the adult beetles appear on them in spring is the best treatment, followed by a second spraying when the grubs hatch—about the tenth of June would be an average date for this state,—spraying upward as much as possible to place the poison on the underside of the leaf where the grubs feed. Unfortunately, financial considerations usually prevent two treatments of this kind, and the usual practice is to omit the first spraying and begin the other about the first of June. Later, when feeding has ended and the grubs and pupæ are on the trunk and on the ground at the foot of the tree, spraying these with kerosene emulsion, or treating (not spraying) with hot water, will destroy them, though if the tree be young and with thin bark, the hot water may injure the tree, and the emulsion should be used in such cases. Treating the insects on the trunk and ground, of course, does not help the tree any at the time, as the injury has all been done, but it will at least reduce the number of insects which would attack the tree later. Sticky bands around the trunks are almost worthless against this insect.

THE WHITE-MARKED TUSSOCK-MOTH.

(*Hemerocampa leucostigma* Abb. & Sm.)

This common insect attacks many of our shade and fruit trees, and is everywhere abundant in Massachusetts. The winter is spent in the egg stage, the eggs being found on the old cocoons from which

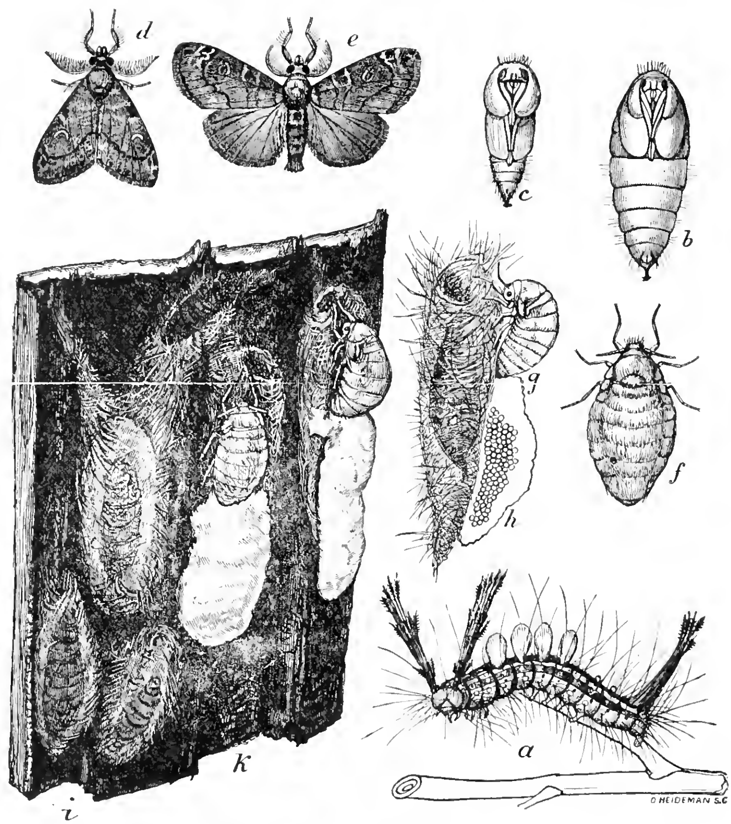


Fig. 2. White-marked Tussock Moth. a, caterpillar; b, female pupa; c. male pupa; d, male moth; e, same, wings spread; f, female moth; g, female moth on cocoon; h, egg mass with froth over it; i, cocoons on tree trunk; k, same, showing females and egg masses also; all slightly enlarged.

the moth laying the eggs emerged. The eggs are in clusters and covered by a white froth, which hardens to a sort of crust, concealing them.

These eggs and the old cocoons to which they are attached may be found on the trunks and limbs of the trees, or on objects nearby.

Occasionally, the cocoons are attached to the smaller twigs, and in such cases a leaf is usually involved, making these places more noticeable during the winter.

The eggs hatch in the spring and the caterpillars feed on the leaves, becoming full grown in June. They then go to the trunk or larger limbs, where they spin gray cocoons from which the moths emerge in July.

The female moths, being without wings, remain on the cocoons from which they emerge and there lay their eggs, covering them with white froth as already described for the preceding brood. These eggs soon hatch and the caterpillars climb to the leaves and feed until the middle or last of August; then, when full grown, return to the trunk or larger branches to make cocoons in their turn, the moths from these emerging shortly thereafter and laying eggs, which remain through the winter before hatching.

This sketch of the life history shows that there are two broods of the insect each year, and consequently two periods of injury to the trees, the first being during the spring months and ending in June; the second being during July and August. When the caterpillars are so abundant as to strip the tree in the spring, the second brood will appear in time to feed on the new growth put out by the tree to replace that lost earlier, thus seriously injuring it by more or less completely defoliating the tree twice in the same year—a drain which no tree can successfully withstand for more than a year or two.

Treatment for the Tussock Moth may be of two kinds. If the caterpillars are already at work on the leaves, spraying with arsenate of lead is effective; but a simpler and cheaper method for their control is to gather and destroy the egg masses, this being made easier by the presence of the white crust over them, making them very noticeable, and by their location, nearly all being on the trunk and large limbs. Destruction of the egg masses should be in July as soon as they appear, and again at any time between the first of October and the last of April, and spraying should only be necessary if the destruction of the eggs has been neglected. Trees not infested can be kept clear, provided their branches do not touch those of infested ones, by banding the trunks with Tree Tanglefoot, for as the female moths cannot fly, such trees can only be reached by the moths or caterpillars crawling to them.

THE FALL WEB-WORM.

(*Hyphantria textor* Harr.)

The tents formed by the caterpillars of this insect are often very noticeable in the early fall months on various shade and fruit trees and often cover several square feet.

The moths, which are flying during June and July, greatly resemble those of the Brown-tail moth, but are without the golden brown tuft at the end of the body possessed by the latter. The eggs are laid in clusters on the leaves, and the caterpillars on hatching at once begin to spin a web under which they feed. As this proceeds the tent is extended until it may cover the surface of an entire limb, greatly injuring the appearance of the tree, and when the webs are numerous entire trees may be covered and stripped of their foliage. After about a month's feeding the caterpillars crawl to protected places where they spin cocoons in which they spend the winter.

This insect is rarely so abundant as to endanger the life of a tree, but its webs are so noticeable in August and September that treatment is very desirable to keep the insects under control and the trees looking well. When the webs first appear it is easy to remove them by hand and crush the caterpillars. When they are so located as to make this impossible, and also when they have become so large as to prevent this, spraying heavily with arsenate of lead around the web is of service, for while the leaves actually fed upon are protected from the spray by the web over them, any subsequent enlarging of this to enclose more food will result in bringing the sprayed leaves under the web, where they will be consumed.

CANKER WORMS.

(*Alsophila pometaria* Harr., the Fall Canker-worm.)
(*Paleacrita vernata* Peck., the Spring Canker-worm.)

Though canker worms are very common in Massachusetts, they only become destructively abundant at intervals of several years, and though both the Fall and Spring Canker worms occur it is probably the former which is most frequently met with.

The two kinds have many features in common. The caterpillars of both feed during the spring months; both transform from the caterpillar to the adult in the ground; the female moths of both are wingless, and in both the eggs are laid on the twigs. These facts are of importance for the successful treatment of both pests.

The fall canker worm moths come out of the ground late in the fall and the female moths crawl up the trunks of trees to the twigs, where they lay their eggs. The eggs do not hatch until the following spring, when the tiny caterpillars (inch worms, measuring worms or loopers, as they are variously called), begin feeding on the newly developed leaves. By the middle or end of June feeding has been completed and the caterpillars, now an inch or more in length, either crawl down or spin down a thread to the ground, which they enter and where they transform to the moths which will appear late in the fall.

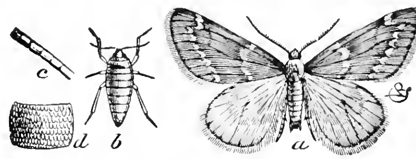


Fig. 3. Fall canker worm. a, male moth; b, female moth; c, d, structural details.

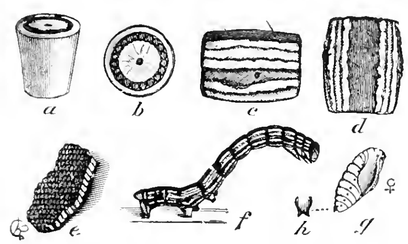


Fig. 4. Fall canker worm. a, side view of single egg; b, top view of same; e, egg mass, natural size; f, full-grown caterpillar; c, d, g, h, structural details.

The spring canker worm moths come out of the ground during the first warm spring days, and like the others crawl up to the twigs, where they lay their eggs. These soon hatch, however, and the caterpillars feed during the spring at the same time as do those of the fall canker worm, and also complete their feeding at about the same time. They then enter the ground to transform, but do not leave it for the trees the same year, waiting until the following spring.

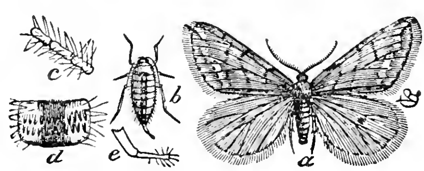


Fig. 5. Spring canker worm. a, male moth b, female moth; c, d, e, structural details.

The first year canker worms become so abundant as to be noticeably destructive it is probable that the earliest knowledge of this will be obtained from the appearance of the leaves where the caterpillars are at work. In such cases, spraying with arsenate of lead is the only treatment available. Thereafter, however, other methods for their control are preferable and should be made use of.

The fact that the females lay their eggs on the twigs; that they come from the ground; and that being wingless, their only way of reaching the twigs is by crawling up the trunk, point to the treatment, which is to band the trunks of the trees with an adhesive such as Tree Tanglefoot. This should be applied in September for the fall canker worm and be kept fresh until winter, one application usually being sufficient. For the spring canker worm, the tanglefoot should be applied on the first warm day—sometimes in February, generally in March—and be kept fresh until the middle of May. If this treatment be carefully made, no trouble from canker worms need be feared.

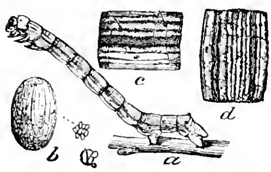


Fig. 6. Spring canker worm. a, full-grown caterpillar; b. enlarged egg and part of a mass, natural size: c, d, structural details.

SPRUCE GALL LOUSE.

(*Chermes abietis* L.)

This tiny plant louse forms galls at the bases of the twigs of various kinds of spruces and seriously injures the trees. Old, dry galls with open cavities in them remain on the tree for years after they are formed and the new ones, which are green, occasionally with pinkish marks, appear in June and July. In these galls the lice feed until August, when the galls begin to turn brown and the cavities within crack open, allowing the insects to escape. During the remainder of the year, the insects in various stages may be found on the tree but are not in galls.

The formation of a gall at the base of a twig almost always results in the death of that twig, so that when these insects are abundant the tree, instead of being thickly covered with foliage, becomes thin, with many dead twigs, and, as a whole, is far from being the ornament it should be.

There are two methods by which the attacks of this insect may be reduced. If the tree has only recently become infested, the galls will be few in number, and may be picked off and destroyed during June and July. If they are too abundant for this to be practicable, spraying very thoroughly in April with one pound of whale-oil soap dissolved in two gallons of water has proved effective.

COTTONY MAPLE SCALE

(*Pulvinaria innumerabilis* Rathv.)

This scale insect is frequently a very serious enemy of soft maples and is often present in smaller numbers on other maples, elms and other plants. It is found on twigs and looks like a small mass of cotton, protruding at one end from beneath a brown scale.

During the spring months before the cottony portion has developed, this insect is not very noticeable, but by the end of June and during the two months following the cottony threads among which the eggs and young are found, make it a prominent object.

The young soon leave the cotton where they were born and wander to the leaves where they settle down, generally along the veins, and each secretes a covering scale. Shortly before the leaves fall they migrate from them to the twigs, where they spend the winter. In the spring they grow rapidly and produce large quantities of honey dew, which adheres to and dries on the leaves or twigs on which it may fall. In June the cottony threads are produced and the insect then becomes more noticeable.

Brushing the infested limbs and twigs with a stiff brush wet with kerosene emulsion has been recommended as a treatment for this insect. The most successful results, however, have been obtained by winter spraying with eighteen to twenty per cent. kerosene emulsion. This may be made by mixing three gallons of the stock emulsion (see directions for making at the end of this article) with about seven and a half gallons of water.

BORERS.

Almost every kind of tree and shrub seems to be attacked by borers, and as their work is inside the stem to such a large extent, successful treatment is often very difficult. As it is impossible to consider the different borers separately here, a few general suggestions are all which can be given on this subject.

In nearly all cases, the eggs of the borers which work in the trunks are laid on the bark. Accordingly, anything covering the bark which will prevent egg laying without injuring the tree will be useful if applied at the proper time. Sometimes, soaping the trunk for this purpose is of value; whitewashing the trunk frequently induces the insect to leave trees thus treated, for others; and wrapping in tar paper is also of value. Careful examination of the trunk and ground will sometimes show where borers are at work, little accumulations of "sawdust" being evident. In such cases, it is frequently possible to cut out the borers, or to run a flexible, pointed wire into the tunnel and spike the borer at its end. Sometimes a little cotton saturated with carbon disulfid can be placed in the outer end of the tunnel and the opening then be closed either with putty or clay, permitting the disulfid gas to follow along the tunnel and suffocate the borer. In fact, the most important and difficult part of the problem is to find where to make the attack, and only careful examination in each case will solve this.

WHITE PINE WEEVIL.

(*Pissodes strobi* Peck.)

This insect bores in the leaders of pine, spruce and perhaps other evergreen trees, killing these shoots, deforming the tree, and of course greatly reducing its value as an ornament.

The beetles lay their eggs in the leaders during the spring, and the boring grubs work inward and downward until they reach the pith, in which they also burrow for a short distance. At first, an affected shoot shows little or no trace of the presence of the borer, but by midsummer it begins to turn brown. The borers change to pupæ and these to adults, which are found the following spring.

But little can be done to control this insect beyond cutting off and burning all infested twigs as soon as they show traces of infestation, thus destroying the insects before they leave.

SAN JOSE SCALE.

(*Aspidiotus perniciosus* Comst.)

While the San José Scale has attracted most attention because of its importance as a fruit tree pest, it is also of great importance as an enemy of many kinds of shade trees and ornamental shrubs. It often entirely destroys willows, poplars and mountain ashes, and is frequently abundant on the elm, ash, ornamental plums and crabs, etc., and to a less extent on the maple.

The adult insect is about the size of a pin head, and is covered by a dark gray or brownish scale or shell nearly circular in outline. In the early spring months only those from one-half to two-thirds grown are living and these become adult in June, beginning to produce young during the last half of this month. The young are born alive, a few every two or three days during the latter part of June and the month of July, and in their turn become adult in about a month at this time of year, and begin to produce young. These are very small

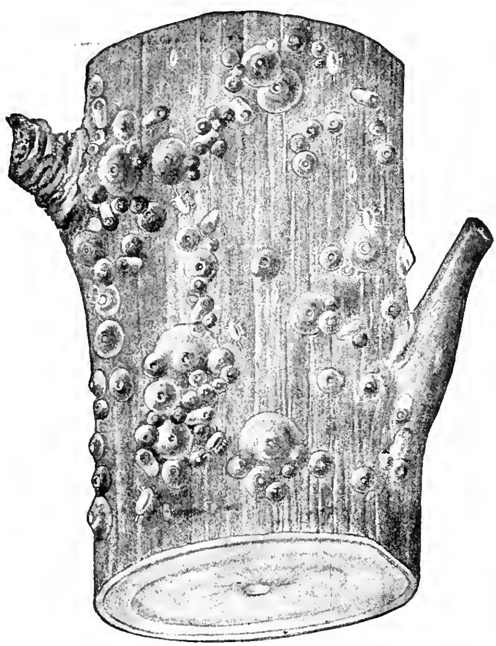


Fig. 7. San José scale; different stages, enlarged five times.

and lemon yellow in color. They crawl about for a short time, then settle down, inserting their beaks in the bark, and begin to feed on the sap of the tree. White waxy threads soon appear on their backs, and these matting together with the molted skins of the insect added, finally form the scale covering the adult.

The extremely small size of this insect, together with its enormous power of multiplication (a single insect in the spring might easily have over three billion descendants before the winter if no casual-ties occurred) render it exceedingly difficult to control. Trees are often nearly dead before the presence of this insect is realized, and constant vigilance is necessary to guard against this pest.

If it were possible to reach all the young while they are crawling about or before they produce their covering scales, treatment would be comparatively easy, but as young are constantly appearing from about the middle of June until winter sets in, this is impossible, and materials strong enough to reach and destroy the insects in spite of their protecting scales must be used. The best spray for this purpose is the lime-sulfur wash, applied while no leaves are on, but if for any reason this cannot be used, Scalecide one part, water twelve to fourteen parts, sprayed on during the same time, is a fairly good substitute, if very thoroughly applied. This insect and methods for its control have been very fully considered in Bulletin 116 of this Station.

THE GYPSY MOTH.

(*Porthetria dispar* L.)

The Gypsy Moth is a native of the Old World. It reached Massachusetts about 1868, and has now spread over the entire eastern portion of the state, and is also found in portions of Rhode Island, Connecticut, New Hampshire and Maine. The eggs are deposited in clusters, mixed with hair from the body of the moth, and are laid during the latter part of July, August and early September. They are placed on the trunks, limbs and sometimes even on the leaves of trees and bushes, and also on stones, rubbish or elsewhere on the ground. The clusters are yellowish brown in color because of the hairs present, and may occupy more than a square inch of space.

The eggs hatch in the spring and the tiny caterpillars feed on the leaves of different plants, over four hundred kinds of which are known to serve for this purpose. The feeding is mainly at night, the caterpillars hiding more or less during the day. By the middle or end of June they have become full grown and are two inches or more in length. They now crawl to some partly protected spot, the underside of a limb being a favorite place, and there they change to pupæ, only a few scattered silk threads representing the cocoon. Within the pupa shell the change from the caterpillar to the moth takes place, and when this has been completed the moths appear, most of them being found in July and August.

The male moth is dark brownish gray and mottled ; the female is dirty white with irregular dark markings. The female, though provided with wings, is unable to fly.

At any time during the fall and winter months the egg masses may be destroyed by soaking them with creosote oil. A good formula for this purpose is :

Creosote oil,	50%
Carbolic acid,	20%
Spirits turpentine,	20%
Coal tar,	10%

A sufficient amount of this should be applied to each egg mass to insure reaching every egg in it.

The habit the caterpillars have of feeding by night and lying hidden during the day is made use of by putting loose bands of burlap around the trunks of the trees for the caterpillars to hide beneath, these bands being examined every day or two and the caterpillars there being destroyed. Banding in this way should be begun by the first of May. Trees not infested and not touching others can be protected by bands of Tree Tanglefoot around their trunks. Spraying infested trees heavily with arsenate of lead is also a valuable treatment and the clearing out of underbrush is necessary in infested districts. Fuller descriptions and information can be obtained by applying to the Gypsy Moth Commission, 6 Beacon St., Boston, which has excellent illustrated bulletins about this insect for distribution.

THE BROWN-TAIL MOTH.

(*Euproctis chrysorrhœa* L.)

This insect, which is a well-known European pest, was brought to Massachusetts about 1892, and is now found throughout the eastern half of the state, and also in New Hampshire, Maine and the Maritime Provinces, and is likely to be found in northern Rhode Island and northeastern Connecticut, though it has not thus far been reported from there. The adult moths appear early in July and fly for perhaps two weeks. They are pure white except for a golden brown tuft at the end of the body of the female, which has given the insect its name. They spread from an inch to an inch and a half when their wings are extended, and in general much resemble the fall web-worm moth, which, however, has no brown tail.

During July the moths lay their eggs in clusters mixed with the brown hairs from the end of the body. The clusters are usually placed on the underside of leaves and only rarely on the bark, and each includes about three hundred eggs In August the eggs hatch into tiny caterpillars, which feed on the leaves, keeping together in colonies. They may feed on a large number of kinds of plants, but appear to prefer the pear and other fruit trees, the oak, elm and mountain ash, and when abundant may skeletonize the leaves of an entire tree at this time. In September each colony passes to the tip of some twig and here constructs a tent or nest in which to pass the winter. This tent is of very closely woven silk threads, and is rarely over four or five inches long by two or three inches at its greatest diameter. It may easily be distinguished from the tents of other insects by its toughness and firmness, its small size, by its location at the very tips of the branches, and by the presence within it during the winter of hundreds of caterpillars one-fourth to one-third of an inch in length. After making the tent, the caterpillars may at first leave it on warm days to continue feeding, but they soon retire to it to pass the winter.

In the spring the caterpillars desert their winter quarters and scatter to feed, attacking buds, blossoms and leaves, and becoming full grown by the middle or latter part of June. They then pupate, usually in the hollows formed by drawing the edges of leaves toward each other, though occasionally in other places, and from these pupæ the moths appear early in July.

Though this insect is less universally destructive to vegetation than the Gypsy Moth, the fact that the hairs of the caterpillar, and to some extent of the moths also, are very brittle, and contain a poison irritating to the human skin, makes them serious pests. The most effective methods of control are to cut off and burn the winter tents before the caterpillars scatter in the spring; to spray infested trees with arsenate of lead when the caterpillars begin their work in August (except on trees bearing fruit), and also when the leaves develop in spring; to band uninfested trees not touching those which are infested, with Tree Tanglefoot, though this will not prevent moths from flying to such trees in July and laying their eggs there; and to destroy the moths which have been attracted to lights. Relief from the irritation caused by the poisonous hairs may be obtained by bathing the affected parts with cooling lotions, or by the use of vaseline. For fuller information apply to the Gypsy Moth Commission, 6 Beacon St., Boston.

MAKING AND APPLYING INSECTICIDES

ARSENATE OF LEAD.

Arsenate of soda (50% strength), 4 ounces.
Acetate of lead, 11 ounces.
Water, 100 gallons.

Put the arsenate of soda in two quarts of water in a wooden pail, and the acetate of lead in four quarts of water in another wooden pail. When both are dissolved, mix with the rest of the water. Warm water in the pails will hasten the process. For the elm-leaf beetle use 10 instead of 100 gallons of water. For most shade trees 50 gallons of water is better than 100 gallons.

A number of ready-made arsenates of lead are now on the market, and except when very large amounts are needed it will probably prove cheaper to buy the prepared material than to make it. With this ready-made material, take one pound to fifty gallons of water in general, but five pounds to fifty gallons for the elm-leaf beetle.

KEROSENE EMULSION.

Hard soap, shaved fine, one-half pound.
Soft water, 1 gallon.
Kerosene, 2 gallons.

Dissolve the soap in the water, which should be boiling; remove from the fire and pour it into the kerosene while hot. Churn this with a spray pump until it changes to a creamy, then to a soft butter-like mass. Keep this stock, using one part in nine of water for soft bodied insects such as plant lice, or stronger in certain cases. If the water be hard add borax or soda to soften it before dissolving the soap.

WHALE OIL SOAP.

Potash whale oil soap, 2 pounds.
Hot water, 1 gallon.

For winter use only.

Potash whale oil soap, 1 pound.
Hot water, 6 gallons.

For summer use.

LIME-SULFUR WASH.

Fresh stone lime, 20 to 22 pounds.
Flowers of sulfur or sulfur flour, 15 to 20 pounds.
Water, 45 to 50 gallons.

Slake the lime with some of the water in a large iron kettle, sprinkling in the sulfur gradually. Start a fire under the kettle to continue the heat begun by slaking the lime, and boil until the mixture becomes dark orange in color, adding water until 35 or 40 gallons are in the kettle. Boiling should probably take 40 minutes to an hour. Stir frequently. If successfully prepared it should have little sediment at the bottom when the boiling is finished. Strain through a fine meshed strainer into the spray pump, adding the rest of the water, and spray while warm. It is generally better to use only the freshly prepared wash, though good results have sometimes been obtained with it when it has stood over night. It should not be applied to trees after the leaves have opened.

BULLETIN No. 126. NOVEMBER 1908.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT

STATION

How to Fight

CRANBERRY INSECTS

By

HENRY J. FRANKLIN

This bulletin is a revision of Bulletin No. [illegible] of this Station and gives the results of the studies made on cranberry insects since that bulletin was published. It contains directions for the treatment of different cranberry insects.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

Annual reports and bulletins on a variety of subjects are published These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

DEPARTMENT OF ENTOMOLOGY.

How to Fight Cranberry Insects.

By Henry J. Franklin, Ph. D.

This bulletin is a revision of bulletin No. 115 of this Station and is intended to bring the economic side of that report up to the end of the year 1907 when the writer's connection with the work ceased, thus giving the results of two full years' study and experiments on these insects. Prof. C. H. Fernald and Dr. H. T. Fernald have assisted the author by suggestions and advice during the investigation and by revising the manuscript of this bulletin.

THE CRANBERRY FRUIT WORM.

Mineola vaccinii (Riley).

Recommendations for treatment:

A. **On bogs which have water supply for winter flowage and for reflowage:**

1. *Reflow immediately after picking, for ten days or two weeks. Draw off this flowage and, after allowing the foliage to ripen, put on the water for the winter.* If, in a series of closely connected bogs, some bearing early varieties only, are so situated that they may be flowed independently of the others, reflow them as soon as the fruit is off, without waiting to finish picking the other bogs.

2. *Draw off the winter flowage early in April as a rule but every third or fourth year hold it until after the middle of May.*

B. **On winter flowed bogs which have not water supply for reflowage:**

1. *Put on the winter flowage as soon as possible after the cranberry foliage has ripened and hardened.*

2. *Hold this flowage every spring until early in April, and every third or fourth year until after the middle of May.*

In Bulletin No. 115 it was recommended to hold this flowage until the 20th of April each year, the idea being to let this flowage protect the buds from early frosts and at the same time destroy the wintering fruit worms to some degree. It seems preferable however, to let the water off earlier and allow the vines to harden as much as possible before the later frosts come in May and the first part of June.

C. **On bogs which are dry or have very scanty winter flowage:**

No practicable remedy has thus far been discovered for the fruit worm on bogs of this kind, and we can only suggest that further experiments with arsenical poisons be made. In our experience, a combined Bordeaux mixture and arsenate of lead spray (the latter being used at the rate of five or six pounds to 50 gallons of water), with about five pounds of resin fish oil soap (per 50 gallons of water) added as an adhesive, has given the best results. This spray, however, often shows a strong tendency to cling to the fruit at picking time and is therefore objectionable. The fact that it is necessary to spray two or three times each season in order to get anything like satisfactory results against the fruit worms also makes this method of treatment objectionable because so much spraying necessitates no small amount of injury to the vines and the fruit. Where ants's nests are present they should not be disturbed as some of the common species of ants found on dry bogs destroy not only fruit worms but also certain other injurious insects, notably the Yellow-headed Cranberry Worm.

D. **For all bogs:**

1. *Bury the "screenings," to destroy any worms which may be in them.*

2. *Clean out all cracks and crevices where worms may have spun up in the screen house—if this is near the bog*—to guard against possible infestation from this source.

More experiments with fall flowage may show that either a more prolonged reflow immediately after picking or an earlier putting on of the winter flowage will be entirely efficient and satisfactory as treatments for this insect when the water supply is sufficient. It is also possible that good results might be obtained on many bogs by increasing the number of catchwaters in the main ditch and running small dikes (boards laid down edgewise and end to end would perhaps be the easiest to build) across the bog from these catchwaters, dividing it into small areas of nearly equal elevation, and thus allowing the water to be held up among the vines without covering them. These dikes need not be built at right angles to the main ditch, but could be placed at angles to suit the general "lay" of the surface of the bog. By this arrangement, the benefits of an annual late holding of winter flowage could be obtained without the attendant injury. This method should get rid of the fruit worm almost entirely, and in many cases, would also be of great value by preventing injury from frost. In case of necessity, this method of flooding the bog could also probably be made use of in fighting the fire worm (see discussion under Fire Worm.)

THE FIRE WORM.

Eudemis vacciniana (Pack.)

This insect is rarely if ever troublesome in Massachusetts on strictly dry bogs. Those which have water supply for quick and repeated reflowage can also be easily kept free from this pest if the water be properly handled, and such bogs are seldom infested to any extent. Those bogs, many of them very large, which are winter flowed and have at most a rather scanty reflowage are the ones often found seriously infested, and the infestation is usually most serious where the winter flowage is deepest.

Parasites and winter killing of the eggs of this insect are apparently the chief factors working against this pest on dry bogs, the former probably being by far the more effective of the two. Winter flowage will destroy the parasites present when the water is put on, but this treatment, instead of also destroying the fire worm eggs, seems to protect them against the severity of the winter. These facts lead us to make the following

Recommendations and suggestions for treatment:

A. **With Water:—**

1. *Where bogs may be so treated it is advisable to divide them into smaller areas by dikes*, thus permitting the late holding of the winter flowage on the higher sections, so that the lower sections can be quickly reflowed at any time up to the end of the first week in June. With a bog thus divided, all the sections could be covered with much less water than would be needed to cover the bog as a whole without

the dikes, and for this reason, in many cases, the mere dividing of the bog would be sufficient to provide for the quick reflowage of the various sections without a late holding of the winter flowage on the higher ones. On bogs where it would be necessary to hold this flowage it would be best to alternate the sections on which the water is held late, from year to year, as annual late holding reduces the crop. With a bog so arranged that the infested portion could be quickly reflowed at any time it would be best to plan to reflow once for about fifty hours during the last week in May, and again for about twenty-four hours as late in June before blossoming as possible without running any serious risk of injuring the buds. Perhaps the tenth of June would be about the right average date.

It should be noted here that dividing large bogs as has just been recommended, would also make it possible to protect them from frost much more effectively and surely.

It is probable that many bogs could be treated satisfactorily as follows:

2. *Divide that portion of the bog surface which includes the infested portion into areas of nearly equal elevation by means of catchwaters in the main ditch and low dikes running out on each side from these, as already described for the fruit worm. With the bogs so arranged, wait, in the case of either or both broods of the fire worm, until the worms have reached the stage of general pupation on the surface of the bog under the vines, then raise the water up among the vines without covering them and hold it there for three days.* When full grown the worms go from the vines to the ground where they pupate, becoming quiet. Later they escape from these pupæ as moths.

The first period during which the fire worms hatch from the eggs is often quite a long one, young worms sometimes hatching continuously for five weeks time. Consequently, the period during which the worms become full grown is also often quite a long one, and may last three or four weeks, during which time one worm after another will leave for the ground to pupate.

When this is the case, the treatment given above may be repeated (at least with the first brood) at intervals of a week. The dikes and catchwaters used for this treatment may also be used for fighting the fruit worm and frosts as already pointed out.

3. If a bog be treated to destroy fire worms as above suggested, the worms will have a chance to do some injury before the water is

used. To prevent this, spray with Arsenate of lead, using six or seven pounds in fifty gallons of water, as soon as the eggs of either brood begin to hatch, As the time of hatching is often prolonged as already stated, it will usually be found advisable to repeat this spraying after a week or ten days for each brood.

B. **Without Water:**

The fact that this insect is not troublesome on dry bogs suggests the following treatment.

Sand an infested bog heavily and then let it go without winter flowage for three or four winters, thus allowing the winter weather and parasites to work against the insect. At the same time, aid these natural agents of control by spraying with Arsenate of lead as recommended under No. 3 above. Of course, anyone using this method of control will necessarily run some risk of winter killing on the bog.

THE FALSE ARMY WORM.

Calocampa nupera Lintner.

Recommendations for treatment:

A. **On bogs with abundant water supply for reflowage:**

1. *Examine the bogs carefully from time to time, from May 1st to May 15th.* This may be done most conveniently by sweeping the vines with an insect net and counting the worms collected in it. In general if only four or five caterpillars are collected by fifty sweeps of an ordinary net, when tried on various parts of a bog, the infestation is only slight, and would, better, in most cases, be disregarded unless abundant water supply is available. If, however, every fifty sweeps collects fifteen to twenty or more, the trouble is likely to be serious and treatment is needed. *If caterpillars are found in sufficient abundance to make it advisable, reflow for from twenty-four to thirty-six hours as soon after May 15th as practicable. If the young caterpillars are present in abundance, this will save a great amount of injury to the buds. Furthermore, less difficulty will be experienced at this time with worms which survive the flooding and are washed ashore alive.*

2. *If caterpillars are present a few days after the first reflow, put on the water again for 24 to 36 hours.*

3. *As far as possible destroy all the worms which are washed*

ashore alive during a reflow. In case the grower is favored with weather damp enough to make it safe, this may probably be most conveniently done by spraying the margins where the worms come ashore, with kerosene and then setting it afire while the water is still on the bog. If the grower is not so favored, it is probable that the spraying alone would be fairly effectual.

B. **On bogs with winter flowage and enough water supply for one good reflow :**

1. *Hold the winter flowage late (until toward the 20th of May) every third or fourth year, if the bog is being regularly attacked by this pest.* This treatment also holds for the fruit worm under similar bog conditions.

2. *In other years, draw off the winter flowage early in April and do not reflow for the caterpillars until danger from frost is practically past unless they are so plentiful as to threaten serious injury.* Of course, if frost so threatens, between the 15th and 25th of May, that it seems necessary to reflow on that account, the water will then destroy the worms.

3. *If the reflow must be used before it will destroy the worms, then* the only resort is arsenical poisoning as recommended below for dry bogs.

4. *If the worms become very plentiful, it would be better, in most cases, to use the reflow about the 20th of May and run the risk of later frosts.*

5. *If the bog is not level and water for only a partial reflow is to be had,* this water may be used as in 1, 2 and 3 for the portions of the bog which can be covered, and the remainder may be treated as recommended for dry bogs.

C. **On bogs with winter flowage only :**

1. *Hold the winter flowage until after the middle of May every third or fourth year.* This is also recommended for the fruit worm.

2. *In other years, treat as for dry bogs.*

D. **On dry bogs :**

1. *If the young worms are found to be hatching plentifully, spray at once (about the 8th of May) with arsenate of lead used at the rate of seven pounds to fifty gallons of water.*

2. These caterpillars show a strong tendency to work at night and hide under the vines or anything else that they can find during the day. *On this account, in case the caterpillars have become so far developed that it is not practicable to spray*, lay down boards for them to hide under and destroy those that collect there.

THE YELLOWHEAD CRANBERRY WORM.

Peronea minuta (Robinson).

In Massachusetts this insect is troublesome only on dry bogs. It works very much as does the true fire worm on winter flowed bogs. It is very heavily parasitized each year and the parasites need only a little assistance to keep it entirely under control. One thorough spraying with Arsenate of lead at the rate of five pounds in fifty gallons of water at the time of the hatching of the eggs of the second brood of worms (there are two broods in Massachusetts, the first seldom doing much injury) is sufficient to clear a badly infested bog for three or four years. The time for this spraying will vary somewhat with the season, but will average from the 4th to the 10th of July.

THE CRANBERRY GIRDLER.

Crambus hortuellus (Hübner).

Recommendations for treatment:

A. **On bogs which can be reflowed:**

1. *Reflow immediately after picking, for a week or ten days.*

2. *If the early fall flowing has been neglected, reflow for a day or two about the 10th of June.*

B. **On dry bogs:**

This insect is rarely, if ever, seriously injurious where the vines have been freshly sanded, while it is worst on those bogs on which a thick accumulation of old leaves has been allowed to collect under the vines. It seems probable therefore, that if a dry bog were kept well sanded, each year's production of old leaves thus being covered up, there would be no trouble from this insect. Frequent sanding is also helpful in throwing off frosts on bogs without water supply.

1. *It is therefore recommended as a preventive of both frost and girdler injury, to sand all dry bogs during the first two weeks in May*

every year. It may also be possible that bogs already infested could be cleared of this insect by sanding, but this remains to be proved. It is certain that sanding helps the vines to recover quickly from attacks of the girdler.

2. *Burn the vines on a badly infested area* with a gasoline torch, at a time when the vines will not otherwise burn readily, so as to guard against setting a fire which might escape from control. This burning should be done early in the season before the growth starts. After burning reset the burned area.

HINTS ON SPRAYING AND ON THE USE OF WATER.

Where water is available for the purpose, it is a good plan to reflow a bog for a day in June, as late before the time of blossoming as possible without causing injury. Such a reflow clears a bog of a large number of injurious insects which, though they may not be so abundant as to attract attention, are still a continuous drain on the vines by eating their leaves and sucking their juices. This reflow by destroying many such insects, gives the vines a better chance during the summer.

In spraying, the following points should be given particular attention:

1. Spray for a purpose. Do not spray "on general principles" only, but when there is good reason to believe the bog really needs it.

2. Be careful to spray rather than sprinkle. For good work it is essential to use a nozzle giving a fine, misty spray. In the experience of the writer, the "Large Mistry" Nozzle has given the most satisfactory results on cranberry bogs.

3. Keep the materials well stirred up in the barrel and spray evenly and *thoroughly.*

4. Spray behind the pump instead of ahead of it and be careful not to drag the hose over freshly sprayed vines, nor to walk through them.

5. Do not be one of the ninety-nine out of every hundred who will look at this bulletin and then make no use of it. Be the hundredth man.

BULLETIN No. 127. NOVEMBER 1908.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT

STATION.

INSPECTION OF

COMMERCIAL FERTILIZERS

BY

H. D. HASKINS, L. S. WALKER and J. C. REED.

This bulletin presents the results of analyses of commercial fertilizers sold in Massachusetts during the season of 1908. It briefly discusses the essential constituents of fertilizers and the sources from which they are derived. Retail cash prices and valuations are given, and the selection and purchase of high grade fertilizers recommended. Summaries show the general condition of the fertilizer industry.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

CHARLES A. GOESSMANN, PH.D., LL.D.	*Honorary Director and Consulting Chemical Expert.*
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
JOSEPH B. LINDSEY, PH. D.,	*Chemist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. S.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
EDWARD B. HOLLAND, M. S.,	*Associate Chemist* (Research Div.).
HENRI D. HASKINS, B. SC.,	*Chemist in Charge* (Fertilizer Div.).
PHILIP H. SMITH, B. SC.,	*Chemist in Charge* (Feed and Dairy Div.).
FRED C. SEARS, M. SC.	*Pomologist.*
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist.*
ROBERT D. MACLAURIN, PH. D.,	*Assistant Chemist* (Research Div.).
LEWELL S. WALKER, B. SC.,	*Assistant Chemist.*
GEORGE H. CHAPMAN, B. SC.,	*Assistant Botanist.*
PHILIP V. GOLDSMITH, B. SC.	*Assistant Chemist.*
JAMES C. REED, B. SC.	*Assistant Chemist.*
J. K. SHAW, M. SC.,	*Assistant Horticulturist.*
JOHN N. SUMMERS, B. SC.,	*Assistant in Entomology.*
F. A. JOHNSON, B. SC.,	*Assistant in Entomology.*
WILLIAM K. HEPBURN,	*Inspector.*
ROY F. GASKILL,	*Assistant in Animal Nutrition.*
R. C. LINDBLAD,	*Observer.*

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. Lindsey, Chemist.

Inspection of Commercial Fertilizers

FOR THE SEASON OF 1908

By H. D. Haskins, Chemist in Charge.

ASSISTED BY

L. S. Walker and J. C. Reed.*

The full text of the fertilizer law of Massachusetts has been published so many times in previous bulletins, that only the more important points will be referred to at this time.

All brands of fertilizers, whether single or compound, must be recorded and licensed annually on or before May 1, at the Massachusetts Experiment Station before they can be legally sold or offered for sale in this state. The fee charged by the state for a fertilizer license is $5.00 for each of the so-called essential ingredients: nitrogen, phosphoric acid, and potassium oxide guaranteed in each and every distinct brand. A certified statement shall be furnished the director by each manufacturer giving the name of each brand offered for sale, the name of the manufacturer and location of the factory, as well as the guaranteed composition of each distinct brand. Manufacturers and importers may appoint any number of agents after having secured their license certificate from the director.

* Organic nitrogen tests were made by P. V. Goldsmith.

Note.—The writer wishes to give credit to Dr. J. B. Lindsey for many valuable suggestions relative to the subject matter of this publication.

Every lot or parcel of commercial fertilizer or fertilizer material shall bear a plainly printed statement giving the following information: number of net pounds of fertilizer in the package, name of brand under which the fertilizer is sold, name and address of the manufacturer or importer, location of factory and guaranteed composition of brand expressed as follows; percentage of nitrogen, of potash (K_2O) soluble in distilled water and of phosphoric acid (P_2O_5) in available form soluble in distilled water, and reverted as well as total. Inferior substances like leather, hair or wool waste in any form shall not be used unless so stated in a conspicuous manner in the guarantee.

Provision is made for the collection of samples of fertilizers and fertilizer materials found in the possession of any manufacturer, importer, agent or dealer. Two samples shall be drawn from at least 10% of the number of packages present and in the presence of parties in interest. One sample shall be retained by the inspector for analysis and the other left with the agent or party whose stock was sampled, the latter sample being for the protection of the manufacturer.

Offenders against the above regulations are subject to a fine. The full text of the fertilizer law will be furnished upon application.

Manufacturers and Licensed Brands.

Including the various branches of the American Agricultural Chemical Co., seventy-six manufacturers, importers and dealers have secured licenses for the sale of four hundred and nine distinct brands of fertilizers and agricultural chemicals in Massachusetts during the season of 1908. The brands may be grouped as follows:

Complete Fertilizers, ...	306
Fertilizers furnishing Phosphoric Acid and Potash,	8
Ground Bone, Tankage and Dry Ground Fish,	40
Agricultural Chemicals, ...	55
Total	409

LIST OF LICENSEES AND BRANDS.

The names of the fertilizer manufacturers and importers legally selling fertilizers in the state follow, together with the names of the brands licensed by each.

The American Agricultural Chemical Co., 92 State St., Boston, Mass.

Special Grass and Garden Mixture,
Grass and Oats Fertilizer,
High Grade Fertilizer with 10% Potash,
Grass and Lawn Top Dressing,
Tobacco Starter and Grower,
High Grade Tobacco Manure,
Fine Ground Bone,
Dissolved Bone Black,
Muriate of Potash,
Double Manure Salts,
High Grade Sulphate of Potash,
Nitrate of Soda,
Dry Ground Fish,
Plain Superphosphate,
Sulphate of Ammonia,
Kainit,
Dried Blood,
Fine Ground Tankage,
Ground South Carolina Phosphate,
Baker's A. A. Ammoniated Super.,
Baker's Complete Potato Manure,
Bradley's Complete Manure Potatoes and Vegetables,
Bradley's Complete Manure Corn and Grain,
Bradley's Complete Manure with 10% Potash,
Bradley's Complete Manure Top Dressing Grass and Grain,
Bradley's X. L. Superphosphate,
Bradley's Potato Manure,
Bradley's Potato Fertilizer,
Bradley's Corn Phosphate,
Bradley's Seeding Down Manure,
Bradley's Eclipse Phosphate,
Bradley's Niagara Phosphate,
Bradley's English Lawn Fertilizer,
Bradley's Columbia Fish and Potash,
Bradley's Abattoir Bone Dust,
Church's Fish and Potash,
Bradley's Complete Manure for Asparagus,
Clark's Cove Bay State Fertilizer,
Clark's Cove Bay State Fertilizer, G. G.,
Clark's Cove Great Planet Manure,
Clark's Cove Potato Manure,
Clark's Cove Potato Fertilizer,
Clark's Cove King Philip Guano,
Crocker's Corn Phosphate,
Crocker's Potato, Hop and Tobacco,
Crocker's A. A. Complete Manure,
Cumberland Superphosphate,
Cumberland Potato Fertilizer,
Darling's Blood, Bone and Potash,
Darling's Complete 10% Manure,
Darling's Potato Manure,
Darling's Farm Favorite,
Darling's Potato and Root Crop Manure,
Darling's General Fertilizer,
Darling's Animal Fertilizer,
Darling's Dissolved Bone and Potash,
Great Eastern Northern Corn Special,
Great Eastern Veg., Vine and Tobacco,
Great Eastern Garden Special,
Great Eastern General,
Pacific High Grade General,
Pacific Potato Special,
Soluble Pacific Guano,
Pacific Nobsque Guano,
Packers' Union Gardeners' Comp. Man.
Packer's Union Animal Corn Fertilizer,
Packer's Union Universal Fertilizer,
Packer's Union Potato Manure,
Quinnipiac Market Garden Manure,
Quinnipiac Phosphate,
Quinnipiac Potato Manure,
Quinnipiac Potato Phosphate,
Quinnipiac Corn Manure,
Quinnipiac Climax Phosphate,
Quinnipiac Onion Manure,
Read's Practical Potato Special,
Read's Farmers' Friend,
Read's Standard,
Read's High Grade Farmers' Friend,
Read's Vegetable and Vine,
Standard Complete Manure,
Standard Fertilizer,
Standard Special for Potatoes,
Standard Guano,
Tucker's Original Bay State Bone Superphosphate,
Tucker's Special Potato,
Wheeler's Corn Fertilizer,
Wheeler's Potato Manure,

Wheeler's Havana Tobacco Grower,
Wheeler's Bermuda Onion Grower,
Williams & Clark's High Grade Special,
Williams & Clark's Americus Phosphate
Williams and Clark's Potato Manure,
Williams & Clark's Royal Bone Phosphate,
Williams & Clark's Prolific Crop Producer,
Williams & Clark's Potato Phosphate,
Williams & Clark's Corn Phosphate.

W. H. Abbott, Holyoke, Mass.

Abbott's Animal Fertilizer,
Abbott's Onion Fertilizer,
Abbott's Eagle Brand,
Abbott's Tobacco Fertilizer.

American Cotton Oil Co., 27 Beaver St., New York, N. Y.

Prime Cottonseed Meal,

American Linseed Co., 100 William St., New York, N. Y.

Linseed Meal.

Armour Fertlizer Works, 861 Calvert Building, Baltimore, Md.

Armour's Fruit and Root,
Armour's Blood, Bone and Potash,
Armour's High Grade Potato,
Armour's All Soluble,
Armour's Ammon. Bone with Potash,
Armour's Bone Meal,
Armour's Complete Potato,
Armour's Corn King,
Armour's Market Garden,
Armour's Grain Grower,
Armour's Star Phosphate.
Armour's Fish and Potash,
Armour's Onion Special,
Nitrate of Soda,
Muriate of Potash.

H. J. Baker & Bro., 100 William St., New York, N. Y.

Castor Pomace.

Beach Soap Co., Lawrence, Mass.

Beach's Advance Brand,
Beach's Reliance Brand,
Beach's Fertilizer Bone.
Beach's Market Garden.

Berkshire Fertlizer Co., Bridgeport, Conn.

Berkshire Grass Special,
Ammoniated Bone Phosphate,
Potato and Vegetable Phosphate,
Complete Fertilizer,
Complete Tobacco Fertilizer.

Bonora Chemical Co., 488 Broadway, New York, N. Y.

Nature's Plant Food "Bonora".

Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.

Bowker's Tobacco Ash Elements,
Bowker's Gloucester Fish and Potash,
Bowker's Potash Bone,
Bowker's Sure Crop Phosphate,
Bowker's Potash or Staple Phosphate,
Bowker's 10% Manure,
Bowker's Bone and Potash, Square Brand,
Bowker's Bone and Wood Ash Fertilizer,
Bowker's Bristol Fish and Potash,
Bowker's Clover Brand, Bone and Wood Ash Fertilizer,
Bowker's Corn Phosphate
Bowker's Farm and Garden Phosphate,
Bowker's Potato and Veg. Phosphate,
Bowker's Fresh Ground Bone,
Bowker's Hill and Drill Phosphate,
Bowker's Tobacco Starter,
Bowker's Fish and Potash, Square Brand,
Bowker's Fish and Potash, D Brand,
Bowker's Corn, Grain and Grass Fertilizer,
Bowker's Cranberry Phosphate,
Bowker's High Grade Fertilizer,
Bowker's Soluble Animal Fertilizer,
Bowker's Potato and Vegetable Fert.,
Bowker's Market Garden Fertilizer,
Bowker's Lawn and Garden Dressing,
Bowker's Complete Alkaline Tobacco Grower,
Bowker's Early Potato Manure,
Bowker's Blood, Bone and Potash,
Bowker's Dissolved Bone,
Bowker's Plain Superphosphate,
Bowker's Nitrate of Soda,
Bowker's Sulphate of Ammonia,
Bowker's Dried Blood,
Bowker's Tankage,
Bowker's Muriate of Potash,

Bowker's Double Sulphate of Potash and Magnesia,
Bowker's Fishermans' Brand Fish and Potash,
Bowker's High Grade Sulphate of Potash,
Bowker's Kainit,
Bowker's Ammon. Food for Flowers,
Bowker's Seeding Down Fertilizer,
Bowker's Dissolved Bone Black,
Bowker's Canada Hard Wood Ashes,
Stockbridge's Tobacco Manure,
Stockbridge's Special Complete for Quick Growth and Forcing,
Stockbridge's Complete for Potatoes and Vegetables,
Stockbridge's Special Complete for Corn and All Grain,
Stockbridge's Special Complete for Seeding Down, etc.

Joseph Breck & Sons, Corporation, 51-52 North Market St., Boston, Mass.

Breck's Lawn and Garden Dressing,
Breck's Market Garden Manure,
Breck's Ram's Head Brand, Pulverized Sheep Manure.

T. W. Brode & Co., 40 So. Front St., Memphis, Tenn.

Owl Brand Cottonseed Meal.

Buffalo Fertilizer Co., William St., Buffalo, N. Y.

Fish Guano,
Farmers' Choice,
Ideal Wheat and Corn,
Celery and Potato Special,
Vegetable and Potato,
High Grade Manure,
Top Dresser,
Buffalo Bone Meal,
High Grade Sulphate of Potash,
Muriate of Potash.

T. H. Bunch Co., Little Rock, Ark.

Cottonseed Meal.

The Coe-Mortimer Co., 24-26 Stone St., New York, N. Y.

E. Frank Coe's Columbian Corn and Potato Fertilizer,
E. Frank Coe's Celebrated Special Potato Fertilizer,
E. Frank Coe's Excelsior Potato Fert.,
E. Frank Coe's Gold Brand Excelsior Guano,
E. Frank Coe's High Grade Ammoniated Bone Superphosphate,
E. Frank Coe's New Englander Corn and Potato Fertilizer,
E. Frank Coe's XXV Ammoniated Bone Phosphate,
E. Frank Coe's Red Brand Excelsior Guano,
Peruvian Vegetable Grower,
Peruvian Market Gardeners' Fertilizer,
Peruvian Grass Top Dressing,
Peruvian Tobacco Fertilizer,
Nitrate of Soda,
Thomas Phosphate Powder, (Basic Slag Phosphate,)
Muriate of Potash,
Genuine Peruvian Guano, Chincha Grade,
Genuine Peruvian Guano, Lobos Grade,
High Grade Sulphate of Potash.

John C. Dow Co., 13-14 Chatham St., Boston, Mass.

Dow's Pure Bone.

Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.

Imperial Plant Food.

Essex Fertilizer Co., Boston, Mass.

Essex Complete Manure for Corn, Grain and Grass,
Essex Complete Manure for Potatoes, Roots and Vegetables,
Essex Market Garden and Potato,
Essex A. 1 Superphosphate,
Essex XXX Fish and Potash,
Essex Lawn Dressing,
Essex Special Tobacco Manure,
Essex Potato Grower,
Essex Special Potato Phosphate.

R. & J. Farquhar & Co., 6-7 South Market St., Boston, Mass.

Farquhar's Vegetable and Potato Fert.,
Thompson's Imp. Vine, Plant and Veg.,
Farquhar's Lawn and Garden Dressing,
Thompson's Special Chrysanthemum Manure,
Farquhar's Pure Ground Bone,
Clay's London Fertilizer.

Fertilizer Products Co., 76 Hudson St., Jersey City, N. J.

Plant Blood.

F. E. Fogg, Dartmouth, Mass.

Corn and Grass Fertilizer.

C. W. Hastings, Ashmont, Mass.

Ferti Flora.

Thomas Hersom & Co., New Bedford, Mass.

Bone Meal,
Meat and Bone.

The Home Soap Co., 103 Webster St., Worcester, Mass.

Ground Bone.

Humphreys Godwin Co., Memphis, Tenn.

Dixie Brand Cottonseed Meal.

Hunter Bros. Milling Co., St. Louis, Mo.

Prime Cottonseed Meal.

Storer F. Jones, 15 Garfield St., Watertown, Mass.

Canada Hard Wood Ashes.

John Joynt, Lucknow, Ontario, Can.

Canada Hard Wood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.

Lister's High Grade Special,
Lister's Success,
Lister's Special Corn,
Lister's Potato Manure,
Lister's Special Tobacco Fertilizer,
Lister's 10% Potato Grower,
Lister's Grass and Grain Fertilizer,
Lister's Special Potato Fertilizer.

James E. McGovern, Andover, Mass.

Animal Fertilizer,

George L. Monroe & Sons, Oswego, N. Y.

Pure Unleached Canada Wood Ashes.

D. M. Moulton, Monson, Mass.

Moulton's Ground Bone.

Mapes Formula and Peruvian Guano Co., 143 Liberty St., New York.

Potato Manure,
Tobacco Starter, Improved,
Tobacco Manure, Wrapper Brand,
Economical Potato Manure,
Average Soil Complete Manure,
Vegetable Manure or Complete Manure for Light Soils,
Corn Manure,
Complete Manure, "A" Brand,
Cereal Brand,
Cauliflower and Cabbage Manure,
Grass and Grain Spring Top Dressing,
Fruit and Vine Manure,
Complete Manure, 10% Potash,
Top-dresser, Improved, Half Strength,
Top-dresser, Improved, Full Strength,
Tobacco Ash Constituents,
Dissolved Bone,
Mapes Complete Manure for General Use,
Mapes Lawn Top Dressing.

National Fertilizer Co., Bridgeport, Conn.

Chittenden's Muriate of Potash,
Chittenden's Carbonate of Potash,
Chittenden's Dissolved Bone Black,
Chittenden's Nitrate of Soda,
Chittenden's Potato Phosphate,
Chittenden's Complete Root,
Chittenden's Fish and Potash,
Chittenden's Connecticut Valley Tobacco Starter,
Chittenden's Connecticut Valley Tobacco Grower,
Chittenden's Market Garden,
Chittenden's Tobacco Special with Carbonate of Potash,
Chittenden's Complete Tobacco,
Chittenden's High Grade Special Tobacco,
Chittenden's Ammoniated Bone,
Chittenden's Formula "A",
Chittenden's Fish and Potash "X"
Chittenden's Dry Ground Fish,
Chittenden's Fine Ground Bone,
Chittenden's Double Manure Salts,
Chittenden's High Grade Sulphate of Potash,
Chittenden's Complete Grass Fertilizer.

Natural Guano Co., Aurora, Ill.

Pulverized Sheep Manure.

New England Fertilizer Co., 40 A North Market St., Boston, Mass.

New England Corn Phosphate.
New England Potato Fertilizer.
New England Superphosphate.
New England High Grade Potato Fertilizer.
New England Corn and Grain Fertilizer.

Northwestern Fertilizer Co., Detroit, Mich.

Northwestern Empire Special.

Olds & Whipple, Hartford, Conn.

O. & W. Home Mixture for Onions,
O. & W. Corn and Potato Fertilizer,
O. & W. Complete Tobacco Fertilizer,
O. & W. Vegetable Potash.
O. & W. Dry Ground Fish.
O. & W. Top Dressing for Grass.
O. & W. High Grade Potato,
O. & W. Fish and Potash.
O. & W. Grey Pomace.

Parmenter & Polsey Fertilizer Co., Boston, Mass.

P. & P. Potato Fertilizer,
Plymouth Rock Brand,
Special Potato Fertilizer,
Pure Ground Bone,
A. A. Brand.

R. T. Prentiss, Holyoke, Mass.

Complete for Corn,
Complete for Potatoes,
Complete for Top Dressing.

The Pulverized Manure Co., Union Stock Yards, Chicago, Ill.

Wizard Brand Manure.

W. W. Rawson & Co., Boston, Mass.

Rawson's Special Lawn and Garden Dressing,
Rawson's Lawn and Garden Dressing.
Rawson's Fine Ground Bone,
Rawson's Wizard Brand Pulverized Sheep Manure.

Ross Bros., 88-92 Front St., Worcester, Mass.

Ross Bros. Odorless Lawn and Garden Fertilizer.

N. Roy & Son, South Attleboro, Mass.

Complete Animal Fertilizer.

Rogers & Hubbard Co., Middletown, Conn.

Hubbard's Complete Phosphate.
Hubbard's Grass and Grain Fertilizer,
Hubbard's Oats and Top Dressing.
Hubbard's Potato Phosphate.
Hubbard's Soluble Corn and General Crops.
Hubbard's Soluble Potato Manure.
Hubbard's Pure Raw Knuckle Bone Flour,
Hubbard's Soluble Tobacco Manure.
Hubbard's Strictly Pure Fine Bone.

The Rogers Manfacturing Co., Rockfall, Conn.

All Round Fertilizer,
High Grade Corn and Onion.
Complete Potato and Vegetable,
Fish and Potash,
High Grade Tobacco and Potato.
High Grade Oats and Top Dressing.
High Grade Grass and Grain.
High Grade Soluble Tobacco.
Pure Knuckle Bone.
Pure Fine Bone.

Sanderson Fertilizer and Chemical Co,, P. O. Box 172, New Haven, Conn.

Sanderson's Special with 10% Potash.
Sanderson's Corn Superphosphate.
Sanderson's Old Reliable.
Sanderson's Formula "A."
Sanderson's Formula "B."
Sanderson's Top Dressing.
Sanderson's Potato Manure.
Walker's Complete Phosphate.
Atlantic Coast Bone, Fish and Potash,
Fine Ground Fish.
Nitrate of Soda,
Sulphate of Potash.
Muriate of Potash,
Plain Superphosphate.

M. L. Shoemaker & Co., Limited, Philadelphia, Pa.

"Swift Sure" Superphosphate General Use,
"Swift Sure" Bone Meal,
"Swift Sure" Guano for Truck, Corn and Onions.

Smith Agricultural Chemical Co., Columbus, O.

Abbott's Tobacco and Potato Special,
Abbott's Truck Guano.
Abbott's German Potash Mixture.
Abbott's Harvest King,
Hardy's Potato Grower,
Hardy's Potato and Tobacco Special,
Hardy's Tankage, Bone and Potash.

Springfield Rendering Co., Springfield, Mass.

Tankage.
Ground Bone.

Thomas L. Stetson, Randolph, Mass.

Stetson's Ground Bone.

F. C. Sturtevant, 216 State St., Hartford, Conn.

Granulated Tobacco and Sulphur.

Swift's Lowell Fertilizer Co., 40 North Market St., Boston, Mass.

Swift's Lowell Bone Fertilizer.
Swift's Lowell Potato Phosphate.
Swift's Lowell Animal Brand,
Swift's Lowell Market Garden Manure,
Swift's Lowell Potato Manure,
Swift's Superior Fertilizer.
Swift's Lowell Lawn Dressing,
Swift's Lowell Ground Bone,
Swift's Special Vegetable Manure,
Acid Phosphate,
Nitrate of Soda,
Muriate of Potash.
Ground Tankage,
Dried Blood,
High Grade Sulphate of Potash,
Special Grass Fertilizer,
Potato Grower,
Empress Brand for Corn and Potatoes.

Tavender Process Co., Boston, Mass.

Am-Pho-Nite.

A. L. Warren, Northboro, Mass.

Warren's Ground Bone.

Whitman & Pratt Rendering Co., Lowell, Mass.

Potash Special,
Potato Plowman.
Corn Success,
Vegetable Grower,
All Crop,
Ground Bone.

Sanford Winter, Brockton, Mass.

Winter's Ground Bone.

Wilcox Fertilizer Works, Mystic, Conn.

Wilcox Potato, Onion and Vegetable Manure,
Wilcox Potato Fertilizer,
Wilcox Complete Bone Superphosphate,
Wilcox Fish and Potash,
Wilcox High Grade Tobacco Special,
Wilcox Dry Ground Fish,
Wilcox Nitrate of Soda,
Wilcox Muriate of Potash,
Wilcox Grass Fertilizer.

A. H. Wood & Co., Framingham, Mass.

B. B. Brand General Fertilizer.

J. M. Woodard & Bro., Greenfield, Mass.

Woodard's Unground Tankage.

The Worcester Rendering Co., Auburn, Mass.

Ground Tankage.

Wunsch Manufacturing Co., Pawtucket, R. I.

New England Standard,
Superior Brand,
Potato Special.

Collection of Samples.

The samples represented in the following tables of analyses, unless otherwise specified, were taken by the authorized sampling agent of the experiment station, Mr. W. K. Hepburn, who during the months of April, May and June, drew 624 samples from dealers' stocks, representing 400 distinct brands. Some of these brands were taken from stock in the possession of farmers who had purchased the goods for their own use. Many of these, therefore, will not appear among the licensed goods but have been listed as farmers' samples. All samples have been taken strictly in accordance with our fertilizer law requirements. Whenever possible the same brand has been taken in various parts of the state and a composite sample, composed of equal weights of the various samples, has been used for analysis. It is believed that this gives a better representation of the brands than can the analysis of one sample.

An effort is made to sample every brand licensed. During the season samples were taken from about 180 agents. The towns visited by our collector vary somewhat from those of the previous season—they comprise about 90 in number and represent every county in the state. Ninety-six more samples have been collected and analyzed than during the preceding year. At our request representative samples were sometimes forwarded of those brands not found in our general markets. Such samples are designated in the tables of analyses as manufacturers' samples.

Essential Constituents of Fertilizers. All commercial fertilizers are bought for the purpose of supplying nitrogen, potash, phosphoric acid and sometimes lime, to growing plants in suitable and available forms; the other eight elements, hydrogen, oxygen, carbon, iron, magnesium, sulphur, chlorine, and calcium or lime, usually regarded as being essential to the proper growth and production of plants, are in most cases abundantly supplied either from the air or soil. It was formerly believed by investigators that sodium, silica, and manganese which are usually found in the plant ash, were essential to the proper growth of plants; more recent investigations, however, have disproved this fact. The commercial as well as the agricultural value of a fertilizer, therefore, depends primarily upon the quantity as well as the quality of the three essential elements of plant food which it contains.

Nitrogen. In considering briefly the various forms and functions of the first three elements mentioned, we find that nitrogen in its natural state is a gas, and that it comprises about four-fifths of our atmosphere. There is only one class of agricultural plants, however, which has the power of acquiring free atmospheric nitrogen, namely legumes such as clover, alfalfa, peas, beans, etc.; they do this by means of nodules which develop on their roots, and which contain micro-organisms. All other plants take their nitrogen from the soil and in combination with other elements.

Nitrogen is taken up by plants largely in the form of nitrates and in this form is the most active as well as the most elusive of the elements of plant food. When organic nitrogenous substances decay in the soil, the nitrogen which they contain is readily converted into ammoniates and then into nitrites and finally into nitrates which, if not taken up by the growing plant, pass away into solution and are lost in the drainage waters. These facts emphasize the importance of a familiarity with the behavior and functions of the various elements of plant food in order that they may be better controlled and husbanded, and grave losses thereby avoided.

Nitrogen in the form of ammoniates and organic matter is not as readily leached out of the soil as are nitrates. In many cases, frequent and small applications of nitrogen in form of nitrates is likely, therefore, to prove more economical and effective, especially in wet seasons, than a large application at one time. In case of mixed fertilizers, too much of the nitrogen should not be present as nitrate; usually a quarter to a third is a fair proportion. Nitrogen is a powerful stimulant and when used in great excess, especially in the absence of a liberal supply of available potash and phosphoric acid, causes an unnatural watery growth, a large development of stem and leaf, with but little fruit.

Nitrogen is the most expensive element of plant food, costing at retail from 18 to 25 cents per pound, while potash and available phosphoric acid may be purchased for 4½ to 5½ cents. Nitrogen occurs in fertilizers in three forms, as nitrates, ammoniates and organic nitrogen.

Nitrogen in form of nitrates is supplied by nitrate of soda, the average commercial product testing 95% nitrate of soda, equivalent to about 15.5 per cent nitrogen. Nitric nitrogen may also be supplied from nitrate of potash or saltpetre which, of course, furnishes valuable potash as well as nitrogen. Two analyses of nitrate of potash from samples collected in our general markets, averaged 12.47% nitrogen and 46.22% potash.

Nitrogen as furnished by sulphate of ammonia, is one of the most active forms of nitrogen except when used on soils deficient in lime.

Analyses of 23 samples made at this station give an average of 20.70% nitrogen.

Organic nitrogen is derived from both animal and vegetable substances. Blood, fish and tankage are easily decomposed in the soil and are considered among the best and most available of the organic nitrogen containing substances of animal origin. Of the vegetable sources of nitrogen, cottonseed meal, castor pomace, and linseed meal are among the best and most available. The following table gives a list of animal and vegetable substances with the average composition of each. In one column of the table will be found the comparative availability by the so-called alkaline permanganate method, of the various organic substances furnishing nitrogen.

	Number of Analyses.	Nitrogen. Lowest.	Nitrogen. Highest.	Nitrogen. Average.	Nitrogen. Comparative Availability.	Phosphoric Acid.	Potassium Oxide.
Animal Ammoniates.							
Dried blood	34	7.99	13.55	10.16	65.7	—	—
Tankage	76	4.11	11.27	5.88	61.0	14.00	—
Dry ground fish	60	6.06	10.48	8.36	64.2	8.87	—
Ground bone	253	.85	5.94	3.06	66.4	24.34	—
Hoof meal	1	—	—	14.15	65.8	—	—
Horn shavings	1	—	—	14.39	64.6	—	—
Hair	1	—	—	9.82	57.3	—	—
Wool waste	13	.39	8.30	3.05	41.0	.56	1.68
Garbage tankage	1	—	—	5.95	23.6	6.06	—
Philadelphia tankage	1	—	—	7.07	29.7	—	—
Ground leather	1	—	—	7.51	32.6	—	—
Vegetable Ammoniates.							
Cottonseed meal	127	3.24	7.99	6.74	46.3	2.56	1.64
Linseed meal	7	5.26	6.42	5.78	45.2	1.47	1.52
Castor pomace	6	4.68	5.85	5.18	55.9	2.12	1.20
Muck or peat	1	—	—	1.57	21.4	—	—

The above figures, representing availability, were taken from the 14th Annual Report of the Vermont Agricultural Experiment Station.

The above method is not suited for the determination of nitrogen availability in vegetable substances such as cottonseed meal, linseed meal and castor pomace. Actual experiments have demonstrated that the nitrogen they contain is fully as available as that in the high grade animal substances. The low availability of the nitrogen, indicated by this method, in vegetable matters is supposed to be due to the large amount of non-nitrogenous matter found in this class of products. The low availability of the nitrogen in hair, wool waste, garbage tankage, ground leather, and Philadelphia tankage, marks these materials as rather inactive sources of plant food.

Potassium. This element is never found in nature unassociated with other elements. The term *potash* used in connection with fertilizers is known to chemists as potassium oxide (K_2O), a compound of potassium and oxygen. The potassium in all potash salts is equivalent chemically to a certain amount of potash (potassium oxide), and through custom and for the sake of comparison is usually guaranteed and reported as such. Potassium is found in a great variety of minerals which, by slow decomposition furnish potash gradually to growing plants. Potash tends to accumulate in the leaves and stems of plants and if these are returned to the soil in the form of manure, the soil is kept better supplied with this valuable constituent. Potash is not as readily lost by leaching as is nitrogen; on the other hand it is more easily diffused and much more apt to pass beyond the downward limit of the roots of some plants than is phosphoric acid. The writer has found by actual analysis in a number of instances in the case of tobacco soils, as high as 500 lbs. of water soluble potash in one acre of soil eight inches deep, and in only one or two instances has he ever found more than traces of water soluble phosphoric acid. Potash has also been found in soil drainage waters collected several feet under the surface of the soil.

Soils vary in their power to retain potash. Sandy soils are much less retentive of potash than clay soils, although sandy soils become more retentive in proportion as their content of humus is increased. The various potash compounds are peculiarly adapted for the production of a superior quality of certain farm crops. For instance, carbonate of potash and sulphate of potash are particularly useful in growing a superior quality of tobacco; the latter salt is especially favorable to the production of sugar and starch in such crops as fruit, potatoes, sugar beets and legumes; while the muriate or chloride is valuable as a source of potash for grass and farm forage crops.

The following table gives a list of the principal potash fertilizers together with the average per cent of potash furnished by each.

	No. of Analyses.	Percent of Potash.		
		Minimum.	Maximum.	Average
High grade sulphate of potash....	48	45.70	53.15	49.25
Carbonate of potash	6	55.68	67.20	60.92
Muriate of potash................	70	45.40	54.80	49.89
Sulphate of potash-magnesia*	24	19.55	31.68	25.32
Kainit..........................	9	10.90	13.65	12.47
Silicate of potash	4	21.48	27.62	24.55
Carnalite	1	—	—	13.68

NOTE. Taken from 1906 Annual Report of Massachusetts Experiment Station.

The low grade potash fertilizers, kainit, sylvanite, carnalite, and silicate of potash, contain a large bulk of material of little or no value in connection with their relatively small percentage of potash. They naturally furnish a favorite source of potash for low grade fertilizers.

Phosphorus. This element, like potassium, is never found in the free state in nature but is associated with other elements, largely lime, iron and alumina, and usually in a more or less unavailable form. There is little danger of this element being lost by leaching.

Phosphoric acid is a term applied to a compound of phosphorous and oxygen, expressed chemically as anhydrous (water free) phosphoric acid (P_2O_5). Phosphoric acid is found in larger quantities in grain and seeds than in the leaves and stems of plants. The soil is therefore exhausted of this element most rapidly by a continued system of grain cropping, especially if the grain is sold from the farm.

The common sources of phosphoric acid, from a commercial standpoint, are phosphate rock, bones, basic slag and guano. Phosphoric acid may be combined with lime in three different forms: (1) as tri-calcic phosphate, commercially known as insoluble phosphoric acid or bone phosphate of lime, (2) di-calcic phosphate or reverted phosphoric acid and (3) mono-calcic phosphate or soluble phosphoric acid.

Insoluble phosphoric acid. This term is applied to a compound consisting of three parts of lime to one part of phosphoric acid; in this form it is not readily available to plants. South Carolina,

* Known frequently as low-grade sulphate of potash.

Florida and Tennessee rock and bone are the common sources of supply; they contain from 60 to 80 per cent of tri-calcic phosphate and when untreated are not ordinarily used for fertilizer because of their insolubility. When treated with sulphuric acid, however, they furnish the soluble and available phosphoric acid usually found in commercial fertilizers.

Soluble phosphoric acid. Mono-calcic or one-lime phosphate is a product resulting from treating the insoluble phosphates with oil of vitriol or sulphuric acid. In the process the sulphuric acid combines with two parts of lime forming gypsum or sulphate of lime, and a compound results having one lime, two water and one phosphoric acid. This form of phosphoric acid is easily soluble in water.

In the treatment of a phosphate with oil of vitriol, it is not economy to add sufficient acid to act upon all of the insoluble phosphate; the insoluble phosphate remaining will be acted upon, more or less, by the soluble phosphoric acid produced and *reverted* (di-calcic) or two-lime phosphate will result. This compound is not soluble in water but is gradually dissolved by soil water and thus becomes available to plants.

The term "*available phosphoric acid*" is the sum of the water soluble and reverted phosphoric acid and designates that portion of the total phosphoric acid which laboratory methods show as being soluble in water and neutral citrate of ammonia of a certain strength. Soluble phosphoric acid is considered to have the same value whether its source is from acid phosphate, dissolved bone black, or dissolved bone; the same may be said of reverted phosphoric acid. The following table gives a list of the more common sources of phosphoric acid with their average composition.

	No. of Analyses.	Phosphoric Acid.		Nitrogen.
		Total.	Available.	
Tennessee phosphate,	1	33.00	—	—
So. Carolina rock phosphate,	5	28.06	—	—
Florida phosphate,	2	36.72	—	—
Bone ash,	1	39.14	—	—
Bone meal,*	253	24.34	—	3.06
Dissolved bone,	9	16.42	12.40	2.14
Dissolved bone black,	38	17.56	16.38	—
Acid phosphate,†	44	15.75	13.40	—
Basic slag,	9	17.73	15.48‡	—

*Analyses variable. Steamed bone ordinarily contains less nitrogen and more phosphoric acid than raw bone meal.

†Two grades are offered, the low grades vary from 12 to 15 per cent and the better grades from 15 to 19 per cent phosphoric acid.

‡By Wagner's method.

There are other substances furnishing phosphoric acid in varying quantities such as tankage, fish, guanos, etc., but these are usually bought for their nitrogen content. The phosphoric acid which they contain, however, is more available, when used in the unacidified condition, than is the phosphoric acid from the natural or mineral phosphates. This is due to the fact that more or less organic matter is associated with the bone and as this decomposes in the soil the bone gradually yields its phosphoric acid. Probably from three to five years are required for all of it to become active, depending to a great extent upon the fineness with which it is ground,

Owing to numerous inquiries regarding basic slag and to the fact that it is a comparatively new product in our local markets, the following brief statement is submitted.

Phosphatic or Thomas slag is a by-product in the modern method of steel manufacture from ores containing noticeable quantities of phosphorus. The process of removing the phosphorus from the ore, briefly stated, consists in adding to the so-called converter containing the milled ore, a definite amount of freshly burned lime which, after a powerful reaction, is found to be united with the phosphorus and swims upon the surface of the molten steel in the form of a slag. At the present time, according to Wagner, practically all of the iron works treat the molten slag as it flows from the converter with hot quartz sand, with the result that the availability of the phosphoric acid is increased from 10 to 30 percent.[1]

The principal constituents of the slag are phosphoric acid, lime, iron oxides and silicic acid. It is placed upon the market in the form of a dark brown powder. Its phosphoric acid was formerly supposed to exist in the form of tetra-calcium phosphate, but the opinion is now generally held, especially by Wagner, that the phosphoric acid is combined in the slag as a double salt of calcium phosphate and calcium silicate, and that in this form the roots are able to utilize it.

The slag has been found to work especially well upon sour marsh and meadow lands, upon porous, well-aired soils rich in humus, as well as upon sandy soils deficient in lime. The usual amount per acre is from 300 to 1000 pounds.

[1] Düngungsfragen, Heft I. p. 16 von P. Wagner 1896: also Anwendung Kuntsliche Dungemittel, vierte Auflage von Wagner, p. 74-75.

In determining the availability of the phosphoric acid in the slag this station employs the Wagner method.[2] The average per cent of total phosphoric acid in the four samples examined was 17.71 of which 15.48 per cent or 87.4 per cent of the whole was available, showing them to be of excellent quality. The commercial value of a pound of the available phosphoric acid has been placed at four cents.

Schedule of Trade Values. The trade values of fertilizing ingredients in raw materials and chemicals for the season of 1908 remain the same as for the previous year. They represent the average pound cost at retail of the various forms of nitrogen, phosphoric acid and potash furnished in unmixed raw materials and chemicals in the New England and Middle States, during the six months preceding March 1, 1908. They are the values agreed upon by representatives of the experiment stations in New England and the Middle States after a careful study of prevailing prices in the large cities in these localities.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1908.

	Cents per pound.
Nitrogen.	
Nitrogen in ammonia salts,	17½
" " nitrates,	18½
Organic nitrogen in dry and fine ground fish, meat, blood, and in high grade mixed fertilizers,	20½
" " " fine* bone and tankage,	20½
" " " coarse* bone and tankage,	15
Phosphoric Acid.	
Phosphoric acid soluble in water,	5
" " " in ammonium citrate, (reverted phosphoric acid),	4½
" " in fine* ground bone and tankage,	4
" " in coarse* bone and tankage,	3
" " in cottonseed meal, linseed meal, castor pomace and ashes,	4
" " insoluble (in neutral citrate of ammonia solution) in mixed fertilizers,	2
Potash.	
Potash as sulphate, free from chlorides,	5
" " muriate (chloride),	4¼
" " carbonate,	8

* Fine and medium bone and tankage are separated by a sieve having circular openings 1-50 of an inch in diameter; valuations of these materials are based upon degree of fineness as well as composition.

[2] See Koenigs Untersuchung landwirtschaftliche und gewerbliche wichtiger Stoffe, Dritte Auflage, p. 173-174.

Commercial Valuation of Fertilizers. The valuations as published in our tables mean the comparative cash cost of an amount of nitrogen, phosphoric acid, and potash in *unmixed standard chemicals and raw materials of good quality*, corresponding with the same amount found in a ton of the fertilizer in question. The water soluble nitrogen has been valued at 18½ cents per pound; the organic nitrogen, assumed in all cases as coming from the highest grade of raw materials, has been valued at 20½ cents per pound—this is manifestly unfair in instances where low grade sources of organic nitrogen are used, and gives such fertilizers too high a value. It certainly creates an unfair competition between the manufacturer who used only high grade materials and the one who used the cheaper or low grade substances in his mixed product. There is great need of some recognized official method of determining the availability of the organic nitrogen in mixed commercial fertilizers. Much good work has been accomplished along this line by Jenkins[1] and also by Jones[2], although the methods as outlined have not yet been adopted as official by the Association of Official Agricultural Chemists. It is the intention of this station to give this matter further consideration.

Soluble phosphoric acid has been valued at 5 cents, reverted at 4½ cents and insoluble at 2 cents per pound. Phosphoric acid in fine bone and tankage has been valued at 4 cents, and in coarse bone and tankage at 3 cents per pound. The phosphoric acid in basic slag has been valued according to its content of available phosphoric acid as shown by Wagner's method, the available phosphoric acid being valued at 4 cents and the insoluble at 2 cents per pound.

In the table of analyses, whenever the potash is reported without foot-note or comment, it may be understood that sufficient chlorine was found present to unite with all of the potash. In cases where part of the potash is found present as sulphate or carbonate, and the analysis indicates the presence of chlorine, the potash equivalent of the chlorine is first calculated and the remainder is counted as sulphate or carbonate as the case may be.

The presence of chlorine or sulphates in a fertilizer advertised to contain its potash in form of carbonate is manifestly just as objectionable as though they were in actual combination with the potash. Total potash has been reported in form of a foot-note in instances where it is evident that organic vegetable substances have been used in the fertilizer. No attempt has been made to value that part of the potash which is insoluble in water.

[1] Connecticut State Exp. Sta. Repts. 1893, 1894-1896.
[2] Vermont Exp. Sta. Repts. 1898, 1899, 1901.

The valuations as published in our tables of analyses *are no indication of the agricultural value of a fertilizer* which is measured only by the value of the increased yield of crop due to the use of any particular brand of goods.

Retail Cash Prices and Percentage of Difference.

The retail cash prices in this year's bulletin have been obtained with the same care and along the same lines as for the previous year. Whenever possible the prices obtained by our collector are verified in writing at the time the analyses are reported to the agents. All cases of wide discrepancies in cash prices on the same fertilizer are taken up individually with the agent; the prices published, therefore, are quite representative. The percentage excess of the average retail cash price per ton over the calculated or commercial value of a fertilizer is the *percentage of difference.* Those fertilizers having the smallest percentage of difference will furnish the greatest amount of plant food for the least money.

The average retail cash price per ton of the 318 samples of complete fertilizers analyzed during the season of 1908 is $36.20; the average commercial value is $25.81; and the percentage of difference is 40.25. This, commonly called "overhead charges," represents the cost in storing, grinding, mixing, bagging, hauling and freighting the goods, as well as commissions to agents, long credits, depreciation of factory plant and profits. It is not surprising, therefore, that the valuations fall so far below the retail cash prices. A comparison of the above figures with those of the previous year show that the average cost of a ton of complete commercial fertilizer is 80 cents higher than for the season of 1907, while on the other hand the average comparative commercial value is $1.62 more per ton. This would indicate that the consumer of commercial fertilizers has received slightly better value for his money the present season.

It would appear that it costs the average manufacturer some 40 per cent over the retail cost of the raw materials to manufacture them into mixed fertilizers and place them upon the market at a profit under existing methods of doing the business. If only a few staple brands of high grade mixtures were made and sold to consumers through their selected representatives, considerable of this excess cost would be avoided and the farmer correspondingly benefited. This matter is worthy of the attention of farmers' organizations.

Selection and Purchase of Fertilizers.

Out of the three hundred odd brands of ready mixed fertilizers that are annually sold in Massachusetts, it is no easy matter for a farmer to make a judicious selection. A few suggestions at this time, therefore, may not be out of place. It is poor judgment to buy a fertilizer because it costs but little per ton unless it contains a fair value of plant food. The higher the grade and more concentrated the fertilizer, the cheaper will be the plant food it contains, also the less bulk and weight to handle, thus reducing freight charges. The low grade fertilizer is the most expensive one to buy as a general thing. Examples of the purchase of a low and high grade fertilizer will illustrate these points.

Supposing a ton of low grade fertilizer is bought for \$25.00, analyzing 1 per cent nitrogen, 8 per cent phosphoric acid, and 3 per cent potash; and a ton of high grade goods is bought for \$40.00, analyzing 3½ per cent nitrogen, 8 per cent phosphoric acid and 10 per cent potash. It will be seen that the high grade fertilizer contains the same amount of phosphoric acid *but over three times as much nitrogen and potash as does the low grade;* it might be reasonably expected therefore, to sell for nearly three times as much but in reality it sells for less than once and three-quarters of what is paid for the low grade article. When, therefore, a ton of the low grade goods costs \$25.00, one-third of a ton of high grade would furnish about the same amount of plant food and at a cost of \$13.33 thereby saving \$11.67. On the basis of ten tons of the \$25.00 goods, costing \$250.00, the same results could be obtained by the use of \$133.00 worth of the high grade fertilizer and a saving of \$116.00 would result.

The above certainly furnishes a strong argument in favor of purchasing the better grades of ready mixed fertilizers. There is also another advantage to be considered, namely, the *quality* of the plant food furnished by the two grades. High grade goods must be made from high grade materials as the following illustrations will show.

150	lbs.	Nitrate of Soda,
450	"	Dried Blood,
1000	"	Acid Phosphate,
400	"	High Grade Sulphate of Potash.
2000	lbs.	

A ton of the above fertilizer furnishes 3.6 per cent nitrogen, 8 per cent available phosphoric acid, and 10 per cent potash, and allows no chance for the addition of filler or make-weight material. In case of the low grade fertilizer the 1 per cent nitrogen, 8 per cent available phosphoric acid, and 3 per cent potash may be furnished by

50	lbs.	Nitrate of Soda,
113	"	Dried Blood,
1000	"	Acid Phosphate,
120	"	High Grade Sulphate of Potash.
1283	lbs.	

This combination contains 1283 lbs. of fertilizing material and the balance of 717 lbs. to make the ton must be supplied by a filler which may have no more value than so much sand, on which the consumer must pay freight charges. He must also handle just so much more weight if he buys the low grade goods.

In case no inert substance is used as a filler in the low grade fertilizers the manufacturer has recourse to those forms of plant food having a low analysis and an inferior availability. Of course it is most desirable that the low grade fertilizing substances should be used in the manufacture of fertilizers; they all have a value and much credit is due the manufacturer for developing processes for the utilization of this class of materials. The point which the writer would make is the inconsistency of charging a higher cost per unit for the plant food in these fertilizers than what is charged in case of goods made from the highest grade of raw materials and chemicals.

The consumer should purchase and use high grade goods, therefore, if ready mixed fertilizers are to be selected. There is yet no general agreement among manufacturers as to the proper proportions and amounts of plant food elements in fertilizers for special crops, as is shown by the wide variation in the goods offered by different dealers for one and the same purpose. There probably never will be such agreement, for conditions differ; each farmer therefore must study to learn what seems best to meet his individual requirements. All other considerations having received due attention, a fertilizer should be selected which will give the largest amount of plant food in a suitable and available form for the least money.

The following tables have been prepared from the results of this year's inspection to show some comparisons between the various grades of fertilizers. All brands having a comparative commercial value of $18.00 or less per ton have been classed as low grade;

those having a value of $18.00-$24.00 per ton as medium grade; and those over $24.00 per ton as high grade fertilizers.

GRADE	Number of Brands.	Per Cent of Whole.	Average Composition: Per Cent Nitrogen.	Per Cent Available Phosphoric Acid.	Per Cent Potash.	Lbs. Available Plant Food in 100 lbs. Fertilizer.	Average Valuation.	Average Cost.	Excess of Selling Price over Valuation.	Percentage Difference.
Low Grade,	26	9.22	1.74	6.90	2.22	10.86	16.06	28.48	12.42	77.33
Medium Grade,	105	37.23	2.42	8.02	3.73	14.17	20.93	31.13	10.20	49.16
High Grade,	151	53.55	4.06	7.65	7.44	19.15	30.51	40.96	10.45	34.25

A study of the above table shows a decided increase in the percentage of nitrogen and potash in the high grade and medium grade fertilizers while the phosphoric acid remains more constant in all three grades.

With less than a 44 per cent advance in price over the low grade fertilizer, the high grade furnishes more than 75 per cent increase in available plant food. The high grade fertilizer also furnishes nearly 90 per cent increase in commercial value. A ton of the average high grade fertilizer furnishes about 46 pounds more of nitrogen, 15 more of available phosphoric acid and 104 more of potash than does a ton of the low grade goods. The high grade fertilizers with a 31.6 per cent advance in price over the medium grade furnish 35 per cent more plant food with about 46 per cent increase in commercial value. The medium grade fertilizers cost only 9 per cent more than the low grade fertilizers and furnish 30.5 per cent greater commercial value.

It is very gratifying to note the small number of low grade fertilizers that is being sold in Massachusetts—only 26 out of a total of 282 or only 9.22 per cent.

Table showing the pound cost of the various elements of plant food in the three grades of fertilizer.

	Low Grade Fertilizer.	Medium Grade Fertilizer.	High Grade Fertilizer.
Nitrogen,	36.35 cts.	30.58 cts.	27.52 cts.
Soluble phosphoric acid,	8.86 cts.	7.46 cts.	6.71 cts.
Reverted " "	7.98 cts.	6.71 cts.	6.04 cts.
Insoluble, " "	3.55 cts.	2.98 cts.	2.69 cts.
Potash,	8.86 cts.	7.46 cts.	6.71 cts.

It is apparent from the above table that the consumer purchasing the low grade fertilizers has paid on the average 8.83 cents per pound more for nitrogen, over 2 cents per pound more for available phosphoric acid and 2.15 cents per pound more for potash than has the user of the high grade fertilizers. The purchaser of the medium grade goods has paid on the average 3 cents per pound more for his nitrogen and ¾ of a cent per pound more for his available phosphoric acid and potash than has the purchaser of the high grade goods.

COMPLETE FERTILIZERS—SUMMARY OF RESULTS OF INSPECTION.

MANUFACTURER.	No. Brands Analyzed.	No. with all three elements equal to guarantee.	No. equal to guarantee in commercial value.	Per cent of brands not showing a commercial shortage.	No. with one element below guarantee.	No. with two elements below guarantee.	No. with three elements below guarantee.
W. H. Abbott	2	1	2	100.	1	—	—
American Agricultural Chemical Co.	76	51	75	98.68	22	2	1
Armour Fertilizer Works	10	7	10	100.	3	—	—
Beach Soap Company	3	3	3	100.	—	—	—
Berkshire Fertilizer Company	5	3	5	100.	2	—	—
Bonora Chemical Company	1	1	1	100.	—	—	—
Bowker Fertilizer Company	29	17	27	93.10	10	2	—
Joseph Breck & Sons	3	2	2	66.66	1	—	—
Buffalo Fertilizer Company	7	3	6	85.71	4	—	—
Coe-Mortimer Company	8	5	8	100.	2	1	—
Eastern Chemical Company	1	1	1	100.	—	—	—
Essex Fertilizer Company	8	3	8	100.	5	—	—
R. & J. Farquhar & Co.	5	2	5	100.	3	—	—
Fertilizer Products Company*	1	1	1	100.	—	—	—
C. W. Hastings	1	0	1	100.	1	—	—
Lister's Agricultural Chemical Works	7	4	6	85.71	2	1	—
J. E. McGovern	1	1	1	100.	—	—	—
Mapes' Formula & Peruvian Guano Co.	17	10	14	82.35	7	—	—
National Fertilizer Company	13	11	13	100.	2	—	—
Natural Guano Company	1	0	0	0.	1	—	—
New England Fertilizer Company	6	5	5	83.33	1	—	—
Northwestern Fertilizing Company	1	0	1	100.	1	—	—
Olds & Whipple	6	3	6	100.	2	1	—
Parmenter & Polsey	4	2	2	50.	1	1	—
R. T. Prentiss	3	1	3	100.	2	—	—
Pulverized Manure Company	1	1	1	100.	—	—	—
W. W. Rawson & Co.	3	1	3	100.	2	—	—
Roger's Manufacturing Company	8	2	8	100.	6	—	—
Roger's & Hubbard Co.	7	6	7	100.	1	—	—
Ross Brothers Company	1	0	0	0.	1	—	—
N. Roy & Son	1	0	0	0.	—	1	—
Sanderson Fertilizer & Chemical Co.	8	5	6	75.	1	1	1
M. L. Shoemaker & Co., L't'd	2	2	2	100.	—	—	—
Smith Agricultural Chemical Company	7	5	7	100.	2	—	—
Swift's Lowell Fertilizer Company	12	5	12	100.	7	—	—
Whitman & Pratt Rendering Co.	4	3	4	100.	1	—	—
Wilcox Fertilizer Works	5	4	5	100.	1	—	—
A. H. Wood & Co.	1	1	1	100.	—	—	—
Wunsch Manufacturing Company	3	2	3	100.	1	—	—

* Ellis Chalmers Co. (Successors).

Summaries. A study of the table showing a summary of results of inspection of complete fertilizers reveals the fact that out of the 282 distinct brands analyzed, 110 or about 39 per cent of the whole number fell below the manufacturer's guarantee in one or more elements. Ninety-eight brands were deficient in one, 10 in two and 2 in all three elements. Twenty-nine brands were deficient in nitrogen, 57 in potash and 38 in phosphoric acid. The deficiencies in many of these brands were made up by an excess of some of the other elements so that only 17 out of the 284 brands analyzed showed a commercial shortage. This shortage ranged from a few cents to $3.36 cents per ton ; only eight brands showed a commercial shortage of over $1.00 per ton. This certainly shows a much better condition than existed during the previous year.

Out of the 34 samples of ground bone, tankage, and dry ground fish analyzed, 5 showed a deficiency in nitrogen and 6 in phosphoric acid ; only one of these brands, however, showed a commercial shortage.

The average retail cash price, valuation, and percentage of difference of the ground bone, dissolved bone, tankage and dry ground fish are as follows:

	Average retail cash price.	Valuation.	Percentage difference.
Ground bone,	$30.08	$29.09	3.40
Dissolved bone,	29.33	27.08	8.31
Tankage,	27.50	31.66	13.14*
Dry ground fish.	39.00	40.63	4.01*

* In excess of selling price.

In the chemicals and raw materials furnishing nitrogen, only one sample of cottonseed meal failed to meet the guarantee. Three samples of dissolved bone black and two samples of acid phosphate failed to meet the guarantee in available phosphoric acid. Among the potash compounds one sample of high grade sulphate, five of muriate and one of carbonate failed to meet the potash guarantee.

The various agricultural chemicals and raw materials as sold at retail in our local markets, have furnished nitrogen, phosphoric acid and potash to the consumer at the following prices :

Nitrogen.

	Cents per pound.
From nitrate of soda.	18.4
From blood.	20.5
From cottonseed meal,	22.05
From linseed meal,	26.7
From castor pomace.	22.4
From dry ground fish.	19.7
From fine tankage.	17.8
From coarse tankage.	13.0

Available Phosphoric Acid.

From dissolved bone black,	7.8
From acid phosphate (superphosphate.)	5.9

Potash.

From carbonate of potash,	8.0
From high grade sulphate of potash,	5.0
From potash-magnesia sulphate,	5.7
From muriate of potash,	4.5
From kainit,	5.11

Explanation of Analyses Tables.

The figures representing the analyses and guarantees are per cents or pounds per hundred. (The first two columns of figures bearing the plus (+) and minus (—) signs show the average standing of the various complete fertilizers *for the past five years* as regards composition; they have absolutely no reference to the selling price of the fertilizer but simply show the *value in dollars and cents of the excess or deficiency of plant food in comparison with what is guaranteed.* Some of these figures were taken from less than a five year average for the reason that a number of the brands have not always been found by our collecting agents. In each case the small figure at the right of the column signifies the number of years which are represented in the average. Blanks signify that the brand has only been on the market one year or has only been analyzed once during the five years.

The column giving "dealer's cash price per ton" shows the cash price that was charged the consumer for one ton of fertilizer at the place where the brand was collected.

The valuation column shows the retail cash cost in our large markets of amounts of nitrogen, phosphoric acid and potash equivalent to those found in a ton of the fertilizer.

The "percentage of difference" column shows the percentage excess of the retail cash price over the valuation.

The "laboratory number" is simply a reference number used in the collection and analyses of the various brands.

In the nitrogen column the water soluble nitrogen includes nitrogen as nitrates and as ammoniates, with more or less amino compounds, in case of acidulated goods, which rank with the ammonia compounds in availability. The organic nitrogen, as expressed in the tables, is that part of the total nitrogen insoluble in water. The total nitrogen includes all forms of nitrogen present.

In the phosphoric acid column the insoluble phosphoric acid is that part of the total phosphoric acid insoluble in water or a neutral solution of citrate of ammonia. The reverted phosphoric acid is that portion dissolved by a neutral solution of citrate of ammonia (specific gravity 1.09) by treating two grams of the fertilizer, previously washed with water, with 100 c. c. of the citrate solution one-half hour at 65° C. It is supposed to represent that part of the phosphoric acid insoluble in water but soluble in soil and root acids—it represents the difference between the total and the sum of the soluble and insoluble phosphoric acids. The available phosphoric acid column represents the sum of the soluble and reverted phosphoric acid.

The potash column shows the per cent of potash soluble in water; results published without an asterisk (*) indicate that the potash is present as chloride or that sufficient chlorine is present in the fertilizer to unite with all of the potash. Foot-notes indicate the amount of potash present as sulphate and carbonate.

The guarantee columns show the percentage of nitrogen, total and available phosphoric acid, and potash guaranteed by the manufacturer to be present.

In the table of analyses of fertilizers manufactured for private use will be found the results on three brands of so-called "humus fertilizers" manufactured by the Wallace Fertilizer Co., 147 Nassau St., New York City.

These materials have not been licensed in Massachusetts but, so far as we have been able to ascertain, they have only been sold in very limited quantities and in each case directly to the consumer. The composition of these materials is very similar to the better grades of peat. An analysis of a bona fide sample of dry ground peat made at this station showed 24.59 per cent humus and a total nitrogen content of 2.49 per cent having an availability by the alkaline permanganate method of 35.34 per cent.

The Wallace fertilizers contain a little more phosphoric acid than is usually found in samples of peat; aside from this, their composition would indicate them to be dried peat, finely ground. The value of these fertilizers lies largely in their nitrogen and their relatively high percentage of humus, but the price charged for them ($60.00 per ton) is altogether out of proportion to their value.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. —	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
W. H. Abbott, Holyoke, Mass.						
Abbott's Tobacco Fertilizer	Sunderland	$ .93	—	$40.00	$37.61	6.35
" " "	E. Whately			40.00	36.32	10.13
Abbott's Eagle Brand Fertilizer	Holyoke	—	$ .67	39.00	34.00	14.70
" " " "	Hadley			39.00	35.02	11.36
American Agric. Chem. Co., 92 State St., Boston.						
Grass and Lawn Top Dressing	Brockton	4.42	—	42.00	27.07	44.33
" " " " "	Dalton			36.50		
Special Grass and Garden Mixture	Concord	—	—	55.00	48.95	12.36
H. G. Fertilizer, with 10% Potash	Concord	3.87	—	39.00	27.56	36.97
" " " " "	Newburyp'rt			38.00		
" " " " "	Southboro			36.00		
" " " " "	Williamst'wn			38.00		
High Grade Tobacco Manure	Bradstreet	3.85[2]	—	48.50	38.75	25.16
Baker's A. A. Ammoniated Superphosphate	New Bedford	1.04	—	32.00	23.27	37.51
Bradley's X L Superphosphate	Amherst	1.45	—	34.00	23.52	40.30
" " "	Bradstreet			32.00		
" " "	New Bedford			32.00	21.41	47.12
" " "	Middleboro			31.00		
Bradley's Potato Fertilizer	Amherst	1.34	—	32.00	20.77	54.06
" " "	W. Springf'd			32.00	19.93	60.56
" " "	Worcester			34.00	20.64	64.72
Church's Fish and Potash	W. Springf'd	2.55	—	29.00	16.90	69.56
" " " "	New Bedford			28.00		
" " " "	North Hadley			29.00		
" " " "	Chicopee Falls			30.00	17.46	71.82
Bradley's Potato Manure	Lawrence	2.91	—	32.00	24.60	30.08
Bradley's Eclipse Phosphate for all Crops	Concord	2.14	—	28.00	17.34	64.33
" " " " "	Amesbury			29.00		
Bradley's Comp. Manure for Potatoes and Vegetables	Bradstreet	1.65	—	40.00	28.77	39.04
" " " " " " "	W. Springf'd			40.00		
" " " " " " "	Worcester			42.00	29.76	35.24
" " " " " " "	Dalton			38.50		
Bradley's Comp. Manure for Asparagus	Concord	3.24[2]	—	39.50	30.22	30.70
Bradley's Comp. Man. for Top Dress. Grass and Grain	Lawrence	1.27	—	38.00	29.23	30.53
" " " " " " " "	Boston			38.00		
" " " " " " " "	Dalton			38.50		
Bradley's Complete Manure, with 10% Potash	Bradstreet	1.05	—	39.00	29.19	35.32
" " " " " "	Newburyp'rt			40.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
537	9.00	2.77	1.24	4.01	4.00	1.25	8.69	2.56	12.49	11.00	9.93	8.00	12.30*	10.00
72	9.58	2.09	1.37	4.06	4.00	.03	7.77	3.45	12.15	11.00	8.70	8.00	11.58*	10.00
488	9.44	1.50	1.72	3.22	2.50	1.22	9.22	3.40	13.84	13.00	10.44	11.00	10.64*	10.00
14	9.41	1.46	1.41	2.90	2.50	1.00	8.54	4.56	14.10	13.00	9.54	11.00	13.38*	10.00
326, 330	9.03	4.66	.25	4.91	3.91	1.13	5.11	1.18	7.42	6.00	6.24	5.00	3.06	2.00
312	2.77	8.33	.36	8.69	8.44	.17	7.30	5.01	12.54	7.25	7.53	—	9.16*	8.25
305, 337, 442, 500	11.71	2.20	1.03	3.23	2.40	4.20	2.26	1.46	7.98	7.00	6.52	6.00	9.80	10.00
78	8.98	3.37	2.31	5.68	5.78	2.33	4.27	1.41	8.01	6.00	6.60	5.00	10.32*	10.00
170	16.84	1.98	.88	2.86	2.50	6.08	3.03	2.53	11.60	11.00	9.11	9.00	2.80*	2.00
47, 77	15.17	2.16	.83	2.99	2.50	7.52	1.72	2.48	11.72	11.00	9.24	9.00	2.44	2.00
203, 209	15.72	1.69	.89	2.58	2.50	6.05	2.77	2.40	11.28	11.00	8.82	9.00	2.34	2.00
40	11.24	1.42	1.00	2.42	2.06	4.41	3.75	2.05	10.21	10.00	8.16	8.00	3.30	3.00
87	13.42	1.17	1.02	2.19	2.06	4.99	2.60	2.64	10.23	10.00	7.59	8.00	3.56	3.00
380	12.52	1.59	.82	2.41	2.06	4.07	3.89	2.56	10.52	10.00	7.96	8.00	3.30	3.00
39, 159, 281	11.90	.96	1.08	2.04	2.07	2.11	3.80	4.12	10.03	7.50	5.91	6.00	2.05	2.00
505	12.07	1.00	1.06	2.12	2.07	2.00	4.05	3.33	9.98	7.50	6.65	6.00	1.86*	2.00
245	11.91	1.63	1.41	3.04	2.50	4.96	2.46	1.77	9.19	8.00	7.42	6.00	5.78	5.00
273, 353	15.34	.90	.50	1.40	1.03	6.91	2.77	1.48	11.16	10.00	9.68	8.00	2.32	2.00
79, 82	12.31	2.10	1.60	3.70	3.30	5.28	2.27	2.56	10.11	9.00	7.55	8.00	7.18	7.00
392, 534	12.62	2.20	1.64	3.84	3.30	5.82	2.72	1.05	9.59	9.00	8.54	8.00	7.30	7.00
274	11.50	2.34	1.44	3.78	3.30	6.50	2.48	1.10	10.08	9.00	8.98	8.00	6.64*	7.00
240, 294, 528	8.22	5.38	.13	5.51	4.95	1.34	4.09	1.48	6.91	6.00	5.43	5.00	3.74	2.50
80, 338	10.17	2.11	1.46	3.57	3.30	3.45	2.44	2.17	8.06	7.00	5.89	6.00	10.44	10.00

*	537	Chlorine	.49%,	equivalent to	.66%	potash,	11.64%	potash as sulphate.
	72	"	.66%	"	.88%	"	10.70%	" "
	488	"	.59%	"	.79%	"	9.85%	" "
	14	"	.85%	"	1.14%	"	12.24%	" "
	312	"	6.45%	"	8.64%	"	.52%	" "
	78	"	1.20%	"	1.61%	"	8.71%	" "
	170	"	1.56%	"	2.08%	"	.72%	" "
	505	"	1.23%	"	1.65%	"	.21%	" "
	274	"	.77%	"	1.03%	"	5.61%	" "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	—	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co. (Continued.)						
Bradley's Niagara Phosphate	W. Springf'd	$3.53[4]	—	$26.00	$18.58	39.93
" " "	Chicopee F'ls			26.00	17.56	48.06
Bradley's Complete for Corn and Grain	Chicopee Falls	1.37[4]	—	38.50	26.30	46.39
Bradley's Columbia Fish and Potash	W. Springf'd	3.66	—	28.00	16.16	73.23
" " " " "	Westfield			28.00	19.27	45.30
Bradley's Corn Phosphate	Newburyport	1.00	—	30.00	19.61	52.98
" " "	Chicopee F'ls			30.00		
Bradley's English Lawn Fertilizer	New Bedford	5.05	—	44.00	31.99	56.31
" " " "	Lexington			56.00		
Bradley's Tobacco Starter and Grower	Westfield	1.21	—	—	27.98	28.66
" " " " "	Southwick			36.00		
Bradley's Seeding Down Manure	Boston	.74[2]	—	—	22.98	—
Clark's Cove Potato Fertilizer	Spencer	1.63	—	30.00	20.11	49.17
Clark's Cove King Philip Alkaline Guano	Spencer	1.67	—	28.00	16.43	70.42
Clark's Cove Great Planet Manure	E. Longmead'w	.40	—	39.00	27.73	40.64
Clark's Cove Bay State Fertilizer	Oakdale	1.14[2]	—	33.00	22.88	44.23
Clark's Cove Potato Manure	Oakdale	3.46[3]	—	33.00	23.36	41.26
Crocker's Potato, Hop and Tobacco Phosphate	Worcester	1.19	—	31.00	20.06	54.53
Crocker's Ammoniated Corn Phosphate	Worcester	1.49[4]	—	31.00	18.48	67.74
Crocker's A. A. Complete Manure	Worcester	.96[2]	—	33.00	28.74	14.82
Cumberland Superphosphate	N. Leominster	2.36[3]	—	31.00	18.75	65.33
Cumberland Potato Fertilizer	N. Leominster	.97[4]	—	31.00	20.33	52.50
Darling's Blood, Bone and Potash	Worcester	1.52	—	41.00	31.87	28.64
Darling's Animal Fertilizer	Worcester	1.89[2]	—	39.00	28.20	38.29
Darling's Dissolved Bone and Potash	West Newbury	—	—	36.50	26.65	36.96
Darling's Complete 10% Manure	Barre Plains	.78[2]	—	38.00	27.12	40.11
Darling's Potato Manure	Worcester	2.88[4]	—	36.00	24.12	49.25
Darling's Farm Favorite	Worcester	.67[4]	—	32.00	20.22	58.25
Darling's General Fertilizer	Worcester	4.61[2]	—	30.00	20.19	48.58
Great Eastern Garden Special	Sunderland	.84	—	38.00	29.15	30.36

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
88	13.90	1.22	.88	2.10	.82	3.84	3.74	2.81	10.39	8.00	7.58	7.00	2.50	1.00
506	14.39	.87	.77	1.64	.82	6.18	2.47	2.33	10.98	8.00	8.65	7.00	2.18	1.00
503	12.57	2.09	1.18	3.27	3.30	5.80	5.38	2.20	13.38	13.00	11.18	12.00	2.60	3.00
83	13.04	.90	1.12	1.02	1.65	1.34	4.34	3.81	9.49	6.00	5.68	5.00	2.16*	2.00
432	12.34	1.32	1.15	2.47	1.65	2.94	3.71	2.84	9.49	6.00	6.05	5.00	2.50	2.00
325 / 504	13.05	1.54	.84	2.38	2.06	5.69	2.72	2.00	10.41	10.00	8.41	8.00	1.80	1.50
205 / 359	8.45	5.86	.04	5.00	4.95	1.89	4.08	1.30	7.27	6.00	5.97	5.00	4.66*	2.50
479 / 480	13.36	2.06	1.54	3.60	3.30	6.72	2.31	1.10	10.13	10.00	9.03	8.00	4.88*	4.00
289	12.93	1.21	1.78	2.09	2.50	5.56	2.96	2.09	11.21	11.00	8.52	9.00	2.24	2.00
427	15.39	1.31	.86	2.17	2.06	6.50	1.85	2.17	10.52	10.00	8.35	8.00	3.16	3.00
409	15.16	.99	.30	1.29	1.03	6.27	2.91	1.92	11.10	10.00	9.18	8.00	2.16	2.00
478	13.34	1.83	1.66	3.49	3.30	4.80	3.03	1.61	9.44	9.00	7.83	8.00	7.04	7.00
621	15.80	1.60	1.24	2.84	2.50	6.56	2.96	1.92	11.44	11.00	9.52	9.00	2.14*	2.00
622	15.60	1.75	1.01	2.76	2.50	6.01	2.20	1.79	10.00	8.00	8.21	6.00	4.74	5.00
397	15.73	1.35	.75	2.10	2.06	6.97	1.04	1.89	10.80	10.00	8.01	8.00	2.94	3.00
405	15.50	1.32	.77	2.09	2.06	7.07	1.25	2.02	10.34	10.00	8.32	8.00	1.68	1.50
366	14.21	2.19	1.55	3.74	3.30	6.05	1.85	1.69	9.59	9.00	7.90	8.00	6.92	7.00
400	13.21	1.27	.87	2.14	2.06	6.65	1.67	2.20	10.52	10.00	8.32	8.00	1.70	1.50
404	11.55	1.32	1.08	2.40	2.00	4.41	3.49	2.05	9.95	10.00	7.90	8.00	3.12	3.00
390	11.22	3.33	1.36	4.69	4.10	4.39	2.62	2.51	9.52	8.00	7.01	7.00	7.32	7.00
402	13.30	2.30	1.48	3.78	3.30	7.04	1.40	1.56	10.00	10.00	8.44	8.00	4.82*	4.00
605	12.93	2.11	1.04	3.15	2.40	3.98	2.20	1.71	7.88	7.00	6.17	6.00	9.30	10.00
623	11.72	3.02	.35	3.37	3.30	3.68	2.82	1.30	7.80	7.00	6.50	6.00	9.14	10.00
619	12.65	1.75	1.07	2.82	2.50	6.08	1.88	1.51	9.47	8.00	7.90	6.00	5.74	5.00
620	13.57	1.27	.99	2.26	2.06	5.44	2.72	2.05	10.21	10.00	8.16	8.00	3.24	3.00
618	12.10	1.48	.65	2.13	1.25	5.25	1.86	2.61	9.72	7.00	7.11	6.00	4.80	3.00
52	11.42	2.04	1.52	3.56	3.30	6.43	1.74	1.71	9.88	9.00	8.17	8.00	7.48*	7.00

* 482	Chlorine 1.27%,	equivalent to 1.70% potash,	.80% potash	as sulphate.
205-359	" 3.07%	" 3.93%	" .73%	" "
479-480	" .33%	" .45%	" 4.43%	" "
621	" 1.27%	" 1.70%	" .44%	" "
402	" .61%	" .81%	" 4.01%	" "
52	" 3.92%	" 5.25%	" 2.23%	" "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	—	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co. (Continued.)						
Great Eastern Vegetable, Vine and Tobacco	Pratt's Junc.	$1.35	—	$31.00	$22.63	37.00
Great Eastern Northern Corn Special A	Pratt's Junc.	1.29	—	31.00	22.89	35.43
Pacific Potato Special " " "	Westport Newburyport	1.62	—	30.00 32.00	21.29	45.61
Pacific Nobsque Guano " " "	Westport Newburyport	1.67	—	29.00 26.00	16.44	67.27
Pacific High Grade General Fertilizer	Charlemont	—	—	37.50	28.74	30.48
Soluble Pacific Guano " " "	Newburyport Clinton	1.56	—	28.60 30.00	19.59	48.03
Packer's Union Animal Corn Fertilizer	Amherst	2.53	—	35.00	22.13	58.14
Packer's Union Potato Manure	Marlboro	2.29	—	33.00	24.54	34.48
Packer's Union Gardeners' Complete Manure " " " " "	Concord Amherst	2.23	—	38.00 —	27.19	39.76
Packer's Union Universal Fertilizer " " " "	Concord Gt. Barring'n	1.98[3]	—	27.00 28.00	18.85	45.88
Quinnipiac Market Garden Manure " " " " " " " "	Fall River Seekonk Pittsfield	1.56	—	38.50 36.00 40.50	29.35	32.88
Quinnipiac Potato Phosphate	Fall River	.98	—	31.00	20.80	49.03
Quinnipiac Corn Manure	Williamstown	1.99	—	—	20.38	—
Quinnipiac Climax Phosphate	Newbury	2.01[4]	—	28.00	18.15	54.27
Quinnipiac Phosphate " "	Seekonk Pittsfield	.83	—	30.00 35.00	22.41	45.02
Quinnipiac Potato Manure	Seekonk	2.84[3]	—	30.00	25.71	16.68
Quinnipiac Onion Manure	Hatfield	1.21[4]	—	37.00	29.09	27.19
Read's Practical Potato Fertilizer " " " " " " " "	North Hadley Newburyport Williamst'n	3.93[4]	—	29.00 31.50 30.50	20.16	50.44
Read's Standard Superphosphate	Ward Hill	1.99	—	30.00	18.84	59.23
Read's H. G. Farmers' Friend Superphosphate " " " " " " " " " " " " " " "	North Hadley Concord E. Longm'dw Williamst'n	.90[3]	—	39.00 38.00 40.00 39.00	28.60	36.36
Read's Vegetable and Vine " " " "	North Hadley Clinton	1.20[3]	—	32.00 34.00	23.36	41.26

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Guaranteed.
450	12.83	1.50	.93	2.43	2.06	5.69	1.75	2.00	9.44	10.00	7.44	8.00	6.12	6.00
447	14.83	1.95	1.02	2.97	2.50	6.27	2.61	2.15	11.03	11.00	8.88	9.00	2.36	2.00
156, 360	10.97	1.70	.82	2.52	2.06	5.76	2.45	2.25	10.46	10.00	8.21	8.00	3.26	3.00
194, 357	14.84	.92	.54	1.46	1.00	5.78	2.42	2.44	10.64	10.00	8.20	8.00	2.22	2.00
596	13.02	1.97	1.59	3.56	3.30	5.95	2.69	1.36	10.00	9.00	8.64	8.00	7.08	7.00
342, 438	15.07	1.31	.87	2.18	2.06	5.86	3.33	2.02	11.21	10.00	9.19	8.00	1.76	1.50
598	18.41	1.76	.96	2.72	2.50	6.75	2.54	2.10	11.39	11.00	9.29	9.00	2.12	2.00
616	14.63	1.18	1.29	2.47	2.06	7.07	2.53	1.56	11.16	10.00	9.60	8.00	5.78	6.00
287, 601	11.93	2.10	.82	2.92	2.40	4.13	2.70	1.64	8.47	7.00	6.83	6.00	9.92*	10.00
290, 516	12.38	1.03	.56	1.59	.82	4.84	3.07	2.71	10.62	10.00	7.91	8.00	4.78	4.00
164, 173, 525	13.01	2.37	1.41	3.78	3.30	5.48	2.73	2.15	10.36	9.00	8.21	8.00	7.06	7.00
179	13.42	1.60	.78	2.38	2.06	4.71	3.53	2.30	10.54	10.00	8.24	8.00	3.38	3.00
508	15.09	1.40	.79	2.19	2.06	6.33	2.91	2.20	11.44	10.00	9.24	8.00	2.50	1.50
608	12.73	1.03	.63	1.66	1.00	4.07	4.35	3.25	11.67	10.00	8.42	8.00	2.90	2.00
193, 524	17.48	1.89	.86	2.75	2.50	6.93	2.21	2.46	11.60	11.00	9.14	9.00	2.34	2.00
174	15.49	2.01	1.21	3.22	2.50	5.86	2.38	1.87	10.11	8.00	8.24	6.00	5.36	5.00
597	12.03	2.09	1.54	3.63	3.30	6.33	2.50	1.07	9.90	9.00	8.83	8.00	7.10	7.00
284, 334, 585	12.28	.05	1.28	1.33	.82	5.16	1.75	1.71	8.62	5.00	6.01	4.00	8.58	8.00
611	14.47	.16	1.10	1.26	.82	6.88	2.79	1.46	11.13	10.00	9.67	8.00	4.44	4.00
285, 300, 467, 591	11.63	2.20	1.14	3.34	3.30	3.65	3.39	1.43	8.47	7.00	7.04	6.00	10.02	10.00
282, 424	13.98	1.57	.91	2.48	2.06	5.80	3.01	2.17	10.98	10.00	8.81	8.00	5.22	6.00

* 287–601 Chlorine 5.33%, equivalent to 7.13% potash. 2.70% potash as sulphate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. —	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co. (Continued.)						
Standard Special for Potatoes	Merrimac	$.92[2]	—	$30.00	$20.25	48.14
Standard Complete Manure	Merrimac	—	—	36.50	28.68	27.25
Standard Fertilizer	Merrimac	—	—	30.00	18.58	61.48
Standard Guano for all Crops	Newburyport	2.25[3]	—	31.00	19.35	60.20
Tucker's Original Bay State Bone Superphosphate	Framingham	—	—	27.50	20.02	37.36
Tucker's Special Potato Fertilizer " " " "	Newburyport Framingham	.87[4]	—	33.00 28.00	20.18	51.14
Wheeler's Corn Fertilizer	Framingham	1.60	—	30.00	17.61	70.33
Wheeler's Potato Manure	Framingham	.47[4]	—	30.00	20.05	49.62
Wheeler's Havana Tobacco Grower	Salisbury	1.18[4]	—	38.00	26.32	44.37
Wheeler's Bermuda Onion Grower	Danvers	1.67[3]	—	—	19.10	—
Williams & Clark's Royal Bone Phosphate	Brockton	2.28	—	28.00	17.88	56.60
Williams & Clark's Americus Potato Manure " " " " "	Brockton Southboro	1.83[2]	—	32.00 31.00	20.66	52.47
Williams & Clark's Prolific Crop Producer " " " " " " " " " "	Brockton Worcester Chicopee F'ls	3.33	—	25.00 28.00 20.00	17.12	53.72
Williams & Clark's Ammoniated Bone Superphosphate	Southboro	1.23[3]	—	31.00	21.00	46.00
Williams & Clark's Americus Corn Phosphate " " " " "	Brockton Southboro	1.35[3]	—	32.00 31.00	19.12	64.74
Williams & Clark's Potato Phosphate	Southboro	5.37[2]	—	31.00	25.95	19.47
Armour Fertilizer Works, Baltimore, Md.						
High Grade Potato Fertilizer " " " " " " " " " " " "	Amherst New Bedford Taunton Haverhill	1.50	—	33.00 31.00 34.00 35.00	24.98 26.58	32.10 25.40
All Soluble " " " " " "	Amherst Taunton Haverhill Concord	1.80	—	33.00 34.00 34.00 34.00	26.84 24.81	22.94 37.04
Blood, Bone and Potash	Amherst	1.27[4]	—	38.00	30.90	22.97
Complete Potato " "	New Bedford Haverhill	2.68[3]	—	33.00 32.00	22.74	42.92

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
577	11.20	1.42	.95	2.37	2.06	3.75	4.24	2.07	10.06	10.00	7.30	8.00	3.18	3.00
610	11.32	1.90	1.50	3.40	3.30	5.95	2.55	2.07	10.57	9.00	8.50	8.00	7.12	7.00
606	11.67	1.29	.77	2.06	2.06	6.12	2.35	2.20	10.67	10.00	8.47	8.00	1.80	1.50
353	14.75	1.17	.95	2.02	1.05	5.88	3.15	2.30	11.33	10.00	9.03	8.00	2.22	2.00
613	13.00	1.55	.74	2.29	2.06	6.78	2.33	1.84	10.95	10.00	9.11	8.00	1.92	1.50
362, 617	14.24	1.46	.79	2.25	2.06	5.41	2.88	2.23	10.52	10.00	8.29	8.00	3.12	3.00
410	13.91	1.22	.58	1.80	1.65	5.76	2.35	2.38	10.49	10.00	8.11	8.00	2.22	2.00
445	12.50	1.46	.79	2.25	2.06	4.48	3.61	2.66	10.75	10.00	8.09	8.00	3.08	3.00
530	9.17	1.85	.51	2.36	2.40	4.77	1.60	1.97	8.34	7.00	6.37	6.00	10.50*	10.00
604	13.41	1.01	.70	1.71	.82	6.05	1.97	2.50	10.52	10.00	8.02	8.00	4.42	4.00
535	14.08	1.32	.40	1.72	1.03	5.12	3.09	2.10	10.31	10.00	8.21	8.00	3.08	2.00
345, 443	14.97	1.53	.87	2.40	2.06	6.01	2.18	1.97	10.16	10.00	8.19	8.00	3.14	2.00
346, 370, 367	14.49	.99	.62	1.61	.82	5.80	3.47	1.89	11.16	8.00	9.27	7.00	1.46	1.00
444	13.16	1.06	.98	2.04	2.50	5.12	3.43	2.48	11.03	11.00	8.55	9.00	2.04	2.00
304, 441	14.05	1.49	.77	2.26	2.06	6.50	1.95	2.07	10.52	10.00	8.45	8.00	1.60	1.50
448	14.26	1.49	1.62	3.11	2.50	6.72	2.05	1.59	10.36	8.00	8.77	6.00	5.40	5.00
49	9.99	1.31	.61	1.92	1.65	7.40	.76	.56	8.72	10.00	8.16	8.00	10.39*	10.00
143, 185, 204	9.18	1.12	1.16	2.28	1.65	6.33	2.01	1.13	9.47	10.00	8.34	8.00	10.28*	10.00
40	11.92	2.48	1.24	3.72	2.89	7.36	1.30	.66	9.32	10.00	8.66	8.00	4.46	4.00
223, 260, 276	11.19	1.76	1.43	3.19	2.80	6.56	1.68	.54	8.78	10.00	8.24	8.00	4.88	4.00
48	10.69	2.72	1.69	4.41	1.11	6.95	1.31	.56	8.82	10.00	8.26	8.00	6.54	7.00
194, 254	11.21	1.19	1.07	2.26	1.65	5.98	1.94	.26	8.18	8.00	7.92	7.00	7.20	6.00

* 530 Chlorine .58%, equivalent to .75% potash. 0.72% potash as sulphate.
49 " 5.30% " 7.09% " 3.30% " "
143-185-204 " 5.93% " 7.94% " 2.34% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	—	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works (Continued).						
Fish and Potash Mixture	New Bedford	$3.80[2]	—	$26.00	$18.10	40.41
" " " "	Taunton			25.00		
Grain Grower	Haverhill	2.25	—	28.00	18.76	56.34
" "	Salem			26.00		
" "	Marlboro			34.00		
Ammoniated Bone with Potash	New Bedford	2.21	—	31.00	19.85	52.79
" " " "	Haverhill			30.00		
" " " "	Concord			30.00		
Fruit and Root Crop Special	Haverhill	1.97[3]	—	30.00	20.79	58.73
" " " " "	Marlboro			36.00		
Corn King	Westfield	2.04[4]	—	32.00	23.18	38.05
Market Garden Special	Seekonk	.30[2]	—	36.00	28.18	27.75
Beach Soap Co., Lawrence, Mass.						
Beach's Advance Brand Fertilizer	Lawrence	4.54	—	33.00	31.67	4.20
Beach's Market Garden Brand Fertilizer	Lawrence	1.27[2]	—	40.00	36.40	9.89
Beach's Reliance Brand Fertilizer	Lawrence	—	—	28.00	25.17	11.24
Berkshire Fertilizer Co., Bridgeport, Conn.						
Berkshire Potato and Vegetable Phosphate	N. Amherst	1.91	—	31.00	19.96	55.32
" " " " "	Somerset			29.50	19.63	50.28
" " " " "	Leeds			32.00	18.68	71.30
Berkshire Complete Tobacco Fertilizer	N. Amherst	2.04	—	33.00	25.89	25.53
" " " "	Hadley			32.00		
Berkshire Ammoniated Bone Phosphate	Leeds	3.34	—	30.00	16.17	85.52
Berkshire Long Island Special	Seekonk	—	—	37.00	28.00	32.14
Berkshire Complete Fertilizer (Root)	Somerset	2.00[3]	—	31.50	25.29	24.55
Bonora Chemical Co., New York City.						
Bonora	Boston	—	—	†	68.52	—
Bowker Fertilizer Co., 43 Chatham St., Boston.						
Bowker's Square Brand Bone and Potash	Middleboro	3.22	—	28.00	18.42	52.00
Bowker's Market Garden Fertilizer	Springfield	.59	—	30.00	25.09	41.10
" " " "	Dalton			30.50		

† Sold only in 1 and 5 lb. packages at 50c per lb.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid Reverted.	Phosphoric Acid Insoluble.	Phosphoric Acid Total. Found.	Phosphoric Acid Total. Guaranteed.	Phosphoric Acid Available. Found.	Phosphoric Acid Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) Guaranteed.
166, 220	7.50	.52	1.70	2.22	2.06	3.90	2.14	1.02	7.06	7.00	6.04	6.00	3.56	2.00
260, 339, 440	10.05	.95	1.01	1.96	1.65	6.33	2.12	.97	9.42	10.00	8.45	8.00	2.90	2.00
151, 233, 279	9.15	1.24	1.66	2.90	2.61	3.77	2.24	1.38	7.39	8.00	6.01	6.00	2.48	2.00
261, 425	10.70	.90	1.05	1.95	1.65	6.18	1.75	1.15	9.08	10.00	7.93	8.00	5 80	5.00
484	8.66	1.48	1.33	2.81	2.47	5.54	2.26	.64	8.44	9.00	7.80	8.00	5.20	4.00
198	12.54	2.40	1.05	3.45	3.20	6.75	1.95	.40	9.10	9.00	8.70	8.00	7.14*	7.00
242	6.04	1.97	1.46	3.43	2.47	4.32	8.81	.61	13.74	10.00	13.13	8.00	6.16*	6.00
270	5.20	3.75	1.03	4.78	4.74	2.09	7.09	.72	9.90	8.00	9.18	7.00	9.90*	9.75
232	6.89	1.71	1.14	2.85	1.65	2.92	7.93	2.15	13.00	10.00	10.85	8.00	3.82	3.00
18	9.99	.84	1.36	2.20	1.70	4.90	2.92	2.20	10.02	8.00	7.82	6.00	3.36	4.00
214	10.00	.90	1.45	2.35	1.70	3.65	3.18	.87	7.70	8.00	6.83	6.00	4.10	4.00
600	9.33	.63	1.38	2.01	1.70	4.13	2.47	.64	7.21	8.00	6.60	6.00	4.80	4.00
17, 20	9.11	.97	1.81	2.78	2.50	5.05	3.25	1.90	10.20	10.00	8.30	8.00	6.24*	6.00
390	9.67	.59	.82	1.41	.80	5.86	2.73	.72	9.31	10.00	8.59	8.00	2.38	2.00
141	9.47	1.04	2.72	3.76	3.30	4.86	2.03	1.25	8.14	8.00	6.89	6.00	6.84	7.00
218	10.51	1.10	1.96	3.06	2.50	5.25	2.30	.82	8.37	10.00	7.55	8.00	6.50	6.00
318	2.91	16.10	—	16.10	15.00	5.18	—	—	5 18	—	5.18	5.00	4.44	3.00
228	14.70	1.31	.61	1.92	1.65	6.14	2.36	2.17	10.67	7.00	8.50	6.00	2.28	2.00
400, 517	12.30	1.48	1.01	2.49	2.47	4.32	5.27	.90	8.49	7.00	7.59	7.00	9.04	10.00

* 108 Chlorine 4 15%, equivalent to 5 56% potash, 1.58% potash as sulphate.
242 " 1.32% " 1.76% " 4 40% " "
270 " 2 29% " 3 06% " 6.84% " "
17-20 " 4% " .66% " 5.58% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	+ Average Value for 5 years of the excess or deficiency of − plant food over the amount guaranteed.		Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Co. (Continued.)						
Bowker's Tobacco Starter	Southwick	$3.12[4]	—	$33.00	$23.70	39.24
Bowker's Potato and Vegetable Fertilizer	Middleboro	1.35[4]	—	32.00	22.62	41.47
Gloucester Fish and Potash	Wrentham	3.68[3]	—	25.00	13.71	82.34
Bowker's Fisherman's Brand Fish and Potash " " " " " "	Southwick Springfield	—	—	27.00 26.00	19.97	32.69
Bowker's Early Potato Manure	North Adams	.01	—	39.00	27.04	44.23
Bowker's Soluble Animal Fertilizer	Fall River	1.41	—	33.00	22.86	44.35
Bowker's Ammoniated Food for Flowers	Boston	10.06[4]	—	†	23.50	—
Bowker's Potato and Vegetable Phosphate	Gt. Barrington	2.68[3]	—	30.00	18.10	65.74
Bowker's Lawn and Garden Dressing " " " " "	Concord Lexington	3.07	—	45.00 56.00	25.80	95.29
Bowker's Bone and Wood Ash " " " " "	Lowell Springfield	1.76[4]	—	28.00 32.00	18.18	65.01
Bowker's Hill and Drill Phosphate	Middleboro	.54	—	33.00	21.89	50.75
Bowker's High Grade Fertilizer	Lowell	3.27	—	32.00	22.89	40.52
Bowker's Special Fertilizer, Corn, Grain and Grass	Amherst	1.32[2]	—	32.00	23.82	34.34
Bowker's Corn Phosphate " " " " " "	Lawrence N. Adams Dalton	1.85	—	32.00 30.00 27.50	18.51	61.15
Bowker's Bone, Blood and Potash	Lowell	—	.14[4]	40.00	30.11	32.84
Bowker's Farm and Garden Phosphate " " " " "	Bridgewater N. Adams	1.01	—	30.00 30.00	17.83	68.25
Bowker's Complète Alkaline Tobacco Grower	Southwick	2.64[3]	—	36.00	37.39	‡ 3.71
Bowker's Special Fertilizer for Different Crops	Gt. Barrington	—	—	33.00	23.00	43.47
Bowker's Sure Crop Bone Phosphate	Lawrence	1.47[4]	—	29.00	17.92	61.84
Bowker's Clover Leaf Brand Bone and Wood Ash Fert	Gt. Barrington	2.51[4]	—	32.00	25.48	25.58
Bowker's Fish and Potash, Square Brand	Montague	1.13[3]	—	31.00	19.03	62.09
Bowker's Fish and Potash, "D" Brand	Wellesley	3.55[4]	—	30.00	15.85	89.27
Stockbridge's Tobacco Manure	S. Deerfield	—	.26[2]	48.00	34.58	38.80
Stockbridge's Spec. Comp. Man. Corn and all Gr. Crops " " " " " " " "	Bridgewater S. Fram'g'm	.25[2]	—	37.00 38.00	29.46	27.29
Stockbridge's Spec. Comp. Manure for Seeding Down	Bridgewater	1.14[2]	—	38.00	26.15	45.31

† Sold only in one-half lb. and 1 lb. packages.

‡ Valuation in excess of selling price.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
481	10.90	1.40	1.56	2.96	2.47	7.10	2.14	2.17	11.41	10.00	9.24	9.00	2.22‡	2.00
219	13.82	1.49	1.15	2.64	2.47	6.43	2.15	2.48	11.06	9.00	8.58	8.00	3.56	4.00
567	14.00	.89	.38	1.27	.82	2.09	4.62	3.24	9.95	9.00	6.71	6.00	1.54	1.00
464 / 498	13.71	1.44	1.03	2.47	2.47	4.13	2.06	2.10	8.29	5.00	6.19	4.00	4.24	4.00
510	11.91	1.61	1.70	3.31	3.30	5.82	1.67	2.23	9.72	9.00	7.49	8.00	6.94	7.00
136	14.18	1.52	.98	2.50	2.50	6.24	2.30	2.46	11.00	—	8.54	8.00	4.62	4.00
315	5.38	1.11	1.73	2.84	2.00	1.47	7.58	1.82	10 87	6.00	9.05	4.00	3.36*	2.00
522	14.06	1.14	.96	2.10	1.65	3.58	3.61	3.17	10.36	9.00	7.19	8.00	2.16	2.00
309 / 351	7.03	3.36	.82	4.18	3.00	1.64	3.48	1.23	6.35	8.00	5.12	4.00	5.66	5.00
251 / 496	14.50	1.23	.71	1.94	1.65	6.37	1.79	2.26	10.42	8.00	8.16	6.00	2.16	2.00
226	15.25	1.62	1.05	2.67	2.47	7.01	2.07	2.20	11.28	10.00	9.08	9.00	2.16	2.00
256	16.36	1.57	1.01	2.58	2.47	6.20	2.36	1.86	10.42	10.00	8.56	6.00	4.56	4.00
573	11.96	1.73	1.08	2.81	2.47	6.33	2.96	2.56	11.85	9.00	9.29	8.00	3 50	4.00
241 / 513 / 539	13.70	1.12	.88	2.00	1.65	5.28	2.90	2.41	10.59	9.00	8.18	9.00	2.26	2.00
235	12.97	2.67	1 57	4.24	4.10	4.77	2.09	1.89	8.75	8.00	6.86	7.00	7.50	7.00
352 / 511	14 34	1.09	.70	1.79	1.65	6.27	1.95	2.50	10.72	9.00	8.22	8.00	2.24	2.00
465	11.28	3.20	3.34	6.54	4.00	.26	5.04	5.63	10.93	5.00	5.30	4.00	4.98*	5.00
519	13.27	1.35	1.32	2.67	2.47	5.80	2.82	1.41	10.03	9.00	8.62	8.00	4 34	4.00
230	14.87	.94	.85	1.79	.82	6.56	1.86	2.17	10.59	9.00	8.42	8.00	2.18	2.00
518	9.70	1.45	1.57	3.02	1.75	.64	9.05	3.10	12.79	9.00	9.69	7.00	4.28	2.25
553	11.91	1.60	1.05	2.65	2.47	2.02	2.66	1.74	6.42	5.00	4.68	4.00	4.34	4.00
568	8.57	2.37	.46	2.83	2.47	1.38	1.85	.74	3.97	8.00	3.23	3.00	2.16	2.00
540	9.60	2.92	2.60	5.52	5.75	4.03	2.06	.87	6.96	6.00	6.09	4.00	7.33*	10.00
328 / 430	13.09	2.36	1 29	3.65	3.29	6.72	3.36	1.18	11.26	11.00	10.08	10.00	6.15	7.00
541	14.07	1.58	.91	2.49	2.47	4.80	2.44	1.92	9.16	9.00	7.24	6.00	10.35	10.00

‡ 481 Potash as sulphate.

* 315	Chlorine .38%, equivalent to	.51% potash.	2.85% potash as sulphate.		
465	" .86%	"	1.15% "	3.83% "	"
540	" 2.21%	"	2.96% "	4.37% "	"

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	−	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Co. (Continued).						
Stockbridge's Sp. Com. Man. for Q'k Growth and Forc.	Fall River			$38.50	$30.23	27.35
" " " " " "	Bridgewater	$1.19[2]	—	38.00	29.83	29.03
" " " " " "	Natick			39.00		
Stockbridge's Sp. Com. Manure for Potatoes and Veg.	Taunton			37.00	30.09	25.47
" " " " " " "	Fall River			38.50		
" " " " " " "	Middleboro	1.92[4]	—	40.00		
" " " " " " "	Concord			32.00	28.91	20.13
" " " " " " "	Mansfield			40.00		
Joseph Breck & Sons Corp., Boston, Mass.						
Breck's Lawn and Garden Dressing	Boston	4.35	—	50.00	30.46	64.14
Breck's Market Garden Manure	Boston	.78	—	32.00	22.90	39.73
Ram's Head Brand Sheep Manure, Pulverized	Boston	—	—	30.00	13.55	121.40
Buffalo Fertilizer Co., Buffalo, N. Y.						
Farmers' Choice	E. Pepperell	2.10[3]	—	27.00	19.27	34.92
" "	Townsend			25.00		
Fish Guano	E. Pepperell	2.55[2]	—	25.00	19.09	30.95
" "	Townsend			25.00		
Ideal Wheat and Corn	Townsend	—	—	28.00	23.78	26.15
" " " "	E. Pepperell			32.00		
Celery and Potato Special	E. Pepperell	1.53[2]	—	36.00	26.33	30.45
" " " "	Townsend			34.00		
Vegetable and Potato	E. Pepperell	1.07[2]	—	34.00	22.44	51.51
" " "	Townsend			34.00		
Top Dresser	N. Amherst	—	$.31[2]	35.00	36.71	† 4.65
"	Townsend			36.00	32.21	11.76
High Grade Manure	N. Amherst	.21[3]	—	32.00	33.56	† 4.64
" " "	Townsend			36.00	26.75	34.57
Coe-Mortimer Co., 24-26 Stone St., New York City.						
Peruvian Market Garden Fertilizer	Hadley	—	—	48.50	42.34	14.57
E. Frank Coe's H. G. Ammon. Bone Superphosphate	Westfield	3.13	—	33.00	22.79	44.80
E. Frank Coe's Excelsior Potato Fertilizer	Dighton	2.56	—	39.00	28.30	37.80
Peruvian Guano, Chincha Grade	Hadley			41.00		
" " " "	N. Amherst			47.50		
" " " "	Sunderland	1.17[3]	—	45.75	38.57	16.67
" " " "	Whately			—		
" " " "	Whately			—		
" " " "	Sunderland			45.75		

† Valuation in excess of selling price.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
199	12.07	3.29	1.62	4.91	4.93	1.85	2.79	1.92	6.56	6.00	4.64	4.00	7.40	6.00
358, 574	11.48	3.83	1.08	4.91	4.93	1.77	2.43	1.94	6.14	6.00	4.20	4.00	7.64	6.00
146, 177	9.21	2.37	1.44	3.81	3.29	3.45	2.69	2.56	8.70	7.00	6.14	6.00	10.04	10.00
227, 311, 564	11.12	2.20	1.38	3.58	3.29	4.32	2.15	1.59	8.06	7.00	6.47	6.00	9.66	10.00
299	8.62	3.80	1.24	5.04	4.12	1.32	4.48	.95	6.75	—	5.80	5.00	6.58	5.00
291	15.80	1.80	1.05	2.85	2.50	7.23	2.26	1.97	11.46	11.00	9.49	9.00	2.21	2.00
295	5.15	—	2.42	2.42	2.68	—	—	—	1.57	1.50	—	—	2.37	1.75
581, 583	13.98	.86	.32	1.18	.82	4.86	5.02	1.43	11.31	9.00	9.88	8.00	5.68	5.00
582, 588	10.80	.88	.72	1.60	.82	4.29	4.79	2.10	11.18	10.00	9.08	9.00	4.05	2.00
576, 579	11.75	1.15	.58	1.73	1.64	2.05	10.36	2.02	14.43	10.00	12.41	9.00	5.83	5.00
577, 595	11.01	1.00	1.03	2.03	1.64	2.75	4.85	2.48	10.08	9.00	7.60	8.00	12.71	10.00
580, 587	14.61	1.70	.36	2.06	2.45	4.00	4.29	1.64	9.93	9.00	8.29	8.00	7.24	7.00
114	8.68	4.04	2.48	6.52	5.74	4.80	3.18	1.46	9.44	7.00	7.98	6.00	3.94	5.00
593	13.48	3.75	1.51	5.26	5.74	5.35	3.51	1.07	9.93	7.00	8.86	6.00	3.76	5.00
118	8.29	2.46	1.31	3.77	3.28	5.73	2.46	1.33	9.52	8.00	8.19	7.00	10.72*	10.00
592	12.51	2.43	.26	2.69	3.28	3.71	3.71	2.07	9.49	8.00	7.42	7.00	10.37	10.00
25	8.20	3.71	1.83	5.54	5.70	5.69	5.57	3.12	14.38	9.00	11.26	8.00	9.46*	10.00
470	11.94	1.35	1.07	2.42	1.85	6.12	5.09	.87	12.08	11.00	11.21	9.00	2.76	2.25
138	10.92	1.81	.78	2.59	2.47	5.28	3.47	3.48	12.23	9.00	8.75	7.00	9.02*	8.00
8, 19, 34, 113, 119, 555	10.46	5.77	1.69	7.46	7.00	3.26	4.32	1.82	9.40	8.50	7.58	6.50	2.64*	2.00

* 118 Chlorine .51%, equivalent to .69% potash, 10.03% potash as sulphate.
25 " 1.48% " 1.98% " 7.48% " "
138 " 2.03% " 2.72% " 6.30% " "
8-19-34-113-119-555 " 1.13% " 1.51% " 1.13% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	−	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Coe-Mortimer Co. (Continued).						
E. Frank Coe's Columbian Corn and Potato " " " " "	Greenfield Westfield	$3.38	—	$28.00 32.00	$20.55	45.98
E. Frank Coe's Celebrated Special Potato " " " " "	Greenfield Westfield	1.86	—	30.00 34.00	22.38	42.98
Peruvian Tobacco Fertilizer	Greenfield	—	—	50.00	41.17	21.44
E. Frank Coe's Gold Brand Excelsior Guano	Dighton	2.13[4]	—	37.00	25.48	45.21
Eastern Chemical Co., Boston, Mass.						
IMP Plant Food	Boston	2.46[3]	—	190.00	100.57	88.92
Essex Fertilizer Co., 39 N. Market St., Boston.						
Essex Complete Manure for Potatoes, Roots and Veg. "	Taunton Worcester Sterling Leominster	1.66	—	40.00 42.00 40.00 40.00	29.45	37.52
Essex Market Garden and Potato Manure " " " " " "	Westport Sterling	2.23	—	35.00 35.00	21.07	66.11
Essex XXX Fish and Potash " " " " " " " " " "	Westport Taunton Sterling Springfield	.98	—	31.00 30.00 32.00 38.00	21.63	50.25
Essex Complete Manure for Corn, Grain and Grass " " " " " " " "	Worcester Leominster	1.43	—	40.00 39.00	29.42	34.26
Essex A1 Superphosphate	Sterling	.56	—	28.00	14.04	99.43
Essex Lawn Dressing	Taunton	1.59	—	45.00	27.91	61.23
Essex Potato Grower	Taunton	—	—	38.00	24.71	53.78
Essex Spec. Potato Phosphate for Potatoes and Roots " " " " " " " "	Taunton Dighton	—	—	37.00 35.00	24.06	49.62
R. & J. Farquhar & Co., Boston, Mass.						
Farquhar's Vegetable and Potato Fertilizer	Boston	3.46	—	42.75	27.66	54.56
Farquhar's Lawn and Garden Dressing	Boston	4.87	—	47.50	28.17	68.62
Thompson's Imp. Vine. Plant and Vegetable Manure	Boston	3.28[2]	—	125.00*	31.96	291.11
Thompson's Special Chrysanthemum Manure	Boston	—	—	250.00*	33.33	650.07
Gay's London Fertilizer	Boston	3.55[2]	—	125.00*	24.95	401.00

* Sold only in small quantities.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
	Moisture.	Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
458 / 502	13.10	.90	.91	1.31	1.23	4.71	4.83	2.66	12.20	10.50	9.54	8.50	3.97	2.50
459 / 469	12.40	1.29	.89	2.18	1.65	4.73	4.97	1.20	10.90	10.00	9.70	8.00	3.03	4.00
455	9.40	4.23	1.90	6.13	5.74	.70	6.95	3.71	11.36	8.00	7.65	6.00	9.64*	10.00
137	12.44	1.70	1.08	2.78	2.40	5.80	3.92	.67	10.39	10.00	9.72	8.00	5.60*	6.00
316	.63	13.31	—	13.31	13.00	24.05	.28	—	24.33	25.30	24.33	—	27.02‡	24.60
221 / 388 / 422 / 429	6.64	1.69	1.81	3.50	3.25	2.69	3.68	2.89	9.26	7.00	6.37	6.00	10.14	10.00
197 / 433	9.24	1.21	.94	2.15	2.00	5.60	2.86	1.22	9.08	9.00	8.46	8.00	4.80	5.00
183 / 223 / 428 / 500	8.88	1.10	1.34	2.44	2.00	4.26	4.16	2.82	11.24	9.00	8.42	8.00	3.46	3.00
363 / 419	7.51	1.18	2.05	3.23	3.28	1.38	4.84	4.76	10.98	7.00	6.22	6.00	10.59	10.00
431	7.71	.75	.63	1.38	1.20	4.09	2.72	.74	7.55	8.00	6.81	7.00	2.17	2.00
222	9.58	2.18	1.86	4.04	4.00	5.31	1.57	.97	7.85	8.00	6.88	7.00	6.00	6.00
211	5.72	1.57	.98	2.55	2.47	4.00	2.60	.82	7.42	—	6.60	6.00	9.66	10.00
182 / 189	8.66	1.53	1.10	2.63	2.46	4.61	3.89	1.04	9.54	9.00	8.50	8.00	6.32	6.00
278	12.92	1.83	1.62	3.45	3.00	4.45	3.25	1.82	9.52	7.00	7.70	—	7.22	7.00
275	8.90	3.52	.46	3.98	3.30	1.38	4.89	4.02	10.29	14.00	6.27	4.00	6.90	7.00
277	10.48	2.47	1.65	4.12	3.50	5.60	3.58	3.38	12.56	12.00	9.18	8.00	6.92	7.00
304	3.41	4.63	.53	5.16	4.00	4.67	3.65	4.96	13.28	12.00	8.32	6.50	4.61*	4.50
301	10.20	2.48	2.79	5.27	4.50	—	1.49	7.11	8.60	8.00	1.49	.75	.18	.25

‡ 316 Potash as nitrate, valued at 5c per lb.
* 455 Chlorine 1.76%, equivalent to 2.35% potash, 7.29% potash as sulphate.
137 " 2.18% " 2.93% " 2.67% " "
304 " 2.60% " 3.48% " 1.13% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	−	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Fertilizer Products Co.,† Jersey City, N. J.						
Plant Blood	Boston	—	—	$72.00	$32.20	123.60
C. W. Hastings, Ashmont, Mass.						
Ferti Flora	Boston	$.47[3]	—	*	19.40	—
Lister's Agricultural Chemical Works, Newark, N. J.						
Lister's Special Potato Fertilizer	Leicester	2.21	—	32.00	21.18	47.31
" " " "	Williamst'n			30.40		
Lister's Special Tobacco Fertilizer	Amherst	2.41[2]	—	33.00	21.39	54.27
Lister's Success Fertilizer	Carlisle	2.09	—	28.97	19.14	54.02
" " "	Leicester			30.00		
Lister's 10% Potato Grower	Carlisle	.64[2]	—	39.42	27.97	40.93
Lister's H. G. Special for Spring Crops	Boylston	1.89	—	36.00	26.79	34.38
Lister's Potato Manure	Seekonk	.85	—	36.00	28.42	26.66
Lister's Corn Fertilizer	Carlisle	2.45	—	29.92	19.75	51.69
" " "	Williamst'n			30.00		
Jas. E. McGovern, Andover, Mass.						
Complete Fertilizer	M'f'rs Sample	—		—	24.26	—
Mapes Formula and Peruvian Guano Co., N. Y. City.						
Mapes' Lawn Top Dressing	Taunton	5.36[4]	—	34.00	19.17	77.36
Mapes' Potato Manure	Taunton	1.56	—	42.00	29.85	38.19
" " "	Lawrence			40.00		
" " "	Fitchburg			42.00		
" " "	Pittsfield			41.00		
Mapes' Grass and Grain Spring Top Dressing	Taunton	1.25[4]	—	44.00	30.39	43.13
" " " " " " "	Lawrence			42.00		
" " " " " " "	Worcester			44.00		
" " " " " " "	Fitchburg			44.00		
Mapes' Complete Manure for General Use	Taunton	1.21	—	40.00	26.71	47.24
" " " " " "	Lawrence			38.00		
" " " " " "	Worcester			40.00		
Mapes' Economical Potato Manure	Taunton	1.76	—	39.00	27.08	44.01
" " " "	Worcester			39.00		
" " " "	Fitchburg			39.00		

* Sold only in small quantities.

† Ellis Chalmers Co., Dedham, Mass., Successors.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Guaranteed.
317	8.55	3.07	1.31	4.38	4.00	2.24	7.64	1.33	11.21	6.50	9.88	6.00	5.85*	4.00
319	81.50	3.52	—	3.52	3.25	3.66	—	—	3.66	2.66	3.66	2.66	3.20	3.30
410 / 514	14.50	1.11	.94	2.05	1.65	4.32	4.69	2.35	11.36	9.00	9.01	8.00	4.40	3.00
561	14.41	1.39	.92	2.31	2.06	5.44	3.64	1.15	10.23	10.00	9.08	8.00	3.40*	3.00
295 / 432	12.48	1.30	.72	2.02	1.24	6.88	2.10	1.87	10.85	11.00	8.98	9.00	2.10	2.00
297	11.40	2.35	1.03	3.38	3.30	3.75	2.42	2.53	8.70	7.00	6.17	6.00	9.54	10.00
565	10.88	1.00	1.22	2.22	1.65	6.08	3.36	2.15	11.59	10.00	9.44	8.00	9.50	10.00
100	15.22	2.14	1.50	3.64	3.30	5.12	2.74	1.97	9.83	9.00	7.86	8.00	7.02	7.00
293 / 512	14.60	.40	1.63	2.03	1.65	5.22	2.95	2.25	10.42	9.00	8.17	8.00	3.30	3.00
7	5.01	2.44	.73	3.17	3.50	.29	6.46	3.38	10.13	10.00	6.75	6.75	5.04	5.50
210	9.13	3.29	.09	3.38	2.47	1.51	2.07	1.28	4.86	3.50	3.58	—	3.24	2.50
152 / 246 / 374 / 526	9.67	[illegible]	.45	3.08	3.30	1.47	6.07	2.44	9.98	10.00	7.54	8.00	7.12*	6.00
208 / 202 / 305 / 301	7.72	4.04	.49	4.53	4.94	.55	6.05	1.10	7.70	6.00	6.60	5.00	8.22	7.00
212 / 259 / 380	10.47	3.21	.49	3.70	3.29	1.09	8.14	1.59	10.82	10.00	9.23	8.00	4.42	4.00
200 / 302 / 372	6.61	2.69	.67	3.36	3.29	.08	5.94	1.38	7.40	6.00	6.02	4.00	8.40*	8.00

* 317 Chlorine .16% equivalent to .22% potash, 5.63% potash as sulphate.
561 " .78% " 1.06% " 2.4?% " "
152-246-374-526 " .41% " .55% " 6.57% " "
200-302-372 " .31% " .42% " 7.08% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	—	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Mapes Formula and Peruvian Guano Co. (Continued.)						
Mapes' Fruit and Vine Manure " " " " "	Taunton Worcester	$5.55	—	$43.00 44.00	$25.83	68.41
Mapes' Corn Manure	Fitchburg	.51	—	38.00	24.37	55.92
Mapes' Cereal Brand " " " " " "	Taunton Fitchburg Pittsfield	1.54	—	32.00 32.00 33.00	18.86	71.42
Mapes' Vegetable Manure for Light Soils	Taunton	3.08	—	45.00	34.71	29.64
Mapes' Average Soil Complete Manure " " " " "	Worcester Fitchburg	3.23[4]	—	39.00 39.00	28.98	34.57
Mapes' Tobacco Starter, Imp.	Southwick	3.30	—	36.00	28.30	27.20
Mapes' Cauliflower and Cabbage Manure	Fitchburg	1.07[4]	—	41.00	28.00	41.85
Mapes' Tobacco Manure, Wrapper Brand	Deerfield	—	$.70[4]	49.00	38.28	28.00
Mapes' Tobacco Ash Constituents	Southwick	1.17	—	35.00	29.70	17.84
Mapes' Complete Manure, "A" Brand	Springfield	1.50	—	38.00	24.16	57.23
Mapes' Top Dresser, Improved Half Strength	Southwick	.23[3]	—	35.00	23.22	50.73
Mapes' Top Dresser, Improved Full Strength	Springfield	.41[2]	—	55.00	46.15	19.17
National Fertilizer Co., Bridgeport, Conn.						
Chittenden's Market Garden Fertilizer	Sunderland	1.61	—	32.00	24.15	32.50
Chittenden's Conn. Valley Tobacco Grower	Sunderland	2.10[3]	—	46.00	34.42	33.64
Chittenden's Conn. Valley Tobacco Starter	Sunderland	2.17[3]	—	46.00	39.35	16.90
Chittenden's Complete Root Fertilizer " " " "	Seekonk Leominster	1.69	—	36.00 39.00	28.23	32.83
Chittenden's Universal Phosphate	Gt. Barrington	3.79[3]	—	27.00	15.09	78.92
Chittenden's Fish and Potash	W. Springfield	1.87	—	28.00	25.21	11.06
Chittenden's XXX Fish and Potash	East Whately	3.14[2]	—	29.00	21.34	35.89
Chittenden's Complete Grass Fertilizer	East Whately	1.45[4]	—	37.00	27.59	34.10
Chittenden's Complete Fertilizer	Sunderland	1.89[3]	—	35.00	28.44	23.06
Chittenden's Complete Fertilizer (Tobacco) " " " "	W. Spring'd Hatfield	1.93[2]	—	36.00 36.00	28.91 30.17	24.52 19.32
Chittenden's Ammoniated Bone Phosphate	Leominster	2.21	—	32.00	17.98	77.97

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash K_2O in 100 lbs. Found.	Guaranteed.
207 / 381	11.73	1.72	.40	2.21	1.65	1.02	5.43	.07	7.42	7.00	6.45	5.00	11.22*	10.00
383	8.04	2.17	.47	2.64	2.47	.08	7.45	2.43	10.54	10.00	8.11	8.00	7.14	8.00
[illegible]	11.40	1.73	.57	2.30	1.65	.38	5.17	4.30	9.85	8.00	5.55	6.00	3.00	3.00
200	8.31	4.65	.65	5.30	4.94	.90	6.20	1.51	8.70	8.00	7.10	6.00	7.76	6.00
364 / 378	10.07	3.80	.37	4.17	4.12	1.02	5.65	.95	8.52	8.00	7.57	7.00	6.12*	5.00
483	7.44	4.39	.83	5.22	4.12	.45	5.82	.97	7.24	8.00	6.27	6.00	2.68*	1.00
304	8.59	3.95	.55	4.50	4.12	1.00	4.37	1.30	7.27	6.00	5.97	6.00	7.03	6.00
554	9.17	3.54	2.51	6.05	6.18	.20	3.58	1.60	5.53	4.50	3.87	—	10.06*	10.00
403	11.64	.58	.12	.70	.50	.25	2.56	3.58	6.37	5.70	2.79	—	15.10†	15.00
404	10.04	2.52	.48	3.00	2.47	1.25	8.93	2.89	13.07	12.00	10.18	10.00	2.85	2.00
430	6.83	4.68	.17	4.85	4.94	.32	2.42	1.48	4.22	4.00	2.74	—	2.11‡	2.00
491	9.01	9.17	.41	9.58	9.88	.49	6.37	1.15	8.01	8.00	6.86	—	4.03*	4.00
33	10.91	1.87	.70	2.57	2.47	6.50	2.04	1.46	10.00	9.00	8.54	7.00	6.40	6.00
30	7.50	2.23	2.52	4.75	4.20	.38	2.71	1.77	4.86	4.00	3.09	—	8.72†	8.00
76	5.09	6.50	2.34	8.84	8.25	—	2.79	.79	3.58	3.00	2.79	—	2.90*	2.00
453 / 420	12.02	1.07	1.58	3.55	3.30	4.73	5.44	2.17	10.34	10.00	8.17	8.00	6.78	6.00
227	11.70	.50	.70	1.20	.80	4.32	4.40	1.87	10.59	10.00	8.72	8.00	1.32	1.00
35	11.40	2.40	1.10	3.50	3.00	5.73	1.20	1.13	8.06	6.00	6.93	-	4.98	4.00
36	11.01	1.68	1.43	3.11	2.50	4.32	1.11	1.13	6.56	7.00	5.43	5.00	4.10	3.00
67	11.01	2.30	1.54	3.84	4.10	5.76	1.59	1.30	8.65	8.00	7.35	6.00	5.95	5.00
57	8.24	2.17	1.38	3.55	3.20	7.39	1.49	1.38	10.26	9.00	8.88	8.00	5.59*	5.00
92 128	7.57 8.84	1.85 2.89	1.76 1.18	3.61 4.07	3.20 3.20	7.14 7.52	1.18 1.20	1.84 1.05	10.16 9.83	9.00 9.00	8.32 8.78	8.00 8.00	6.00* 5.00*	5.00 5.00
421	12.08	1.39	.49	1.88	1.65	6.08	2.21	2.15	10.44	10.00	8.29	8.00	2.24	2.00

* 207–381 Chlorine .28%, equivalent to .37% potash, 10.85% potash as sulphate.
364–378 " .57% " .76% " 5.36% " "
483 " .47% " .64% " 2.04% " "
554 " 1.17% " 1.57% " 9.39% " "
491 " .84% " 1.13% " 2.90% " "
76 " .33% " .46% " 2.50% " "
57 " .53% " .71% " 4.87% " "
92 " .86% " 1.04% " 5.02% " "
128 " .43% " .58% " 5.08% " "

† 403 Total potash 15.84% Chlorine 1.16%, equivalent to 1.55% potash, 3.16% potash as sulphate, 11.13% potash as carbonate.
30 Total potash 8.80% Chlorine 1.03%, equivalent to 2.18% potash, 6.54% potash as carbonate.
‡ Potash as sulphate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	−	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
National Fertilizer Co. (Continued.)						
Chittenden's Potato Phosphate	West Auburn	$1.12	—	$34.00	$24.28	40.03
Chittenden's Tobacco Special	S. Deerfield	2.88[2]	—	35.00	30.89	13.30
" " "	E. Whately			35.00		
National Guano Co., Aurora, Ill.						
Pulverized Sheep Manure	Worcester	—	—	25.00	12.73	99.52
New England Fertilizer Co., Boston, Mass.						
New England High Grade Potato Fertilizer	So. Lowell	2.34[4]	—	34.00	24.59	38.26
New England Superphosphate	So. Lowell	.80	—	32.00	22.63	41.40
" "	Orange			—		
New England Potato Grower	So. Lowell	—	—	37.00	25.82	43.29
New England Corn and Grain Fertilizer	So. Lowell	1.81[2]	—	26.00	16.47	54.82
" " " " "	Orange			25.00		
New England Potato Fertilizer	So. Lowell	.91	—	30.00	18.12	65.56
New England Market Garden Manure	So. Lowell	—	—	38.00	29.46	28.98
Northwestern Fertilizing Co., Chicago, Ill.						
Northwestern Empire Special Manure	Seekonk	—	—	34.00	29.21	16.39
Olds & Whipple, Hartford, Conn.						
Olds & Whipple's Tobacco Fertilizer	N. Hadley	2.50	—	36.00	31.12	15.68
" " "	N. Amherst			36.00	30.73	17.15
" " "	Sunderland			36.00		
" " "	N. Hadley			36.00		
High Grade Potato Manure	N. Amherst	—	—	37.00	32.20	14.09
Home Mixture for Onions	N. Amherst	2.39[2]	—	34.00	27.88	21.95
" " " "	Bradstreet			37.00	27.96	32.33
Home Mixture for Grass	N. Amherst	—	—	34.00	26.66	27.53
Home Mixture for Corn and Potatoes	M'f'rs Sample	1.54[2]	—	34.00	26.18	29.87
Fish and Potash	S. Deerfield	—	—	30.00	20.52	46.10
" " "	M'f'rs Samp.			30.00		
Parmenter & Polsey Fertilizer Co., Boston, Mass.						
A. A. Brand	So. Lowell	.20[1]		42.00	28.94	45.04

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.			
				Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
566	13.87	1.16	1.20	2.36	2.06	7.33	1.62	1.46	10.41	10.00	8.95	8.00	6.70	6.00
56 / 68	8.21	1.84	3.29	5.13	4.00	—	3.47	3.18	6.65	4.00	3.47	3.00	4.96*	5.50
384	4.93	—	2.25	2.25	2.50	1.70	—	—	1.70	1.75	1.70	1.50	1.80	1.50
272	8.68	1.27	1.55	2.82	2.46	6.65	1.36	1.23	9.24	9.00	8.01	8.00	6.08	6.00
234 / 456	8.23	1.48	1.27	2.75	2.46	4.99	3.33	1.33	9.65	10.00	8.32	8.00	4.02	4.00
256	7.61	2.05	.72	2.77	2.46	4.39	2.04	1.07	7.50	7.00	6.43	6.00	10.14	10.00
258 / 454	8.36	1.03	.78	1.81	1.23	5.03	2.50	.69	8.22	8.00	7.53	7.00	2.24	2.00
265	9.16	.31	1.60	1.91	1.64	3.88	3.28	.41	7.57	8.00	7.16	7.00	4.02	4.00
252	8.06	2.83	1.50	4.33	4.94	4.22	2.92	1.51	8.65	8.00	7.14	7.00	6.34	6.00
176	12.06	2.01	1.77	3.78	3.30	5.82	2.24	2.15	10.21	9.00	8.06	7.00	6.84	7.00
5	7.89	2.18	2.66	4.84	4.53	.29	3.25	.70	4.24	—	3.54	3.00	6.72*	5.50
13 / 27 / 105	7.48	4.21	1.34	5.55	4.53	—	3.08	.52	3.60	—	3.08	3.00	5.50*	5.50
15	6.79	.77	3.26	4.03	3.20	.17	6.46	3.30	9.93	6.00	6.63	—	10.28	10.00
20	7.98	2.10	1.84	3.94	3.30	—	6.40	2.50	8.90	—	6.40	6.00	6.84	6.50
74	7.55	1.18	2.49	3.67	3.30	—	6.35	2.50	8.85	—	6.35	6.00	7.84	6.50
36	7.18	1.82	1.94	3.76	3.30	.13	5.63	2.79	8.55	—	5.76	6.00	6.66	6.00
548	5.05	2.15	1.50	3.65	3.30	.83	5.04	3.14	9.01	—	5.87	6.00	5.62*	6.00
545 / 552	6.53	.36	2.28	2.64	2.50	.19	4.78	4.96	9.93	—	4.97	5.00	3.96	3.00
271	10.14	2.35	1.82	4.17	4.12	4.93	2.36	.82	8.11	8.00	7.29	7.00	6.24	8.00

* 56–68 Chlorine 1.73%, equivalent to 2.31% potash, 2.65% potash as carbonate.
5 " 1.15% " 1.53% " 5.19% " sulphate.
13-27-105 " .94% " 1.26% " 1.96% " " 2.33% potash as carbonate.
548 " .91% " 1.22% " 4.40% " "

4

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	−	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Parmenter & Polsey Fertilizer Co. (Continued).						
P. & P. Potato Fertilizer	So. Lowell	$1.88[4]	—	$32.00	$23.94	33.67
P. & P. Special Potato Fertilizer	Spencer	.16	—	38.50	26.64	44.52
" " " "	E. Longm'w			38.50		
Plymouth Rock Brand Fertilizer	S. Lowell	.67	—	32.00	22.94	39.49
" " " "	Spencer			32.00		
" " " "	E. Longm'w			32.00		
R. T. Prentiss, Holyoke, Mass.						
Prentiss' Corn Fertilizer	Granby	2.49[2]	—	33.00	26.75	23.36
Prentiss' Complete for Top Dressing	Granby	—	$1.53[3]	40.00	35.32	13.25
Prentiss' Complete for Potatoes and Root Crops	Granby	1.48[3]	—	35.00	30.44	14.98
Pulverized Manure Co., Chicago, Ill.						
Wizard Brand Shredded and Pulverized Manure	Marlboro	—	—	37.00	12.00	195.47
" " " " " "	Marlboro			34.00		
W. W. Rawson & Co., Boston, Mass.						
Rawson's Special Lawn and Garden Dressing	Boston	4.82[2]	—	35.00	21.64	61.73
Rawson's Lawn and Garden Dressing	Boston	2.28[2]	—	50.00	23.28	114.77
Wizard Brand Pure Pulverized Sheep Manure	Boston	—	—	35.00	13.66	156.22
Rogers Manufacturing Co., Rockfall, Conn.						
Complete Potato and Vegetable Fertilizer	N. Hadley	1.56	—	33.00	22.63	45.82
" " " " "	Fitchburg			33.00	22.79	49.20
" " " " "	Worcester			35.00		
High Grade Soluble Tobacco Manure	Hadley	1.69[4]	—	—		
" " " " "	Sunderland			44.00	40.58	8.43
" " " " "	Whately			44.00	40.33	9.09
" " " " "	Fitchburg			45.00	39.03	14.01
" " " " "	Sunderland			44.00		
Fish and Potash	Sunderland	2.70	—	31.00	22.94	35.13
High Grade Fertilizer for Oats and Top Dressing	Hadley	2.03[3]	—	44.50	39.30	13.86
" " " " " " " "	Sunderland			45.00		
" " " " " " " "	Fitchburg			46.00	38.27	20.19
All Round Fertilizer	Worcester	3.05[3]	—	32.00	19.36	65.37
High Grade Corn and Onion Fertilizer	Sunderland	.78[3]	—	36.00	29.20	23.28
" " " " " "	Fitchburg			37.00	28.24	31.02

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.		Total.		Phosphoric Acid in 100 lbs.			Total.		Available.		Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
266	8.36	1.29	1.45	2.74	1.65	4.32	2.98	.92	8.22	7.00	7.30	6.00	6.88	6.00
417, 468	7.98	1.92	1.20	3.12	3.28	5.09	3.92	.92	9.93	9.00	9.01	8.00	6.62	7.00
267, 412, 476	8.41	1.72	1.00	2.72	2.47	4.13	4.16	1.79	10.08	9.00	8.29	8.00	4.58	4.00
495	10.66	1.59	1.12	2.71	2 88	6.88	1.87	.69	9.44	10.00	8.75	8.00	8.42*	8.00
490	8.71	4.07	1.37	5.44	5.76	5.86	1.10	.41	7.37	8.00	6.96	6.00	8.58*	8.00
492	9.46	2.00	.96	2.96	2.88	7.52	1.46	.46	9.44	10.00	8.98	8.00	10.14*	10.00
418, 420	6.75	—	2.15	2.15	2.10	—	—	—	1.54	1.20	—	—	1.64	1.35
239	5.27	3.19	—	3.19	1.65	1.45	5.84	1.74	9.03	9.00	7.29	8.00	2.86	2.00
236	5.07	3.43	.10	3.53	3.29	1.51	4.37	1.46	7.34	5.00	5.88	4.00	4.88	5.00
237	10.20	—	2.50	2.50	2.50	—	—	—	1.37	—	1.37	1.20	2.04	1.50
102	9.45	1.99	.51	2.50	2.25	6.65	2.67	1.48	10.80	10.00	9.32	—	4.16	5.00
375, 389	9.49	1.58	.99	2.57	2.25	5.37	3.20	2.48	11.05	10.00	8.57	8.00	4.28	5.00
21, 28	7.47	2.85	2.51	5.36	5.00	.68	7.00	3.30	10.93	8.00	7.68	6.00	11.56*	11.00
116	6.34	3.03	2.21	5.24	5.00	1.60	5.82	3.61	11.03	8.00	7.42	6.00	11.86*	11.00
370, 538	6.79	2.09	2.32	5.01	5.00	.87	6.78	2.94	10.59	8.00	7.65	6.00	11.52*	11.00
539	7.65	.82	2.94	3.76	3.25	2.24	2.21	2.02	6.47	6.00	4.45	4.00	3.32	3.75
22, 33	8.92	4.73	1.64	6.37	6.30	.87	8.03	3.18	12.08	9.00	8.90	7.00	6.72	7.50
376	9.45	4.15	2.10	6.25	6.30	.23	8.42	3.35	12.00	9.00	8.65	7.00	6.06	7.50
361	9.01	1.35	.42	2.27	1.65	6.08	3.15	1.59	10.82	10.00	9.23	8.00	1.44	2.00
38	7.59	2.68	1.36	4.04	3.60	3.56	3.17	3.43	10.16	8.00	6.73	6.00	6.96	7.00
305	10.00	.60	3.48	4.08	3.60	2.34	3.31	2.05	7.70	8.00	5.65	6.00	6.60	7.00

* 495 Chlorine 4.87%, equivalent to 6.52% potash, 1.90% potash as sulphate.
490 " 4.70% " 6.31% " 2.27% " "
492 " .25% " .35% " 9.79% " "
21-28 " .61% " .81% " 10.75% " "
116 " .38% " .51% " 11.35% " "
370-538 " .48% " .65% " 10.87% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	−	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Rogers Manufacturing Co. (Continued).						
High Grade Soluble Tobacco and Potato	Mansfield	$2.80[2]	—	$42.00	$33.41	25.73
High Grade Grass and Grain for Seeding Down	Fitchburg	.49[2]	—	41.00	35.97	13.98
Rogers & Hubbard Co., Middletown, Conn.						
Hubbard's Soluble Potato Manure	Whately	2.03	—	43.00	38.14	12.74
Hubbard's Potato Phosphate	Whately	2.01	—	33.00†	23.25	41.91
" " "	Gt. Barring'n			33.00	23.85	38.37
Hubbard's Oats and Top Dressing	Taunton	2.49	—	54.00	51.21	10.33
" " " " "	E. Longm'w			59.00		
Hubbard's Soluble Tobacco Manure	Whately	2.57[2]	—	48.00	40.12	19.64
Hubbard's Soluble Corn and General Crops	Whately	1.96	—	37.00	25.36	45.90
Hubbard's Complete Phosphate	Gt. Barring'n	2.42[4]	—	28.00	18.27	53.25
" " "	Amherst			28.00		
Hubbard's Fruit or Grass and Grain Fertilizer	Seekonk	2.89	—	44.00	33.53	31.22
Ross Bros. Co., Worcester, Mass.						
Ross' Lawn and Garden Fertilizer	Worcester	—	$ .62	38.00	18.53	105.07
N. Roy & Son, South Attleboro, Mass.						
Roy's Animal Fertilizer	M'f'rs Sample	—	2.64[4]	32.00	33.08	43.23
Sanderson Fert. and Chem. Co., New Haven, Conn.						
Sanderson's Tobacco Formula "B"	Sunderland	1.30	—	32.30	27.68	16.69
" " " "	Bradstreet			34.00	28.41	19.69
" " " "	N. Hadley			32.30	28.83	12.03
" " " "	Sunderland			32.30	28.45	13.53
Sanderson's Top Dressing Grass and Grain	Ringville	.29[3]	—	38.00	25.99	46.21
Sanderson's Formula "A"	Sunderland	.92	—	32.30	26.42	22.25
" " "	Bradstreet			34.00	27.21	22.19
" " "	Dighton			32.50		
" " "	Sunderland			32.30	24.65	31.03
Sanderson's Special with 10% potash	Gt. Barrington	1.00[2]	—	35.00	23.77	47.24
Sanderson's Corn Superphosphate	Gt. Barrington	1.73[3]	—	30.00	17.67	69.78
Atlantic Coast Bone, Fish and Potash	Dighton	3.06[2]	—	25.00	16.79	52.32
" " " " " "	Clinton			26.00		
" " " " " "	Gt. Barring'n			26.00		

† Price given by manufacturer.

‡ Valuation in excess of selling price.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid Reverted.	Phosphoric Acid Insoluble.	Phosphoric Acid Total. Found.	Phosphoric Acid Total. Guaranteed.	Phosphoric Acid Available. Found.	Phosphoric Acid Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
563	8.22	1.79	2.25	4.04	3.50	.13	7.21	4.89	12.23	9.00	7.34	7.00	9.06*	8.75
571	7.76	.31	2.60	2.91	3.60	.26	10.43	8.14	18.83	16.00	10.69	—	13.24	12.50
121	9.12	4.56	1.29	5.85	5.00	.23	8.91	4.22	13.36	10.00	9.14	7.00	6.08*	5.00
123	10.68	1.23	.87	2.10	2.00	5.48	4.06	2.79	12.33	10.00	9.54	9.00	5.74	5.00
531	8.90	1.02	1.28	2.30	2.00	3.39	6.13	4.63	14.15	10.00	9.52	9.00	4.79	5.00
229, 473	3.78	8.76	1.13	9.89	8.50	.26	5.47	3.48	9.21	8.00	5.73	3.90	8.94	8.00
545	7.70	3.31	2.02	5.33	5.00	.64	7.34	4.84	12.82	10.00	7.83	7.00	10.46*	10.00
111	6.33	1.87	.88	2.75	2.50	2.17	4.30	2.41	8.88	8.00	6.47	6.00	9.21	8.00
532, 562	10.24	.77	.70	1.47	1.00	4.54	4.59	1.41	10.54	9.00	9.13	8.00	3.90	3.50
178	6.35	.73	2.42	3.15	2.20	—	9.46	6.12	15.58	16.00	9.46	9.00	11.70	12.00
385	8.17	1.86	.76	2.62	2.50	—	3.74	2.43	6.17	6.00	3.74	—	4.54*	5.50
322	4.08	1.65	2.53	4.18	5.42	.29	10.56	9.29	20.14	16.20	10.85	8.14	3.64	4.16
29	8.48	1.52	2.09	3.61	3.33	4.29	2.56	2.69	9.54	10.00	6.85	6.00	6.02*	6.00
65	8.95	1.80	1.89	3.69	3.33	4.00	3.22	2.76	9.98	10.00	7.22	6.00	6.16*	6.00
107	8.09	1.70	2.09	3.79	3.33	3.68	3.36	3.17	10.21	10.00	7.04	6.00	6.14*	6.00
452	9.01	1.56	2.18	3.74	3.33	3.80	2.98	3.28	10.06	10.00	6.78	6.00	6.06*	6.00
614	8.60	1.93	1.62	3.55	4.00	1.09	4.59	3.40	9.08	—	5.68	7.00	6.62	7.00
35	8.13	1.59	1.83	3.42	3.30	4.41	2.60	2.35	9.36	9.00	7.01	6.00	6.28	6.00
71, 140	8.26	1.82	1.73	3.55	3.30	4.26	2.63	2.94	9.83	9.00	6.89	6.00	6.56	6.00
453	9.35	1.89	1.29	3.18	3.30	1.06	4.96	3.04	9.06	9.00	6.02	6.00	6.62	6.00
535	7.57	.63	1.74	2.37	2.47	1.22	4.10	.56	5.88	8.00	5.32	5.00	9.54*	10.00
523	10.56	.62	1.22	1.84	1.67	3.17	4.91	2.23	10.31	9.00	8.08	7.00	2.24	2.00
169, 434, 521	8.50	.48	1.28	1.76	1.67	1.83	3.07	2.12	7.02	6.00	4.90	4.00	5.08	4.00

* 563	Chlorine	.39%,	equivalent to	.52%	potash,	8.54%	potash as sulphate.
121	"	.20%	"	.26%	"	5.59%	"
545	"	.31%	"	.41%	"	10.05%	"
385	"	1.74%	"	2.32%	"	2.22%	"
29	"	.99%	"	1.32%	"	4.70%	"
65	"	.79%	"	1.05%	"	5.11%	"
107	"	.70%	"	.93%	"	5.21%	"
452	"	.57%	"	.76%	"	5.30%	"
535	"	1.83%	"	2.45%	"	7.09%	"

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	−	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Sanderson Fertilizer and Chemical Co. (Continued).						
Walker's Complete Phosphate	Dighton	$1.96[3]	—	$25.50	$17.82	43.09
Sanderson's Old Reliable Superphosphate	Kingville	2.03[2]	—	30.00	20.15	48.83
M. L. Shoemaker & Co., Philadelphia, Pa.						
"Swift-Sure" Superphosphate for General Use	Sunderland	2.92	—	33.00	30.00	10.00
" " " " "	Hatfield			36.00	28.91	24.52
" Guano for Truck, Corn and Onions	Sunderland	—	—	29.50	24.74	19.24
Smith Agricultural Chemical Co., Columbus, Ohio.						
Abbott's Tobacco and Potato Special	Townsend	1.75	—	30.00	22.31	34.46
Truck Guano	Sunderland	—	$ .03[2]	39.00	27.60	41.30
" "	Townsend			36.00	31.56	14.06
Harvest King	Townsend	1.35	—	27.00	18.55	45.56
Hardy's Potato Grower	Concord	—	.68[2]	32.00	23.74	34.79
Hardy's Tobacco and Potato Special	Westport	.70	—	31.00	23.05	38.84
" " " " "	Concord			32.00		
" " " " "	Bridgewater			33.00		
Hardy's Potato and Tobacco Special	Sunderland	—	—	34.00	24.15	40.78
Hardy's Tankage, Bone and Potash	Concord	.67	—	30.00	16.26	90.65
" " " " "	Newburyport			32.00		
Swift's Lowell Fert. Co., 40 N. Market St., Boston.						
Swift's Superior Fertilizer with 10% Potash	Seekonk	.64[4]	—	42.00	30.74	36.62
Swift's Lowell Animal Brand for all Crops	Sunderland	.84	—	29.00	23.32	24.35
" " " " " "	Springfield			32.00	23.40	37.47
" " " " " "	N. Westport			34.00		
" " " " " "	Somerset			30.50		
Swift's Special Vegetable Manure	Amherst	2.00[4]	—	40.00	29.72	34.59
Swift's Lowell Market Garden Manure	Taunton	1.04	—	37.00	29.00	32.75
" " " "	Seekonk			40.00		
Swift's Lowell Potato Phosphate	Springfield	.88	—	34.00	23.28	50.34
" " " "	N. Westport			36.00		
Swift's Lowell Lawn Dressing	Concord	.65	—	45.00	28.34	58.78
" " " "	Lexington			45.00		
Swift's Lowell Special Grass Mixture	Lexington	1.50[3]	—	39.00	29.36	32.85

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
139	9.65	.63	1.16	1.79	1.67	3.94	3.71	3.10	10.75	10.00	7.65	7.00	2.60	2.00
613	8.60	.88	1.57	2.45	2.50	1.60	7.41	.61	9.62	10.00	9.01	7.00	2.28	2.00
60	9.40	2.31	1.03	3.34	2.88	8.61	2.19	2.56	13.36	—	10.80	8.00	5.71*	4.50
109	9.69	2.15	1.30	3.45	2.88	6.43	3.69	3.24	13.36	—	10.12	8.00	4.66*	4.50
62	11.95	1.50	.82	2.32	1.65	7.48	2.25	2.58	12.31	—	9.73	8.00	6.22	5.00
594	12.92	.36	1.85	2.21	1.65	5.82	3.24	.46	9.52	10.00	9.06	8.00	5.26	4.00
64	11.93	.96	2.79	3.48	3.30	4.90	3.42	.92	9.24	10.00	8.32	8.00	6.19	7.00
586	11.29	.25	4.10	4.35	3.30	5.63	2.59	.15	8.37	10.00	8.22	8.00	6.82	7.00
589	10.90	.45	1.34	1.79	1.20	2.92	5.88	1.00	9.80	10.00	8.80	8.00	3.22	2.00
306	14.52	1.13	.67	1.80	1.20	5.50	4.17	.56	10.23	10.00	9.67	8.00	8.64	10.00
168 } 238 } 347 }	14.50	.83	1.65	2.48	1.65	5.03	3.69	1.36	10.08	10.00	8.72	8.00	5.08	4.00
542	15.08	.66	1.81	2.47	1.65	5.99	3.53	.64	10.16	10.00	9.52	8.00	5.72	4.00
303 } 331 }	12.20	.50	.81	1.31	1.24	3.86	5.20	1.74	10.80	10.00	9.06	8.00	2.18	2.00
187	8.99	2.30	1.47	3.77	3.65	3.99	3.65	1.04	8.68	8.00	7.64	7.00	10.00	10.00
32	8.60	1.11	1.46	2.57	2.46	4.41	4.64	2.41	11.46	10.00	9.05	8.00	4.32	4.00
97 } 171 } 213 }	7.67	1.51	1.37	2.88	2.46	5.12	3.04	1.84	10.00	10.00	8.16	8.00	4.22	4.00
575	10.84	2.36	1.56	3.92	3.29	4.67	4.82	.90	10.39	9.00	9.49	8.00	6.14	7.00
145 } 175 }	8.61	2.64	1.55	4.19	4.10	4.93	2.44	1.46	8.83	8.00	7.37	7.00	6.08	6.00
94 } 157 }	7.10	1.46	1.15	2.61	2.46	4.32	2.95	1.79	9.06	9.00	7.27	8.00	6.42	6.00
298 } 349 }	10.31	2.21	1.80	4.01	4.10	4.96	2.51	.92	8.39	8.00	7.47	7.00	6.10	6.00
355	9.11	2.09	1.97	4.06	4.11	4.64	3.65	.69	8.98	8.00	8.29	7.00	6.28	6.00

* 60 Chlorine .40% equivalent to .54% potash, 5.17% potash as sulphate.
109 " .46% " .62% " 4.04% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Average Value for 5 years of the excess or deficiency of plant food over the amount guaranteed. +	—	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Swift's Lowell Fertilizer Co. (Continued).						
Swift's Lowell Dissolved Bone and Potash	N. Westport	$ .67	—	$31.00	$19.29	60.70
Swift's Lowell Potato Manure	N. Westport	1.93	—	32.00	18.18	76.01
Swift's Lowell Potato Grower	Concord	.38[2]	—	30.00	27.32	31.77
Swift's Lowell Empress Brand for Corn and Potatoes	Spencer	1.73	—	28.00	16.54	69.28
Swift's Lowell Bone Fertilizer for Corn and Grain " " " " " " " " " " " " " "	S. Lowell Spencer Sunderland	1.40	—	30.00 30.00 27.50	18.06	55.79
Whitman & Pratt Rendering Co., Lowell, Mass.						
Whitman & Pratt's Corn Success	M'f'rs Sample	2.49[4]	—	27.50	19.85	38.53
Whitman & Pratt's Vegetable Grower " " " "	Seekonk N. Chelmsf'd	2.44[4]	—	36.00 36.50	29.80	21.65
Whitman & Pratt's Potash Special	N. Chelmsford	1.31[2]	—	36.50	29.59	23.35
Whitman & Pratt's Potato Plowman	N. Chelmsford	1.50[4]	—	36.50	28.39	28.56
Wilcox Fertilizer Works, Mystic, Conn.						
Wilcox's Fish and Potash " " " "	Amherst New Bedford	2.82	—	28.00 30.00	21.07 20.15	32.89 48.88
Wilcox's Potato, Onion and Vegetable Manure " " " " " " "	Amherst New Bedford	3.34	—	36.00 36.00	29.57 29.82	21.74 20.72
Wilcox's H. G. Tobacco Special " " " "	Amherst Fall River	4.31[4]	—	36.00 37.00	29.88 29.80	20.48 24.16
Wilcox's Potato Fertilizer	Amherst	3.58	—	30.00	20.96	43.13
Wilcox's Grass Fertilizer " " " " " "	S. Deerfield Seekonk Fall River	2.86[3]	—	35.00 36.00 36.50	30.63	16.97
A. H. Wood & Co., Framingham, Mass.						
B. B. Brand General Fertilizer	Framingham	3.33[3]	—	30.00	27.14	10.54
Wunsch Manufacturing Co., Pawtucket, R. I.						
New England Standard	Dighton	—	—	32.00	24.40	31.14
Superior Brand	Dighton	—	—	36.50	29.03	25.75
Potato Special	Dighton	—	—	30.00	25.54	17.46

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
144	8.88	1.24	.81	2.05	1.65	5.50	3.78	1.34	10.62	10.00	9.28	10.00	2.28	2.00
195	8.82	1.20	.71	1.91	1.64	3.24	4.64	.20	8.08	8.00	7.88	7.00	3.02	4.00
313	7.82	1.87	1.38	3.25	3.20	3.68	2.95	.38	7.01	7.00	6.03	6.00	9.70	10.00
411	8.66	1.12	.63	1.75	1.23	4.45	3.58	.60	8.72	8.00	8.03	7.00	2.20	2.00
[illegible] 415 530	8.80	1.15	.91	2.06	1.64	4.00	3.20	1.18	9.34	9.00	8.16	8.00	3.14	3.00
392	10.62	1.05	.96	2.01	1.64	4.64	4.20	1.89	10.32	10.00	8.93	8.00	3.24	3.00
149 367	9.07	1.92	1.54	3.46	3.29	4.54	4.69	2.51	11.74	10.00	9.23	8.00	7.80	7.00
403	8.51	2.05	1.11	3.16	2.88	2.66	4.58	2.00	9.24	8.00	7.24	6.00	10.00*	10.00
406	8.16	.60	2.87	3.47	3.20	1.28	6.68	2.48	10.44	10.00	7.96	8.00	7.10*	7.00
43	16.11	.93	1.96	2.89	2.46	2.21	3.34	2.71	8.26	6.00	5.55	5.00	3.87	3.00
135	17.00	.85	1.97	2.82	2.46	1.73	3.54	2.35	7.62	6.00	5.27	5.00	3.60	3.00
41	11.02	2.01	1.78	3.79	3.30	2.11	6.26	1.15	9.52	8.00	8.37	7.00	7.46*	6.00
154	13.41	2.07	1.68	3.75	3.30	5.73	2.69	1.74	10.16	8.00	8.42	7.00	7.12*	6.00
50	7.76	1.69	2.23	3.92	3.30	.10	5.86	2.58	8.54	7.00	5.96	5.00	8.18*	7.00
134	6.24	1.58	2.16	3.74	3.30	—	6.27	3.71	9.98	7.00	6.27	5.00	7.98†	7.00
45	15.72	1.19	1.41	2.60	2.05	.33	4.93	2.90	8.16	7.00	5.26	6.00	5.40*	4.50
58 155 165	8.60	2.70	1.74	4.44	4.11	3.01	4.03	2.86	9.90	10.00	7.04	6.00	6.30*	5.00
436	6.04	1.25	1.93	3.18	2.47	1.85	6.51	3.97	12.33	11.00	8.36	7.00	6.24	5.00
172	14.89	1.33	1.68	3.01	2.47	.10	8.12	2.46	10.77	—	8.31	8.00	4.84	4.00
180	12.31	1.72	1.59	3.31	3.29	.19	7.97	2.04	10.20	9.00	8.16	8.00	9.38	7.00
190	10.01	1.83	1.71	3.54	1.65	.06	6.94	3.24	10.24	7.00	7.00	6.00	4.88	6.00

* 403	Chlorine	.63%.	equivalent to	.84%	potash.	9.16%	potash as	sulphate.
406	"	4.89%	"	6.54%	"	.56%	"	"
41	"	4.11%	"	5.51%	"	1.95%	"	"
154	"	3.49%	"	4.66%	"	2.46%	"	"
50	"	.44%	"	.59%	"	7.59%	"	"
45	"	2.72%	"	3.64%	"	1.76%	"	"
58-155-165	"	2.81%	"	3.77%	"	2.53%	"	"

† 134 Potash in form of sulphate.

Fertilizers Furnishing Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
DISSOLVED PHOSPHATES AND POTASH.				
American Agric. Chem. Co., 92 State St., Boston, Mass.				
Packers' Union Wheat, Oats and Clover Fertilizer	Great Barrington	$22.00	$13.46	63.44
Wheeler's Grass and Oats Fertilizer	Danvers	—		
Lister's Agricultural Chemical Works, Newark, N. J.				
Lister's Grain and Grass Fertilizer	Williamstown	25.00	12.83	94.85
WOOD ASHES.				
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Pure Unleached Hard Wood Ashes	Boston	16.00	9.78	63.65
Canada Hard Wood Ashes	Taunton	16.00	6.98	129.23
John Joynt, Lucknow, Ontario, Canada.				
Pure Hard Wood Ashes	Amherst	10.50	8.80	19.31
" " " "	North Hadley	10.50	7.58	38.52
" " " "	Sunderland	12.00	10.58	13.42
" " " "	Lexington	17.00	8.05	111.18
OTHER BRANDS.				
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Bowker's Tobacco Ash Constituents	Southwick	33.00	23.15	42.55
" " " "	South Deerfield	33.00		
F. E. Fogg, Shawmut, Mass.				
Fogg's Fertilizer	Manufac'rs Sample	20.00	6.37	213.97

Fertilizers Furnishing Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
529 } 603 }	15.35	7.16	3.97	2.02	13.15	12.00	11.13	11.00	2.26	2.00
509	10.12	3.07	7.11	2.00	12.18	11.00	10.18	10.00	1.98	2.00
247*	13.97	—	—	—	1.82	1.00	—	—	5.20	4.00
215*	9.50	—	—	—	1.20	1.00	—	—	3.76	4.00
10*	11.42	—	—	—	1.16	1.00	—	—	4.92	4.00
280*	4.64	—	—	—	1.28	1.00	—	—	4.10	4.00
37*	17.30	—	—	—	1.79	1.00	—	—	5.72	6.00
340*	13.71	—	—	—	1.59	1.00	—	—	4.24	4.00
471 } 541 }	8.62	.64	7.11	4.58	12.33	...	7.75	6.00	14.31†	15.00
451	6.48	—	.94	.31	1.25	1.00	.94	—	6.35	6.00

* 247 Calcium oxide 30.40.
215 " " 35.48.
10 " " 39.16.
280 " " 37.88.
37 " " 41.10.
340 " " 35.79.

† Total potash 14.98. Enough soluble sulphates present to unite with all of the potash, only traces of chlorine present.

Fertilizers Manufactured for Private Use. (Not Licensed.)

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works, Baltimore, Md.				
R. T. Prentiss' Special for Potatoes	Granby	$36.00	$31.67	13.67
R. W. Cartter, Springfield, Mass.				
Special Home Mixture	West Springfield	40.00	31.34	27.63
Coe-Mortimer Co., 24-26 Stone St., New York City.				
Cowls' Special No. 1	North Amherst	37.00	31.31	18.17
" " No. 2	North Amherst	35.00	28.27	23.80
" " No. 1	North Amherst	37.00	32.00	15.62
" " No. 2	North Amherst	35.00	29.62	18.16
Mitchell Fertilizer Co., Tremley, N. J.				
Mitchell's Special Fertilizer	Seekonk	38.00	32.42	17.21
Mitchell's Vegetable Fertilizer	Seekonk	35.00	27.57	26.95
Olds & Whipple, Hartford, Conn.				
B. M. Warner's Tobacco Formula	Hatfield	37.00†	29.93	23.62
Prentiss, Brooks & Co., Holyoke, Mass.				
Lime Ashes	Granby	10.00	5.16	93.80
Readsboro Chair M'f'g Co., Readsboro, Vt.				
Wood Ashes	South Deerfield	8.10	6.05	33.88
H. N. Walker, Dighton, Mass.				
Walker's Own Special Mixture	Dighton	—	22.38	—
Wallace Fertilizer Co., 147 Nassau St., New York City.				
Humus Fertilizer No. 1	Arlington	60.00	7.91	658.53
" " No. 2	Arlington	60.00	8.37	616.84
" " No. 3	Arlington	60.00	9.19	552.88
S. D. Woodruff & Sons, Orange, Conn.				
Woodruff's Home Mixture	Mansfield	30.00	27.37	9.61
Worcester Rendering Co., Auburn, Mass.				
Complete Fertilizer	West Auburn	33.25	37.60	11.56*
NITROGEN COMPOUNDS.				
Coe-Mortimer Co., 24-26 Stone St., New York City.				
Nitrate of Potash	Sunderland	88.00	94.56	6.93*
" " "	West Springfield	86.00	90.12	4.57*
Mitchell Fertilizer Co., Tremley, N. J.				
Mitchell's Nitate of Soda	Seekonk	56.00	56.24	.42*

* Valuation in excess of selling price.

† Manufacturer's price.

Fertilizers Manufactured for Private Use. (Not Licensed.)

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen: Organic.	Nitrogen Total: Found.	Nitrogen Total: Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid Total: Found.	Phosphoric Acid Total: Guaranteed.	Phosphoric Acid Available: Found.	Phosphoric Acid Available: Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
493	7.55	2.77	1.72	4.49	3.75	5.88	1.26	.74	7.88	8.00	7.14	6.00	8.78*	10.00
91	.09	2.40	—	2.40	—	—	7.06	4.94	12.00	—	7.06	—	14.40*	—
11	8.72	2.09	2.70	4.79	5.00	4.80	2.39	1.56	8.75	6.00	7.19	—	5.16*	6.00
12	8.57	2.11	1.51	3.62	4.00	5.03	2.47	1.46	8.96	6.00	7.50	—	6.68*	6.00
320	11.11	3.06	1.58	4.64	5.00	3.14	4.07	2.74	9.95	—	7.21	6.00	6.57*	6.00
321	8.17	2.65	1.42	4.07	4.00	3.75	3.36	3.30	10.41	—	7.11	6.00	6.24*	6.00
147	10.47	2.48	1.83	4.31	4.12	5.68	2.66	1.46	9.80	9.00	8.34	8.00	8.34	8.00
186	13.31	1.88	1.51	3.39	3.30	6.05	2.91	.66	9.62	9.00	8.96	8.00	6.46	6.00
127	6.44	2.93	2.87	5.80	—	.32	.36	.18	.86	—	.68	—	5.40*	—
489†	16.91	—	—	—	—	—	—	—	1.02	—	—	—	2.72	—
546†	28.83	—	—	—	—	—	—	—	1.56	—	—	—	3.00	—
202	14.70	1.14	1.22	2.36	—	3.33	1.38	1.15	5.86	—	4.71	—	9.30	—
344	25.18	—	—	‡ 2.08	3.00	—	—	—	1.84	—	—	—	.24	—
330	18.61	—	—	‡ 2.31	2.50	—	—	—	1.62	—	—	—	.16	—
356	27.36	—	—	‡ 2.15	2.50	—	—	—	2.49	.25	—	—	.88	.40
570	15.65	.37	2.88	3.25	—	4.16	5.53	2.00	11.69	—	9.69	—	5.00	—
569	3.95	2.59	2.19	4.78	—	—	10.69	4.12	14.81	—	10.69	—	9.14	—
42	1.04	—	—	13.18	15.00	—	—	—	—	—	—	—	45.80	50.00
81	1.58	—	—	11.75	15.00	—	—	—	—	—	—	—	40.64	50.00
142	1.91	—	—	15.20	15.30	—		—	—	—	—	—	—	—

* 493 Chlorine 4.60% equivalent to 6.16% potash, 2.62% potash as sulphate.
91 " 1.33% " 1.78% " 12.62% " "
11 " 1.09% " 1.46% " 3.70% " "
12 " 1.17% " 1.57% " 5.11% " "
320 " 1.35% " 1.81% " 4.76% " "
321 " 1.69% " 2.26% " 3.98% " "
127 " 1.44% " 1.93% " 4.02% " "

‡ Available Nitrogen { No. 344, .87; No. 330, .97; No. 356, 1.01 } Humus { No. 344, 20.60; No. 330, 24.60; No. 356, 16.00 }

† No. 489 Calcium oxide, 49.27. No. 546 Calcium oxide, 27.60.

Ground Bones, Dissolved Bones, Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chem. Co., 92 State St., Boston.				
Fine Ground Bone	Amherst	$30.00	$26.71	12.31
Fine Ground Bone	New Bedford	30.00	26.29	13.35
" " "	Middleboro	30.00		
" " "	Boston	30.00		
" " "	Newburyport	29.00		
" " "	Framingham	30.00		
Armour Fertilizer Works, Baltimore, Md.				
Armour's Bone Meal	Haverhill	25.00	27.88	4.01
" " "	North Adams	33.00		
Beach Soap Co., Lawrence, Mass.				
Beach's Bone Fertilizer	Manufac'rs Sample	28.00	29.12	3.84*
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.				
Bowker's Fresh Ground Bone	Bridgewater	29.00	23.49	27.71
" " " "	Leominster	28.00		
" " " "	Great Barrington	33.00		
John C. Dow & Co., 13-14 Chatham St., Boston, Mass.				
Dow's Pure Ground Bone	Boston	30.00	26.48	13.29
Essex Fertilizer Co., 39 N. Market St., Boston, Mass.				
Essex Ground Bone	Taunton	30.00	30.93	3.00*
Thomas Hersom & Co., New Bedford, Mass.				
Pure Bone Meal	New Bedford	25.00	28.35	11.81*
Home Soap Co., Worcester, Mass.				
Pure Ground Bone	Worcester	28.00	27.24	2.78
National Fertilizer Co., Bridgeport, Conn				
Chittenden's Fine Ground Bone	Leominster	28.00	27.95	.18
W. W. Rawson & Co., 5 Union St., Boston, Mass.				
Rawson's Fine Ground Bone	Boston	30.00	25.59	17.22
Rogers Manufacturing Co., Rockfall, Conn.				
Pure Knuckle Bone Flour	Amherst	35.00	34.91	.26
Rogers & Hubbard Co., Middletown, Conn.				
Raw Knuckle Bone Flour	Wellesley	39.00	31.43	24.08
M. L. Shoemaker & Co. (Limited), Philadelphia, Pa.				
"Swift-Sure" Bone Meal	Sunderland	33.00	37.20	11.29*
Springfield Rendering Co., Springfield, Mass.				
Ground Steamed Bone	Springfield	25.00	30.05	16.80*
T. L. Stetson, Randolph, Mass.				
Pure Ground Bone	Brockton	35.00	29.29	19.49
" " "	Manufac'rs Sample	35.00		
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.				
Swift's Lowell Ground Bone	Fall River	28.00	28.90	1.39*
" " " "	Lexington	29.00		
Hinckley's Ground Bone	Framingham	30.00	31.46	4.65*
A. L. Warren, Northboro, Mass.				
Warren's Ground Bone	Manufac'rs Sample	27.50	27.24	.95

* Valuation in excess of selling price.

Ground Bones, Dissolved Bones, Tankage and Dry Ground Fish.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Mechanical Analyses.	
		Water Soluble.	Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.		Coarse.	Fine
				Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
51	7.17	—	—	2.69	2.47	—	—	—	24.79	22.30	—	—	52.46	47.54
201, 224, 289, 329, 413	7.86	—	—	2.77	2.47	—	—	—	23.18	22.30	—	—	46.99	53.01
249, 515	3.41	—	—	2.69	2.17	—	—	—	24.23	24.00	—	—	32.50	67.50
224	3.20	—	—	3.53	4.10	—	—	—	21.59	18.00	—	—	32.10	67.90
350, 439, 520	6.10	—	—	2.34	2.47	—	—	—	22.46	18.00	—	—	57.52	42.48
296	3.72	—	—	2.00	2.00	—	—	—	26.46	24.00	—	—	38.50	61.50
217	2.81	—	—	3.09	3.00	—	—	—	25.69	23.25	—	—	26.86	73.14
336	3.73	—	—	2.31	2.29	—	—	—	26.99	28.00	—	—	34.14	65.86
390	5.20	—	—	2.50	2.00	—	—	—	26.89	28.00	—	—	55.71	44.29
578	4.26	—	—	2.66	2.47	—	—	—	24.26	22.30	—	—	30 38	69.62
248	7.49	—	—	2.51	2.47	—	—	—	22.46	22.80	—	—	36.81	63.19
359	8.03	—	—	3.96	3.80	—	—	—	24.72	24.00	—	—	10.45	89.55
572	7.56	—	—	3.49	3.50	—	—	—	25.51	24.50	—	—	36.68	63.32
544	4.10	—	—	5.30	4.12	—	—	—	22.90	20.00	—	—	30.69	69.31
487	3.64	—	—	2.55	2.47	—	—	—	25.71	23.00	—	—	12.27	87.73
354, 408	8.93	—	—	4.25	4.20	—	—	—	22.69	20.66	—	—	68.18	31.82
191, 327	4.35	—	—	2.80	2.47	—	—	—	24.16	23.00	—	—	28.42	71.58
437	3.42	—	—	2.20	2.47	—	—	—	30.32	23.00	—	—	21.25	78.75
323	9.27	—	—	4.60	5.02	—	—	—	19.75	17.46	—	—	82.33	17.67

Ground Bones, Dissolved Bones, Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Whitman & Pratt Rendering Co., Lowell, Mass.				
Pure Ground Bone	Hatfield	$30.00	$30.49	1.62*
" " "	Salem	30.00		
Sanford Winter & Son, Brockton, Mass.				
Winter's Ground Bone	Manufac'rs Sample	—	29.86	—
DISSOLVED BONES.				
W. H. Abbott, Holyoke, Mass.				
Abbott's Animal Fertilizer	Holyoke	27.00	28.96	6.76*
Mapes Formula and Peruvian Guano Co., New York City.				
Mapes' Dissolved Bone	Springfield	35.00	26.88	30.20
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.				
Dissolved Bone	Taunton	26.00	25.39	2.40
TANKAGE.				
Thomas Hersom & Co., New Bedford, Mass.				
Meat and Bone	New Bedford	25.00	29.75	15.96*
Springfield Rendering Co., Springfield, Mass.				
Ground Tankage	Springfield	27.50	31.05	11.43*
Swift's Lowell Fertilizer Co., Lowell, Mass.				
Ground Tankage	Springfield	38.00†	34.89	8.91
J. M. Woodard & Bro., Greenfield, Mass.				
Unground Tankage	Greenfield	20.00	28.46	29.73*
Worcester Rendering Co., Auburn, Mass.				
Ground Tankage	Auburn	27.00	34.16	20.96*
DRY GROUND FISH.				
American Agric. Chem. Co., 92 State St., Boston.				
Dry Ground Fish	Bradstreet	39.00	41.49	6.00*
" " "	North Hadley	39.00	40.84	4.50*
" " "	Hatfield	39.00		
Berkshire Fertilizer Co., Bridgeport, Conn.				
Dry Ground Fish	Sunderland	40.00	38.41	4.14
National Fertilizer Co., Bridgeport, Conn.				
Chittenden's Dry Ground Fish	Bradstreet	—	41.88	—
" " " "	Sunderland	40.00	41.85	4.42*
" " " "	Bradstreet	38.00‡	41.46	8.34*
Olds & Whipple, Hartford, Conn.				
Dry Ground Fish	North Hadley	38.00	38.75	1.93*
Sanderson Fert. and Chem. Co., New Haven, Conn.				
Sanderson's Dry Ground Fish	Bradstreet	40.00	39.35	1.65
" " " "	Whately	38.00	42.22	10.00*
" " " "	Sunderland	38.00	38.60	1.55*
Wilcox Fertilizer Works, Mystic, Conn.				
Dry Ground Fish	Amherst	40.00	42.06	4.90*

* Valuation in excess of selling price.
† Manufacturer's price (for spot cash) in ton lots.
‡ Manufacturer's wholesale price for large shipment.

Ground Bones, Dissolved Bones, Tankage and Dry Ground Fish.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Mechanical Analyses. Coarse.	Mechanical Analyses. Fine.
112 / 348	2.88	—	—	2.22	2.47	—	—	—	29.09	25.00	—	—	22.67	77.33
407	8.51	—	—	3.22	3.00	—	—	—	25.00	25.00	—	—	39.15	60.85
496	10.35	1.72	2.30	4.02	3.00	1.73	10.10	5.88	17.71	15.00	11.83	12.00	—	—
497	6.07	1.38	1.57	2.95	2.06	3.52	11.63	1.97	17.12	—	15.15	12.00	—	—
162	9.28	1.34	1.26	2.60	1.04	6.65	7.57	3.18	17.40	14.00	14.22	12.00	—	—
345	5.27	—	—	5.02	4.66	—	—	—	18.00	16.34	—	—	61.77	38.23
485	5.91	—	—	6.63	6.00	—	—	—	13.30	13.00	—	—	68.02	31.98
39	6.51	—	—	7.19	6.00	—	—	—	13.28	13.00	—	—	49.39	50.61
457	11.87	—	—	5.51	4.60	—	—	—	17.42	20.00	—	—	84.56	15.44
401	4.45	—	—	5.09	4.11	—	—	—	15.15	16.00	—	—	26.16	73.84
60	8.50	—	—	8.79	8.23	.81	4.69	1.05	6.55	7.00	5.50	—	—	—
283 / 602	8.55	—	—	8.36	8.23	1.06	2.86	2.20	6.12	7.00	3.92	—	—	—
3	12.66	—	—	7.09	7.41	.81	3.44	4.35	8.60	8.00	4.25	—	—	—
1	7.71	—	—	8.75	8.23	2.00	3.33	2.50	7.83	6.00	5.33	—	—	—
55	7.57	—	—	8.77	8.24	.64	4.45	3.10	8.19	6.00	5.09	—	—	—
115	11.08	—	—	8.90	8.24	1.87	2.71	1.64	6.22	6.00	4.58	—	—	—
204	9.47	—	—	6.91	6.59	1.00	7.26	7.22	15.48	12.00	8.26	—	—	—
73	9.59	—	—	8.21	8.24	.87	3.25	4.73	8.85	6.00	4.12	—	—	—
120	9.61	—	—	8.74	8.24	1.34	4.47	2.58	8.39	6.00	5.81	—	—	—
547	9.80	—	—	7.96	8.23	1.10	3.86	3.48	8.44	6.00	4.96	—	—	—
44	8.88	—	—	9.05	8.50	.93	3.15	2.94	7.62	6.00	4.08	—	—	—

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble	Organic.	Guaranteed.
Nitrate of Soda.									
Amer. Agric. Chem. Co., 92 State St., Boston.	Boston	$60.00	$58.20	3.09	286	2.01	15.73	—	15.00
Armour Fertilizer Co., Baltimore, Md. . . .	New Bedford .	$58.00	57.72	.48	158	1.90	15.60	—	15.60
Bowker Fertilizer Co., Boston, Mass.	Boston	60.00	58.20	3.09	263	2.25	15.73	—	15.00
" " " " " . . .	Leominster . .	60.00			449				
Coe-Mortimer Co., 24-26 Stone St., N. Y. City	West Spring'd	55.00	58.90	*6.62	86	1.71	15.92	—	15.00
Essex Fertilizer Co., 39 N. Market St., Boston	Taunton . . .	62.00	58.09	1.56	192	1.76	15.70	—	15.67
" " " " "	Dighton . . .	56.00			106				
National Fertilizer Co., Bridgeport, Conn. .	Bradstreet .	60.00†	56.46	6.27	4	1.67	15.26	—	15.00
" " " " " .	Bradstreet . .	60.00	57.72	3.95	124	1.78	15.60	—	15.00
Swift's Lowell Fertilizer Co., Boston, Mass. .	Springfield . .	56.00	57.28	.66	96	1.37	15.48	—	14.80
" " " " " " .	Taunton . . .	†59.00			149				
" " " " " " .	Concord . . .	58.00			308				
Wilcox Fertilizer Works, Mystic, Conn.	Seekonk . . .	60.00	58.53	2.51	181	1.95	15.82	—	15.00
Dried Blood.									
Swift's Lowell Fertilizer Co., Boston, Mass. .	Springfield . .	45.00	48.97	*8.80	95	10.54	—	‡10.91	9.83
" " " " " " .	Taunton . . .	44.00			216				
" " " " " " .	Concord . . .	45.00			310				
Cottonseed Meal.									
American Cotton Oil Co., Greenville, Miss. .	Hatfield . . .	28.00	26.77	8.33	129	7.45	—	6.53	6.50
" " " " " .	Bradstreet . .	29.50	26.94	9.50	131	7.39	—	6.57	6.50
F. W. Brode & Co., Memphis, Tenn.	North Hadley	29.00	26.77	8.33	103	6.27	—	6.53	6.50
Humphreys, Godwin & Co., Memphis, Tenn. .	Hadley	35.00	35.01	*.02	6	7.26	—	‡7.87	6.50
" " " " " .	North Hadley	29.00	27.47	5.56	106	6.67	—	6.70	6.50
" " " " " .	Hatfield . . .	35.00	33.83	3.45	125	6.89	—	8.25	6.50
" " " " " .	Bradstreet . .	29.00	27.27	6.34	130	8.17	—	6.65	6.50
" " " " " .	Whately . . .	35.00	33.17	5.52	132	6.66	—	8.09	6.50
" " " " " .	Bradstreet . .	35.00	33.21	5.38	133	6.42	—	8.10	6.50
" " " " " .	Southwick . .	29.75	24.03	23.80	461	8.51	—	c 5.86	6.50
Hunter Bros. Milling Co., St. Louis, Mo. . .	Sunderland . .	30.00	29.50	1.69	61	8.60	—	7.19	6.50
Linseed Meal (Flax Meal).									
American Linseed Co., Chicago, Ill.	Hatfield . . .	31.40	24.15	30.02	108	7.68	—	5.89	5.76
Castor Pomace.									
H. J. Baker & Bro., New York City.	M'f'rs Sample	24.00	20.62	16.30	551	6.83	—	5.03	4.75
Olds & Whipple, Hartford, Conn. (a)	Hatfield . . .	24.00	23.90	.41	110	7.41	—	5.83	5.00
" " " (a)	Whately . . .	24.00	20.09	14.35	122	8.40	—	5.12	5.00
" " " (b)	M'f'rs Sample	24.00	22.14	8.40	549	7.11	—	5.40	5.00

* Valuation in excess of selling price.
† Manufacturer's price in ton lots for spot cash.
‡ 95 Total phosphoric acid, 5.30 per cent.
  6 " " " 1.97 "
  potash 1.16
(a) Castor pomace.
(b) Grey pomace.
(c) Deficiency paid in full by manufacturer.

NOTE. Cottonseed meal contains from 2 to 3 per cent of phosphoric acid and from 1.5 to 2.5 per cent of potash: of which about 1.25 per cent is water soluble.

Linseed meal contains on the average 1.47 per cent of phosphoric acid and 1.52 per cent potash.

Castor pomace contains on the average 2.12 per cent of phosphoric acid and 1.20 per cent potash.

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
High Grade Sulphate of Potash.								
Amer. Agric. Chem. Co., 92 State St., Boston.	Amherst	$52.00	$51.36	1.24	39	.95	51.36	48.67
" " " " " "	Boston	54.00	49.52	9.04	302	1.35	49.52	48.67
Bowker Fert. Co., 43 Chatham St., Boston	Amherst	54.00	50.56	6.80	558	1.38	50.56	48.00
Buffalo Fertilizer Co., Buffalo, N. Y.	Springfield	48.00	49.12	2.28*	100	1.54	49.12	50.00
Coe-Mortimer Co., 24-26 Stone St., N. Y. City	Sunderland	47.00†	51.92	9.47*	54	.52	51.92	48.00
" " " "	West Springfield	46.00	50.80	9.44*	84	.54	50.80	50.00
National Fertilizer Co., Bridgeport, Conn.	Bradstreet	47.50‡	40.20	3.45*	117	1.37	49.20	48.00
Swift's Lowell Fertilizer Co., Boston.	Fitchburg	50.00	49.72	.56	368	.07	49.72	48.00
Sulphate of Potash-Magnesia.								
National Fertilizer Co., Bridgeport, Conn.	Sunderland	29.00	21.12	37.31	557	6.58	24.85	26.00
Sanderson Fert. and Chem. Co., New Haven.	Bradstreet	30.00	26.80	11.94	75	1.26	26.80	25.00
Muriate of Potash.								
Amer. Agric. Chem. Co., Boston	Charlemont	43.00	41.58	3.41	584	2.87	48.92	50.00
Armour Fertilizer Works, Baltimore, Md.	Fall River	47.50	42.94	10.62	188	.38	50.52	50.00
Bowker Fertilizer Co., Boston	Leominster	45.00	39.20	14.80	423	2.48	46.12	48.00
Buffalo Fertilizer Co., Buffalo, N. Y.	East Longmeadow	43.00	39.20	9.70	472	.13	46.12	50.00
" " " "	Granby	44.00	43.21	1.82	501	.12	50.84	50.00
Coe-Mortimer Co., 24-26 Stone St., N. Y. City " " " "	Hadley Sunderland	42.00 43.60	44.07	2.88*	24 63	1.04	51.85	50.00
National Fertilizer Co., Bridgeport, Conn.	South Deerfield	46.00	42.52	8.18	59	1.18	50.02	50.56
Sanderson Fert. and Chem. Co., New Haven.	Ringville	45.00	42.88	4.94	612	1.42	50.44	50.00
Swift's Lowell Fertilizer Co., Boston " " " " "	Taunton Fitchburg	45.00 44.00	42.57	4.54	163 369	1.72	50.08	50.00
" " " " "	Concord	45.00	42.06	6.99	307	.23	49.48	50.00
Carbonate of Potash.								
National Fertilizer Co., Bridgeport, Conn.	Bradstreet	98.00	102.69	4.57*	3	—	04.18	05.00
Olds & Whipple, Hartford, Conn. (Veg. Pot.)	M'f'rs Sample	44.00	38.08	15.54	550	1.24	24.56§	25.00
Kainit.								
Amer. Agric. Chem. Co., Boston	Framingham	16.00	14.47	10.57	414	3.80	16.91	12.00
Parmenter & Polsey Fert. Co., Peabody, Mass.	East Longmeadow	14.50	11.00	31.81	477	1.85	12.94	12.00

* Valuation in excess of selling price.

† f. o. b. Boston.

‡ Manufacturer's wholesale price. Ton lots for spot cash $52.00.
Manufacturer's cash price per ton in ton lots.

§ 2.03% as sulphate, 22.53% as carbonate. Total potash 30.40. The material also contained 24.34% lime.

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Phosphoric Acid in 100 lbs. Moisture.	Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.
Dissolved Bone Black.													
American Agric. Chem. Co., 92 State St., Boston, Mass.	Bradstreet	$24.00	$16.16	48.51	70	13.09	14.11	1.70	.13	15.94	16.00	15.81	15.00
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Raynham	24.00	11.74	104.43	571	5.85	.38	10.50	4.78	15.66	16.00	10.88	15.00
National Fertilizer Co., Bridgeport, Conn.	Bradstreet	24.00‡	15.96	50.40	2	14.60	14.79	.93	.83	16.55	—	15.72	16.00
National Fertilizer Co., Bridgeport, Conn.	Bradstreet	20.00‖	14.45	38.40	126	9.14	13.62	.81	.26	14.69	—	14.43	16.00
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.	Springfield	21.50	16.74	28.43	98	9.42	13.60	2.36	2.54	18.50	—	15.96	15.00
Superphosphates (Acid Phosphates).													
American Agric. Chem. Co., 92 State St., Boston, Mass.	Springfield	16.00	13.67	17.04	90	10.64	8.64	4.59	2.25	15.48	—	13.23	12.00
Armour Fertilizer Works, Baltimore, Md.	New Bedford	15.00	14.17	5.86	204	11.05	12.32	1.75	.67	14.74	14.00	14.07	—
Bowker Fertilizer Co., Boston, Mass.	Amherst	22.00	15.51	41.84	560	7.86	11.17	4.28	1.23	16.68	15.00	15.45	14.00
Olds & Whipple, Hartford, Conn.	North Amherst	27.00	25.29	6.76	16	8.34	4.16	22.82	1.48	28.46	—	26.98	27.00
Parmenter & Polsey Fertilizer Co., Peabody, Mass.	East Longmeadow	16.00	13.97	14.53	474	11.82	8.89	4.59	2.38	15.86	12.00	13.48	12.00
Swift's Lowell Fertilizer Co., 40 N. Market St., Boston.	Springfield	15.00	12.34	21.55	101	10.46	8.80	2.96	2.20	13.96	14.00	11.76	12.00
" " " " " "	Fitchburg	16.00	13.50	18.51	396	9.28	8.76	4.42	1.89	15.07	14.00	13.18	12.00
Basic Slag Phosphate.													
Coe-Mortimer Co., 24-26 Stone St., New York City. " " " "	Hadley Sunderland	15.00 15.00	†13.13	16.14	23 31	—	—	15.38	2.07	17.45	17.00	†15.38	*15.00
" " " " " " " "	West Springfield Worcester	15.05 —	†13.42	11.77	85 383	—	—	15.59	2.37	17.96	17.00	†15.59	*15.00

* Guarantee based on Wagner's method of analysis.

† Valuation based upon availability of phosphoric acid as determined by Wagner's method of analysis, which shows the phosphoric acid dissolved by a 2 per cent citric acid solution. The available phosphoric acid is valued at 4 cents and the insoluble at 2 cents per pound.

‡ Manufacturer's price for spot cash in ton lots.

‖ Manufacturer's price for 15 to 20 ton lots, spot cash.

BULLETIN No. 128. JANUARY 1909.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

INSPECTION OF

Commercial Feed Stuffs.

BY

P. H. SMITH and P. V. GOLDSMITH.

This bulletin contains the analyses of commercial feed stuffs found in the Massachusetts markets during the year 1908 together with such comments as are called for by the results of the inspection. Topics of especial importance are grain screenings in feed stuffs, and complete rations for dairy stock. In addition will be found a tabulated list of the wholesale cost of feeding stuffs for the year.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

CHARLES A. GOESSMANN, PH.D., LL.D.	*Honorary Director and Consulting Chemical Expert.*
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
JOSEPH B. LINDSEY, PH. D.,	*Chemist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. S.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
EDWARD B. HOLLAND, M. S.,	*Associate Chemist* (Research Div.).
HENRI D. HASKINS, B. SC.,	*Chemist in Charge* (Fertilizer Div.).
PHILIP H. SMITH, B. SC.,	*Chemist in Charge* (Feed and Dairy Div.).
FRED C. SEARS, M. SC.	*Pomologist.*
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist.*
ROBERT D. MACLAURIN, PH. D.,	*Research Chemist.*
LEWELL S. WALKER, B. SC.,	*Assistant Chemist.*
GEORGE H. CHAPMAN, B. SC.,	*Assistant Botanist.*
PHILIP V. GOLDSMITH, B. SC.	*Assistant Chemist.*
JAMES C. REED, B. SC.	*Assistant Chemist.*
J. K. SHAW, M. SC.,	*Assistant Horticulturist.*
JOHN N. SUMMERS, B. SC.,	*Assistant in Entomology.*
F. A. JOHNSON, B. SC.,	*Assistant in Entomology.*
WILLIAM K. HEPBURN,	*Inspector.*
ROY F. GASKILL,	*Assistant in Animal Nutrition.*
R. C. LINDBLAD,	*Observer.*

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

Department of Plant and Animal Chemistry

J. B. LINDSEY, Chemist.

Inspection of Commercial Feed Stuffs

By P. H. SMITH* and P. V. GOLDSMITH.

CONTENTS

INTRODUCTION.

Purpose of Feed Law.

The purpose of the Massachusetts feed law (Acts and Resolves of Massachusetts for 1903, Chapter 122) is to so regulate the sale of commercial feed stuffs that both the manufacturer and consumer may be protected from misrepresentation and fraud. With this object in view every lot or parcel sold, offered or exposed for

* The writer wishes to acknowledge the valuable suggestions made by Dr. Lindsey, the assistance of Mr. L. S. Walker in making many fiber determinations, and of Mr. G. H. Chapman, assistant botanist, for the microscopical work performed.

sale in this state must have affixed in a conspicuous place the following statement: *

Name of feed stuff,
Name of manufacturer,
Address of manufacturer,
Net weight of package,
Guaranteed percentage of protein,
Guaranteed percentage of fat.

In case of adulteration the true composition of the mixture must be plainly marked upon the package. In case foreign material is added to standard grains or by-products, the mixture must bear a distinctive name or brand, and the true character of the admixture must be stated upon the label.

How a feed stuff is examined.

As a guarantee of protein and fat are required by law these determinations are, with but few exceptions, made upon all feed stuffs collected. The protein guarantee is required because protein is the most valuable component and the one most necessary to supplement the home grown coarse fodders and cereals. The fat guarantee is required since it serves to a certain extent as an index of the quality of a feed. A fiber determination is often of great value in detecting adulteration with oat hulls, ground corn cobs and other low grade material. A fiber guarantee would be desirable and is required in many states.

The microscope is used to detect adulteration and also to determine the ingredients used in making up a compounded feed. Microscopic observations are also valuable in corroborating the evidence obtained by chemical analysis. Ash determinations are made on poultry feeds, first because a high ash content in a mash or scratch grain indicates an excessive amount of added grit, and second, because in case of beef scraps and meat and bone meals the ash content is indicative of the amount of bone incorporated, or contained in the product.

*Hays and straws, the whole seeds or the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn, wheat bran, wheat middlings, wheat mixed feed, and the pure grains ground together and unmixed with other substances are exempt from the provisions of this Act.

Inspector's Duties. The duty of the inspector is to visit the places where feeds are on sale, see that the requirements of the law are observed and to take samples of the different brands and forward the same to the laboratory for examination.

How samples are taken. The samples are drawn by means of a sampling tube which removes a core from the entire length of the sack. The number of sacks sampled depends upon the amount in stock. A sample in order to be considered representative should be drawn from at least 10 bags. The portions removed from the several sacks are thoroughly mixed and a part of this mixture or composite placed in a bottle and sent to the experiment station. A blank form, a copy of which is reproduced below, is filled out and attached to each sample collected.

Massachusetts Agricultural Experiment Station

AMHERST, MASS.

Brand ____________________

Mfd. by ____________________

Guar.: Protein __________ *Fat* __________

Coll. of ____________________

Net Weight __________ *Ton Price* __________

Collector __________ *Date* __________

Sax in stock __________ *Sax sampled* __________

Witness ____________________

Work of the Present Year. During the past year 895 samples of feed stuffs have been collected, 489 of which are reported in this bulletin. It not being possible to issue more than one feed bulletin annually, the analyses of those feeds collected early in the year with the exception of cottonseed meals were reported to manufacturers only, with such comments and suggestions as the results warranted. In case it is not possible to publish the results of the examination of inferior feed stuffs in the regular bulletins, the public will be fully informed of conditions by circulars, newspaper articles and by correspondence.

Observance of the Law. The comparatively few violations of the feed law observed were largely technical. Practically all of the jobbers and manufacturers either ship their goods with guarantee attached to packages, or in the case of bulk shipments furnish tags and statements covering the law. As hitherto, the trouble is largely with the retailers who neglect to attach tags furnished or who are ignorant of the legal requirements. Both are inexcusable as this statute has been in force since 1903—an amply sufficient time for all interested parties to become acquainted with its requirements. In several instances during the past season the station has put violations of the law into its attorney's hands for prosecution but in each case the matter has been satisfactorily adjusted out of court.

Concerning Bulk Sales. A number of notices have been served where dealers have purchased in bulk and put the feed up in their own sacks. The station rules "that for sales in bulk the retailer must have plainly printed cards stating brand, name and address of manufacturer and guarantee of protein and fat tacked upon a conspicuous place on or near the bin in which the feed is stored. *If the retailer bags the feed in his own sacks and so offers the same for sale, tags must be attached as in the case of other feeds.* So far as is known jobbers and manufacturers willingly furnish the dealer with tags covering the requirements of the law.

High Prices. On account of the prevailing high prices for all concentrates it is important for the consumer to purchase intelligently in order to secure the maximum return for money expended. While it is true that oat hulls, screenings, and ground corn cobs have some food value it is also true that as a general rule the compounded feeds with which they are incorporated sell for as high a price as the better grades of concentrates. The use of such low grade material is inadvisable unless its selling-price is commensurate with its food value. It is not intended to check or prohibit the sale of low grade material, since it is becoming more and more necessary to utilize all by-products having any substantial food value, but as long as true relative values are not maintained the station will continue to advocate the use of such feeds as it considers most satisfactory and economical.

STANDARDS FOR CATTLE AND POULTRY FOODS.

A standard for comparison is always necessary in passing judgment on the composition of concentrated feeds. The percentages of protein, fat and fiber **serve as an index** of their character in the majority of cases. To be of **standard quality,** the various concentrates should be free from foreign material, mould and rancidity, in good mechanical condition, and maintain the following percentages of protein, fat and fiber :*

	Feed Stuff.	Protein.	Fat.	Fiber.
Protein Feeds.	*Blood Meal*	*85*	*0.2*	—
	Cottonseed meal (high grade)	*41-46*	*8-10*	7
	Cottonseed meal (medium grade)	*36-41*	*7-9*	*8*
	Cottonseed meal (low grade)	*24*	*5-6*	*18*
	N. P. linseed meal	*38*	*2*	*9*
	O. P. linseed meal	*32*	6	*9*
	Gluten feed	*25*	*3*	*7.5*
	Distillers' dried grains (corn)	*32*	*10*	*12*
	Malt sprouts	*25*	*1*	*12.5*
	Brewers' dried grains	*22*	*5*	*12*
	Wheat middlings (flour)	*18-20*	*5*	*3.5*
	Wheat middlings (standard)	*17-19*	*5*	7
	Wheat mixed feed	*16-18*	*4.5*	*8.5*
	Wheat bran	*15-17*	*4.5*	*10*
	Oat middlings	*17*	*7*	*2.5*
	Rye feed	*15*	*3*	*4*
Starchy (Carbohydrate) Feeds.	*Ground oats,*	*11*	*4*	*10*
	Ground wheat	*11*	*2*	*3*
	Barley meal	*11*	*1.5*	*6*
	Rye meal	*10*	*1.5*	*2*
	Corn meal	*9*	*3*	*2*
	Hominy meal	*10*	*7.5*	*4.5*
	Provender	*10*	*3.5*	*6*
	Corn and oat feed	*8-10*	*3-5*	—
	Fortified oat feed	*12-14*	*3-5*	—
	Oat feed	*5-8*	*2*	*20-26*
	Corn bran	*9*	*5*	*10*
	Dried beet-pulp	*8*	*0.3*	*18*
Poultry Feeds.	*Meat scraps*	*50*	*15*	—
	Meat and bone meal	*40*	*10*	—
	Bone meal	*25*	—	—
	Poultry mash and meal	*15*	*4.5*	—
	Chick and scratching grains	*10*	*3*	—
	Alfalfa meal, entire plant	*14*	*1.5*	*25*
	Clover meal, entire plant	*12*	*2*	*25*

*Fiber is the least valuable of the several constituents: the above standards for fiber represent the maximum percentage which the feed should contain to be of standard quality.

CHEMICAL ANALYSES OF FEED STUFFS.

(Autumn Collection, 1908.)

1. Protein Feeds.

COTTONSEED MEAL. (Winter and Spring Collection.)

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.
		Found.	Guar.	Found.	Guar.	
		%	%	%	%	%
High Grade.						
American Cotton Oil Co., N. Y. City.						
Choice, ... W. N. Potter's Sons Co	Hadley	42.69	41.00	—	9.00	—
Choice, ... Taunton Grain Co.....	Taunton	41.59	41.00	—	9.00	—
Choice, ... August Beck	Fitchburg	42.42	41.00	—	9.00	—
Choice, ... C. S. Barber	Bernardston ...	46.29	41.00	—	9.00	—
H. E. Bridges & Co., Memphis, Tenn.						
Geo. P. Atkinson	Reading	41.24	41.00	—	9.00	—
J. Cushing & Co.......	Hudson	43.00	41.00	—	9.00	—
P. W. Eaton & Co.....	Williamstown .	44.98	41.00	—	9.00	—
F. W. Brode & Co., Memphis, Tenn.						
Dove, ... Dennison Plummer Co.	New Bedford ..	41.07	38-41	—	7-9	—
Owl, ... Eastern Grain Co.....	Bridgewater ...	47.03	41-43	—	7-9	—
Owl, ... Lummus & Parker....	Danversport ..	41.15	41-43	—	7-9	—
Owl, ... Haverhill Milling Co..	Haverhill......	41.51	41-43	—	7-9	—
Owl, ... Morse Bros...........	Southbridge ..	42.73	41-43	—	7-9	—
Owl, ... Cutler Co.............	N. Wilbraham.	41.64	41-43	—	7-9	—
Humphreys, Godwin & Co., Memphis, Tenn						
Dixie, ... Warner Bros..........	Sunderland ...	42.07	41.00	—	9.00	—
Hunter Bros. Milling Co., St. Louis, Mo.						
Prime, ... Warner Bros..........	Sunderland ...	45.45	41.00	—	9.00	—
Prime, ... J. B. Garland & Son..	Worcester	44.98	41.00	—	9.00	—
Prime, ... G. M. Stratton........	Montague	44.89	41.00	—	9.00	—
McCaw Mfg. Co., Macon, Ga.						
Prime, ... J. W. Doon & Son....	Natick	42.51	41.00	—	9.00	—
Prime, ... G. M. Foster	Lowell	42.55	41.00	—	9.00	—
Prime, ... W. K. Gilmore & Sons	Wrentham	41.73	41.00	—	9.00	—
J. Lindsay Wells Co., Memphis, Tenn.						
Star, ... Mackenzie & Winslow	Fall River	42.96	41.00	—	9.00	—
Star, ... Butman & Cressey....	Lynn..........	42.38	41.00	—	9.00	—
Star, ... Mitchell & Sawyer....	Sterling	43.75	41.00	—	9.00	—
Average.............	....	43.07	—	—	—	—
Medium Grade.						
F. W. Brode & Co., Memphis, Tenn.						
Owl, ... A. H. Wood & Co.....	Framingham ..	39.62	41-43	—	7-9	—
Owl, ... J. B. Bridges & Co....	South Deerfield	37.64	38-41	—	7-9	—

COTTONSEED MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.
		Found.	Guar.	Found.	Guar.	
		%	%	%	%	%
Humphreys, Godwin & Co., Memphis, Tenn						
Dixie, ... J. F. Ray	Franklin	39.75	41.00	—	9.00	—
S. D. Viets Co., Springfield, Mass.						
W. J. Meek	Fall River	39.27	40-43	—	9.00	—
J. Lindsey Wells Co., Memphis, Tenn.						
Sun, ... A. E. Lawrence & Son	Ayer	40.59	41.00	—	9.00	—
Average	....	39.37	—	—	—	—
Low Grade.						
J. Bibby & Son, Liverpool, England.						
Cottonseed Cake, . Geo. B. Pope & Co....	Waltham	26.63	23.00	—	4 00	—

COTTONSEED MEAL. (Autumn Collection.)

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber.
High Grade.						
J. B. Garland & Son, Worcester.						
Golden Eagle, ... S. B. Boutell & Son...	Shrewsbury ...	41.03	41.00	9.84	9.00	—
Humphreys, Godwin & Co., Memphis, Tenn						
Dixie, ... J. O. Ellison & Co.....	Haverhill......	42.78	41.00	8.80	9 00	—
Dixie .... Warner Bros	Sunderland ...	41 64	41.00	7.77	8.00	—
Dixie, ... Bliss & Co.	Taunton.......	44.93	43.00	10.28	9.00	—
Hunter Bros. Milling Co., St. Louis, Mo.						
Spring'd Flour & Grain Co.	Springfield	42.29	41.00	9.08	7.50	—
W. B. Johnson & Co., Memphis, Tenn.						
E. O. Parker	Stoughton	41.33	41.00	8.89	9.00	—
J. E. Soper & Co., Boston.						
E. A. Briggs Co.......	Attleboro	44.45	41.00	9.41	8.00	—
J. F. Walker, Memphis, Tenn.						
Purity, ... Mackenzie & Winslow	Fall River	46.07	41.00	10.12	9 00	—
Average	....	43.07	—	9.27	—	—
Medium Grade.						
Buckeye Cotton Oil Co., Greenwood, Miss						
Bedford Coal & Grain Co.	Bedford	37.95	41.00	8 98	—	—
T. H. Bunch, Little Rock, Ark.						
Old Gold, ... F. E. Smith	Amherst	40.72	41.00	8.73	9.00	—

COTTONSEED MEAL—(Continued.)

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Humphreys, Godwin & Co., Memphis, Tenn						
Dixie,............R. D. Bowen	Leominster	38.70	41.00	8.50	9.00	—
Dixie,...........Conant & Co..........	Littleton	40.41	41.00	8.25	9.00	—
Hunter Bros. Milling Co., St. Louis, Mo.						
J. Wadsworth & Co. ..	Northboro.....	37.25	38.50	7.59	8.00	—
Average.............	....	39.01	—	8.41	—	—
Low Grade.						
J. Bibby & Son, Liverpool, England.						
Cottonseed Cake, .G. B. Pope & Co......	Waltham	25.06	23.00	5.15	4.00	—
Oil Cake Feed, ...J. Loring & Co........	Watertown	18.42	18.20	7.43	6.80	—

LINSEED MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
1. New Process.						
American Linseed Co., Chicago.						
Cleveland Flax,...Ropes Bros...........	Danvers	35.45	36-40	3.26	1-3	—
C. P. Washburn	Middleboro....	34.31	36-40	2.79	1-3	—
J. B. Garland & Son ..	Worcester	34.10	36-40	3.79	1-3	—
Average.............	....	34.62	—	3.28	—	—
2. Old Process.						
American Linseed Co., New York.						
Mackenzie & Winslow	Fall River	35.36	32-36	7.84	5-7	—
Cutler Co.	N.Wilbraham..	36.68	32-36	6.00	5-7	—
Archer-Daniels Linseed Co., Minneapolis						
Weld & Beck.	Southbridge ...	34.19	32.00	6.60	6.00	—
Kellogg & Miller, Amsterdam, N. Y.						
W. N. Potter & Co....	Charlemont....	34.57	36.70	6.40	7.83	—
Metzger Seed & Oil Co., Toledo, Ohio.						
J. F. Ray	Franklin	34.14	30-36	6.82	5-7	—
Average.............	....	34.99	—	6.73	—	—

FLAX FEED.

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein.		Fat.		Fiber.
		Found.	Guar.	Found.	Guar.	
		%	%	%	%	%
H. Jennings, Boston.						
H. J., ...Malden Grain Co.	Malden	16.19	17.34	12.36	17.37	—
New Occidental Milling Co., Minneapolis						
Superior, ...W. F. Filmore........	Palmer........	15.67	16.00	10.07	14.00	—

GLUTEN FEED.

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein Found.	Protein Guar.	Fat Found.	Fat Guar.	Fiber.
American Maize Products Co., New York						
Cream of Corn, ..G. B. Brown	Ipswich	25.62	23-26	2.38	2.50	—
Cream of Corn, ..J. W. Doon & Co.	Natick	24.70	23-25	2.82	2.50	—
Corn Products Mfg. Co., Chicago.						
Buffalo, ...T. A. Holt Co.........	Andover	25.27	23-25	2.94	2.50	—
Buffalo, ...W. E. Bryant & Co....	Brockton	27.34	23-25	2.61	2.50	—
Buffalo, ...G. F. Green Coal Co..	Campello	25.41	23-25	1.63	2.50	—
Buffalo, ...Haverhill Milling Co..	Haverhill	25.45	23-25	2.87	2.50	—
Buffalo, ...H. K. Webster & Co..	Lawrence	25.76	25.00	3.67	3.50	—
Buffalo, ...S. L. Davenport & Son	N. Grafton	25.41	23-25	2.16	2.50	—
Buffalo, ...Curley Bros...........	Wakefield	25.85	23-25	3.17	2.50	—
Buffalo, ...W. K. Gilmore & Sons	Walpole	27.56	23-25	2.06	2.50	—
Buffalo, ...D. F. Howard	Ware	22.95	23-25	2.45	2.50	—
Buffalo, ...A. S. Gurney & Co....	Wareham	24.97	23-25	2.81	2.50	—
Buffalo, ...Prentiss, Brooks & Co.	Westfield......	24.53	23-25	3.52	2.50	—
Average.............	....	25.50	—	2.72	—	—
Pekin,............Hathaway&Mackenzie	New Bedford..	26.06	24.00	2.76	2.50	—
Pekin.............J. S. Wolfe Co.	Pittsfield	25.89	24.00	2.25	2.50	—
Pekin.............Taunton Teaming Co.	Taunton.......	25.36	24.00	3.13	2.50	—
Average.............	....	25.77	—	2.71	—	—
Corn Products Mfg. Co., New York City						
Diamond, ...F. E. Smith	Amherst	25.24	23-25	3.32	2.50	—
Diamond, ...A. Dodge & Son......	Beverly	25.45	23-25	2.85	2.50	—
Globe,............Potter & Co.	Athol	26.72	26.00	2.62	2.50	—
Globe,............W. N. Potter Grain Co	Gardner	25.85	26.00	3.42	2.50	—
G. M. Foster	Lowell	24.97	23-25	2.95	2.50	—
St. Louis Syrup & Pres. Co., St. Louis.						
A. J. Richards & Son .	Quincy	23.65	25.00	3.40	2.75	—
Highest	....	27.56	—	3.67	—	—
Lowest..............	....	22.95	—	1.63	—	—
Average.............	....	25.46	—	2.86	—	—
Second Grade (below 23% protein.						
Corn Products Mfg. Co., Chicago.						
Buffalo...........Ropes Bros...........	Salem	22.16	23-25	2.08	3.50	—

GLUTEN FEED—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found	Fat. Guar.	Fiber
		%	%	%	%	%
Douglas & Co., Cedar Rapids, Mich.						
Cedar Rapids, ...J. Franks............	New Bedford..	19.88	24.00	3.86	4.00	—
J. C. Hubinger Bros. Co., Keokuk, Iowa						
J. W. Raymond	Concord	21.41	23.50	2.18	2.60	—
C. P. Washburn	Middleboro ...	22.33	23.50	2.67	2.60	—
Meech & Stoddard, Middletown, Conn.						
A. Altman...........	New Bedford..	19.97	23.00	4.86	4.00	—
Piel Bros. Starch Co., Indianapolis, Ind.						
Lexington Grain Co...	Lexington	20.05	22.50	2.16	3.50	—
J. E. Soper & Co., Boston.						
Bay State,........T. E. Borden.........	N. Westport...	20.89	23.00	3 21	4.00	—
Western Glucose Co., Chicago.						
Western, ...O. F. Metcalf & Sons..	Franklin	21.41	23-25	2.76	2.50	—
Western, ...J. B. Garland & Son...	Worcester	20.84	23-25	3 58	2.50	—
Western, ...Wilson & Holden	Worcester	22 64	23-25	3.62	2.50	—
Average............	....	21.16	—	3.10	—	—

DISTILLERS' DRIED GRAINS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found	Fat. Guar.	Fiber
Ajax Milling & Feed Co., Buffalo.						
Ajax Flaxes,......Eastern Grain Co.....	Bridgewater ...	31.11	31-33	12.32	12-14	—
Ajax Flakes,......J. Cushing & Co.	Fitchburg	32.56	31-33	12.98	12-14	—
Ajax Flakes,......H. G. Hill Co.........	Williamsburg..	31.55	31-33	10.51	12.00	—
J. W. Biles Co., Cincinnati, Ohio.						
Fourex. ....F. E. Smith	Amherst.......	29.57	33.00	8.39	11.00	—
Fourex. ....S. P. Puffer	N. Amherst....	32.43	33.00	14.75	11.00	—
Twoex...........P. W. Eaton & Co....	Williamstown..	29.75	30 00	6.59	3.00	—
Continental Cereal Co., Peoria, Ill.						
Atlas, ...W. N. Potter Grain Co	Gardner	31.50	31-33	12.40	12-14	—
Atlas, ...Potter Grain Co.......	Shelburne Falis	30.94	36.00	11.82	11.50	—
J. D. Page & Co., Syracuse, N. Y.						
Empire State,.....J. E. Merrick & Co....	Amherst	29.18	32.50	8.18	11.50	—
Average............	....	30.95	—	10.88	—	—
Second Grade.						
J. W. Biles Co., Cincinnati, Ohio.						
Onex, ...A. Carr	Northboro.....	25.14	26.00	7.55	10.00	—

MALT SPROUTS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Chas. M. Cox Co., Boston.						
B. W. Brown	Concord	27.78	25-27	0.89	1.5-3	—
Thatcher & Ireland	Littleton	26.33	25-27	0.87	1.5-3	—
D. W. Ranlet Co., Boston.						
W. A. Haynes Co.	Maynard	26.03	23-25	0.92	1.0-1.5	—

BREWERS' DRIED GRAINS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Anheuser-Busch Brew. Assoc., St. Louis						
J. B. Garland & Son	Worcester	29.39	24.00	7.62	7.50	—
Atlantic Export Co., Milwaukee, Wis.						
H. K. Webster Co.	Lawrence	29.92	27.00	5 67	7.00	—
John C. Hattendorf, Chicago.						
John Shea	Lawrence	28.52	24.50	5.48	5.24	—

WHEAT MIDDLINGS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
1. Flour.						
Bay State Milling Co., Winona, Minn.						
Red Dog. ....W. N. Potter Grain Co	Gardner	17.03	18.00	3.80	5.00	—
Geo. C. Christian & Co., Minneapolis.						
Milford Grain Co.	Milford	17.29	14.00	5.57	4.00	—
City Milling Co., Grand Rapids, Mich.						
Vimco. ....M. H. Rolfe	Newburyport	14.97	—	4.21	—	—
Detroit Milling Co., Detroit, Mich.						
Apex. ....N. Hatfield Grain Co.	N. Hatfield	15.79	—	4.26	—	—
Hennepin Mill Co., Minneapolis.						
Ben Hur Red Dog, Warner Bros.	Sunderland	19.74	18.00	5.20	5.00	—
Ben Hur Red Dog, J. W. Raymond	Concord	18.16	17.00	4.91	5.00	—
Millbourne Mills, Philadelphia.						
J. B. Bridges & Co.	S. Deerfield	17.99	13-15	4.01	3-6	—
Moseley&MotleyMill.Co.,Rochester,N.Y						
W. N. Potter's Sons & Co.	Northampton	15.97	17.00	4.78	5.30	—
Northwest. Cons. Mill. Co., Minneapolis.						
XXX Comet. .....Haverhill Milling Co.	Haverhill	17.55	18.25	4.54	5.25	—
XXX Comet. .....A. D. Thomas	Palmer	16.81	18.25	3.85	5.25	—
James Lally, Jr	Milford	14.21	16.25	5.43	5.25	—

WHEAT MIDDLINGS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.
		Found.	Guar.	Found.	Guar.	
		%	%	%	%	%
Pillsbury's Mills, Minneapolis.						
A, ... Griswold & Adams	Dalton	17.77	14.00	4.76	4.50	—
A, ... C. L. Marsh	Webster	17.11	14.00	4.77	4.50	—
XX Daisy, ... J. Cushing & Co.	Hudson	18.34	16.00	5.20	4.50	—
Russell-Miller Milling Co., Minneapolis.						
Evans & Bowker	Baldwinsville	16 55	16.00	5.18	5.00	—
J. J. Rowell	Pepperell	17.16	16.00	5.21	5.00	—
H. C. Puffer Co.	Springfield	16.72	16.00	5.30	5.00	—
Washburn-Crosby Co., Minneapolis.						
Adrian, ... E. A. Cowee	Jefferson	20.71	20 00	5.50	4.50	—
Adrian, ... J. Franks	New Bedford	17.46	20.00	4.81	4.50	—
Unknown.						
Red Dog, ... Wallace Grain Co.	Clinton	15.14	14-18	3.92	3-6	—
Red Dog, ... A. Carr	Northboro	14.39	—	3.27	—	—
Average		16.99	—	4.69	—	—
2. Standard.						
Allen Baker Commission Co., St. Louis.						
Royal, ... J. M. Buck	Stockbridge	16 94	15.75	5.14	4.00	—
Ames, Burns & Co., Jamestown, N. Y.						
Sykes Coal & Grain Co.	North Adams	17.25	16-20	3.83	3-5	—
Atlas Flour Mills, Milwaukee, Wis.						
Atlas, ... Bedford Coal & Grain Co.	Bedford	18.21	17.50	5.52	5.50	—
Atlas, ... Highland Mills	Newton High'ds	17.29	17.50	5.17	5.50	—
Ballard & Ballard Co., Louisville, Ky.						
Shipstuff, ... E. A. Briggs Co.	Attleboro	15.97	15.69	4.54	3.75	—
Shipstuff, ... Hingham Grain Mill	Hingham	15.97	15.69	4.57	3.75	—
Barber Milling Co., Minneapolis.						
Star, ... D. J. Harrington	Turners Falls	18.21	14-18	5.85	4-6	—
Berger-Crittenden Mill. Co., Milwaukee.						
Badger, ... A. F. Sanctuary	Amherst	17.34	16.00	4.55	4.00	—
Badger, ... Whitman Coal & Gr. Co	Whitman	17.77	16.00	4.82	4.00	—
Cataract City Milling Co., Niagara Falls.						
Niagara . . . . . G. A. Stevens	Worcester	16.59	15.05	4.83	5.07	—
Geo. C. Christian & Co., Minneapolis.						
Poland, ... Milford Grain Co.	Milford	16.46	14.00	5.82	4.00	—
Poland, ... C. C. Wilder	Springfield	15.79	14.00	5.38	4.00	—
Detroit Milling Co., Detroit, Mich.						
Apex, ... A. F. Sanctuary	Amherst.	15.71	18.00	4.42	6.00	—
Eckhart & Swan Milling Co., Chicago.						
W. P. Griffin	Pittsfield	16.46	—	4.27	—	—

WHEAT MIDDLINGS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Gregory, Bliss & Co., Duluth, Minn.						
Commander,......J. H. Nye & Co.......	Brockton	17.55	17.00	4.80	5.25	—
Hecker-Jones-Jewell Mill Co., N. Y. City.						
Hecker's,..........A. S. Gurney & Co....	Wareham	16 50	—	4.92	—	—
Hennepin Mill Co., Minneapolis.						
Ben Hur,..........J. Marin & Co........	Haverhill......	16.85	15.00	4 48	4.00	—
Ben Hur,..........Warner Bros	Sunderland ...	16.81	15.00	5.00	4.00	—
Hubbard Milling Co,, Mankato, Minn.						
C. P. Washburn	Middleboro ...	17.34	14.50	6.01	5.10	—
New Prague F.M. Co., New Prague, Minn.						
Seal of Minnesota, Mackenzie & Winslow	Fall River	18.34	16.00	6.09	4.75	—
Northwest. Cons. Mill. Co., Minneapolis						
C. F. Rice	Brookfield	16 63	15.25	5.72	5.25	—
D. H. Craig	Plymouth	16.50	16.75	5.86	5.25	—
Phœnix Mill Co., Minneapolis.						
J. Wadsworth & Co. ..	Northboro.....	17.42	16.30	4 51	4.70	—
Pillsbury's Mills, Minneapolis.						
B,................W. P. Reynolds	Canton	17.34	14 00	5.54	4.50	—
B,................Howard & Smith	Hatfield.......	15.88	14 00	5.08	4.50	—
David Stott, Detroit, Mich.						
Climax, ...D. McCarthy	Turners Falls..	16.50	—	4.93	—	—
Thompson Milling Co., Lockport, N. Y.						
Griswold & Adams....	Dalton	16.90	—	5.59	—	—
Washburn-Crosby Co., Minneapolis.						
J. T. Fitts	Greenbush	17.16	15.00	5.36	4.00	—
G. B. Brown..........	Ipswich	16 55	15.00	4.84	4 00	—
R. D. Bowen	Leominster	16.46	16.00	4.95	4.00	—
Unknown.						
Scott Grain Co	Amesbury	17.34	—	5.38	—	—
E. A. Cowee..........	Hudson	17.08	—	5.23	—	—
E. F. Wheeler	Stow	14 48	—	5.00	—	—
Highest	....	18.34	—	6.09	—	—
Lowest..............	....	14 48	—	3.83	—	—
Average............	....	16 84	—	5.09	—	—

ADULTERATED WHEAT MIDDLINGS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.
		Found.	Guar	Found.	Guar.	
		%	%	%	%	%
Brooks Elevator Co., Minneapolis.						
Gopher, ...Henry Carver	Marshfield.....	15 67	16.00	5.06	5.00	—
New Occidental Milling Co., Minneapolis.						
Aloras, ...J. Cushing & Co........	Fitchburg	16.37	16.00	7.22	5.00	—
Aloras, ...Prentiss, Brooks & Co...	Holyoke........	16 76	16.00	5.78	5.00	—
Aloras, ...Thatcher & Ireland.....	Littleton	16.76	16.00	8.01	5.00	—
Aloras, ...W.H.Cunningham & Son	Malden........	15.93	16.00	6.26	5.00	—
Aloras, ...W. W. McIntyre	Marlboro......	12.43	16.00	7.22	5.00	—

WHEAT MIXED FEED.

Acme Milling Co., Indianapolis, Ind.						
Acme,............J. W. Doon & Co.	Natick	15.36	15-17.5	4.24	4-5	—
Acme,............A. E. Gilbert	W. Brookfield .	15.71	15-17.5	4.16	4-5	—
Allen Baker Commission Co., St. Louis.						
Apex, ...H. Knight............	Newburyport ..	16.50	14-17	4.67	4-5	—
Ansted & Burk Co., Springfield, Ohio.						
G. M. Stratton........	Montague	16.19	14.5-15 5	4.50	3.5-4.5	—
Ballard & Ballard Co., Louisville, Ky.						
G. C. Turner..........	Chester	15.44	15.00	4.57	4.17	—
Bryant & Soule.......	Middleboro....	15.01	16 50	4.19	4.80	—
T. E. Borden	N. Westport...	15.14	15.00	4.57	4.17	—
Blanton Milling Co., Indianapolis.						
Blanton,..........Dennison Plummer Co.	New Bedford..	15.23	15-17.5	4.48	4-5	
Blish Milling Co., Seymour, Ind.						
Bulls Eye,........Potter & Co	Athol	15.93	15.8-16.2	4.45	4.7-4.9	—
Bulls Eye,........A. M. Haggart........	Franklin	15.67	15.8-16.2	4.64	4.7-4.9	—
Burbeck & Brett, North Abington.						
All Right, ...Burbeck & Brett	N. Abington...	15 79	—	4.77	—	—
Chapin & Co., Boston.						
Erie, ...W. L. Palmer	Medway.......	16.28	—	4.43	—	—
Ozark,............E. H. Dyer	Belchertown ..	16 64	14-18	3.81	3-5	—
Ozark,............J. W. Doon & Co.....	Natick	17.36	—	4.54	—	—
Vermont, ...J. J. Rowell	Pepperell	17.29	14-18	5.00	4-6	—
Vermont, ...G. W. Davis Co.......	Westfield......	16.37	14-18	4 58	4-6	—
Vermont, ...Wilson & Holden.....	Worcester	16 85	14-18	4.79	4-6	—
Eastern Grain Co	Bridgewater ...	15.79	—	4.19	—	—
Claro Milling Co., Lakeville, Minn.						
Claro, ...Burbeck & Brett	N. Abington...	15.71	14-17	5.31	3-5	—
Claro, ...Cutler Co	Warren	16.06	14-17	5.18	3-5	—
Wm.A.Coombs Mill.Co.,Coldwater,Mich.						—
W. A. Haynes Co.....	Maynard	15.36	—	4.33	—	

WHEAT MIXED FEED—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Chas. M. Cox Co., Boston.						
Wirthmore,.......C. Jones.............	Lynn..........	15.88	16-19	5.23	4.5	—
Wirthmore,.......C. R. Conant.........	Whitman	15.36	16-19	4.96	4.5	—
Crescent Milling Co., Minneapolis.						
Golden Cream,....W. P. Barney	Seekonk.......	16.06	17.60	4.74	5.50	—
Duluth-Superior Mill. Co., Duluth, Minn.						
Boston,...........G. F. Wetherbee Est.	Gardner	16.41	16.00	5.03	4.50	—
Boston,...........F. Diante............	S. Braintree ...	15.44	16.00	4.88	4.50	—
Everett, Aughenbaugh & Co., Waseca, Minn.						
E. A. C. O.,......G. B. Brown..........	Ipswich	16.32	15-19	4.96	3.5	—
Flint Mill Co., Milwaukee, Wis.						
Huron, ...H. W. Kimball.......	Westboro	16.99	15-18	4.99	4.7	—
Rutland,..........G. F. Green Coal Co .	Campello......	16.19	14-18	5.12	4.6	—
Vermont, ...Eastern Grain Co.....	Bridgewater ...	16.37	14-18	4.93	4.6	—
Garland Milling Co., Greensburg, Ind.						
Garland,..........W. C. S. Wood.......	Norton	16.23	16.00	4.32	4.00	—
Garland,..........Potter Grain Co.	Shelburne Falls	16.37	15.25	4.29	3.75	—
Garland,..........A. Milot & Son	Taunton	15.71	16.00	4.00	4.00	—
Hart Milling & Power Co., Flushing, Mich.						
G. A. Stevens	Worcester	15.09	—	4.35	—	—
Isaac Harter Milling Co., Toledo, Ohio.						
Harters,..........E. A. Cowee..........	Jefferson	16.06	—	4.54	—	—
Hennepin Mill Co., Minneapolis.						
Ben Hur,.........Warner Bros.........	Sunderland....	16.50	16.00	4.65	4.50	—
Hunter Bros. Milling Co., St. Louis.						
Matchless,........Howe Bros...........	Gardner.......	16.64	15.00	4.65	4.00	—
Sunshine,.........N. Paquin & Sons....	Fall River	17.16	15.00	4.35	4.00	—
Sunshine,.........D. H. Craig..........	Plymouth	15.97	15.00	4.49	4.00	—
Sunshine,.........Weld & Beck	Southbridge ..	16.46	15.00	4.51	4.00	—
Kehlor Flour Mills Co., St. Louis.						
Kehlor's, ...E. C. Packard........	Brockton	16.46	14-16	4.64	4.5	—
Kehlor's..........Thatcher & Ireland...	Littleton	17.11	14-16	4.58	4.5	—
Law'ceb'g Roller Mills, Lawrenceburg, Ind						
Snowflake, ...Dennison Plummer Co.	New Bedford..	15.79	—	4.29	—	—
Snowflake,........A. J. Richards & Son.	Quincy	15.84	—	4.33	—	—
Lexington Roller Mills, Lexington, Ky.						
Lexington, ...E. A. Cowee..........	Auburn	15.44	—	4.46	—	—
Listman Mill Co., LaCrosse, Wis.						
Elmco, ...H. L. Patrick.........	Hopedale	17.42	18.44	5.19	4.60	—
Lorenson Milling Co., Lisbon, N. D.						
Durum, ...C. B. Sampson........	Holyoke.......	14.13	—	5.65	—	7.89

WHEAT MIXED FEED—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Lyon & Greenleaf, Wauseon, Ohio.						
C. S. Barber..........	Bernardston ..	15.44	—	4.46	—	—
D. L. Marshall Milling Co., Buffalo.						
Uniform, ...W. L. Palmer	Medway..... .	14.57	16-19	4.16	3-5	—
Uniform, ...Hathaway&Mackenzie	New Bedford .	14 66	16-19	4.22	3-4	—
Uniform, ...E. C. Frost...........	Shelburne Falls	16.28	16-19	4.02	3-5	—
Uniform, ...Whitman Coal &Gr.Co	Whitman......	14.62	16-19	4.30	3-5	—
Millbourne Mills, Philadelphia.						
Millbourne,.......Wachusett Grain Co..	Clinton........	14.92	13-18	4.86	3-6	—
Millbourne,.......A. Culver Co..........	Rockland	16.37	13-18	4.30	3-6	—
R. P. Moore Milling Co., Princeton, Ind.						
King, ...Springfield Flour & Grain Co.	Springfield	15.79	15 00	4.58	4.00	—
Noblesville Milling Co., Noblesville, Ind.						
N. M.,............G. B. Pope & Co......	Waltham......	15.58	—	4 47	—	—
Northwest. Cons. Mill. Co., Minneapolis.						
Planet, ...W. N. Potter Gr. Co..	Gardner	17.16	16.00	4.90	5 25	—
Planet, ...C. R. Nelson.........	Mt. Hermon ..	16.55	16.00	5.55	5.25	—
Northwest. Mill. Co., Little Falls, Minn.						
C. B. & F. H. Goss....	Melrose	14.97	17.00	4.72	4.50	—
Irving Powers & Co., Boston.						
Boar's Head, ...Curley Bros...........	Wakefield	16.06	—	4.57	—	—
Pillsburys Mills, Minneapolis.						
Fancy, ...Bryant & Soule.......	Middleboro....	15.76	14.00	4.40	4 50	—
Quaker Oats Co., Chicago.						
Buckeye,.........H. Shacter	Brockton	15.84	13-17	4.73	4-4.7	—
Buckeye,.........Taft Bros.............	Uxbridge......	16.23	13-17	5.17	4-4.7	7.62
Henry Russell, Albany, N. Y.						
Choice,...........H. G. Hill Co	Williamsburg..	16.23	15-19	4.67	4.5-6	—
Regular,..........Sprague & Williams..	S. Framingham	16.55	—	5.41	—	—
Regular,..........H. G. Hill Co.........	Williamsburg..	16.59	—	5.02	—	—
Russell-Miller Milling Co., Minneapolis.						
Occident,.........A. E. Lawrence & Son	Ayer	16.76	15-18	5.52	4-5	—
Occident,.........Mackenzie & Winslow	Fall River	16.23	15-18	4.46	4-5	—
Occident,.........H. A. Crossman	Needham	16.06	15-18	4.66	4-5	—
Sheffield-King Milling Co., Minneapolis.						
Gold Mine, ...Morse Bros	Southbridge ...	15.97	17.00	4 63	4.50	—
Gold Mine, ...J. B. Garland & Son..	Worcester	16.46	17.00	4.70	4.50	—
Sheffield Mill. & Elev. Co., Minneapolis.						
Big Diamond, ...E. H. Dyer...........	Belchertown...	15.75	19.00	5.16	4.50	—
Sparks Milling Co., Alton, Ill.						
Try-Me, ...J. F. Shine	Dedham	16.41	17.15	4.64	4.45	—

WHEAT MIXED FEED—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
David Stott, Detroit, Mich.						
Honest, ...W. R. Ross...........	Holyoke	15.58	—	4.76	—	—
Stratton & Co., Concord, N. H.						
F. G. Morey..........	Billerica.......	15.23	—	4.82	—	—
Thornton & Chester Milling Co., Buffalo.						
Wm. Baylies' Sons....	New Bedford..	16.46	14-18	4.88	3-5	—
Valier & Spies Milling Co., St. Jacob, Ill.						
R. E. Fairchild	Belchertown...	15.71	—	4.90	—	—
Waggoner=Gates M.Co., Independ'ce,Mo						
Mill Run,.........Eastern Grain Co	Bridgewater ..	16.76	—	4.08	—	—
Mill Run,.........N. Hatfield Grain Co.	N. Hatfield ...	17.95	—	4.10	—	—
Washburn=Crosby Co., Minneapolis.						
Mackenzie & Winslow	Fall River.....	15.06	15.03	4.19	4.25	—
Whitman Coal and Grain Co., Whitman						
Best, ...Whitman Coal &Gr.Co	Whitman	15.84	16-18	4.98	4-5	—
Unknown.						
Columbia,........G. R. Doane..........	N. Brookfield..	15.67	—	4.59	—	—
Columbia,........J. S. Nason & Co.	Westboro	14.62	—	5.31	—	—
Extra Powerful, ..W. F. Filmore, ...	Palmer	16.94	—	4.67	—	—
Pine Tree,........C. G. Burnham	Holyoke.......	16.28	—	4.38	—	—
Highest	....	17.95	—	5.65	—	—
Lowest..............	....	14.13	—	3.81	—	—
Average.............	....	16.02	—	4.65	—	—

ADULTERATED WHEAT FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
F. L. Cressey, Boston.						
Indiana,..........J. A. Bouvier.........	New Bedford..	9.70	10-12.05	2.62	2-3.2	16.68
Indiana Milling Co., Terre Haute, Ind.						
Jersey, ...A. D. Potter..........	Orange........	12.60	10-12.05	3.17	2-3.2	13.25
Jersey, ...Cutler Grain Co.......	S. Framingham	11.80	10-12.05	3.13	2-3.2	16.23
A. Waller & Co., Henderson, Ky.						
Blue Grass,.......Morse & Bigelow.....	Marlboro	9.97	10.00	3.39	2.50	15.10
Blue Grass,.......J. A. Bouvier.........	New Bedford..	10.01	10.00	2.76	2.50	16.61
Average.............	....	10.82	—	3.01	—	15.57

WHEAT BRAN.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Atlas Flour Mills, Milwaukee, Wis.						
Atlas, ...Bedford Coal & Grain Co.	Bedford	15.75	15.00	4.67	3.20	—
Allen Baker Commission Co., St. Louis.						
J. M. Buck	Stockbridge ...	15.32	14-17	4.05	4-5	—
Ansted & Burk Co., Springfield, Ohio.						
Bran & Screenings Hale Knight..........	Newburyport ..	14.62	14-15	4.14	3-4	—
Banner Milling Co., Buffalo, N. Y.						
Banner, ...Taunton Grain Co....	Taunton.......	16.23	—	5.30	—	—
Barber Milling Co,, Minneapolis.						
Star Flakes,......D. J. Harrington......	Turners Falls..	15.62	13-17	4.93	4.6	—
Bay State Milling Co., Winona, Wis.						
Winona, ...N. Paquin & Sons.....	Fall River.....	14.66	15.00	4.80	4.75	—
Berger-Crittenden Mill. Co., Milwaukee.						
Badger, ...Butman & Cressey....	Lynn..........	16.10	15.00	4.27	4.00	—
Badger, ...A. S. Gurney & Co....	Wareham	15.18	15.00	4.12	4.00	—
Cain Mill Co., Atchinson, Kan.						
Cain's, ...H. Bruckman.........	Lawrence	14.31	13.00	4.21	3.00	—
Seymour Carter, Hastings, Minn.						
Clover Leaf,......A. M. Haggart	Franklin	15.49	14.30	4.66	5.20	—
Clover Leaf,......H. C. Puffer Co.......	Springfield	15.14	14.30	4.26	5.20	—
Chapin & Co., Boston.						
Wilkins,..........V. E. Moore..........	Springfield	16.72	14-18	4.67	3-5	—
Cheyenne Riv. Roll. Mills, Kindred, N.D.						
O. K., ...W. Lord	Athol	13.56	14.50	4.30	4.50	—
Geo. C. Christian, Minneapolis.						
Jersey, ...Milford Grain Co.....	Milford	14.39	13.00	5.00	4.00	—
J. G. Davis Co., Rochester, N. Y.						
W. R. Williams.	Oxford	15.32	15.97	4.81	5.72	—
Eagle Roller Mills, New Ulm, Minn.						
M. T. Huntington	Pittsfield	14.92	15.10	5.01	4.80	—
Hunter Bros. Milling Co., St. Louis.						
F. W. Sawtelle & Co..	Hyde Park	14.79	14.00	4.41	3.50	—
W. J. Jennison Co., Minneapolis.						
G. B. Pope & Co	Waltham.	15.05	15.00	4.63	4.00	—
Kansas Milling Co., Wichita, Kan.						
Climax, ...W. N. Potter's Sons & Co.	Northampton..	17.77	15.50	4.29	4.00	—

WHEAT BRAN—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.
		Found.	Guar.	Found.	Guar.	
		%	%	%	%	%
Kemper Mill & Elev.Co.,Kansas City,Mo.						
K. ....Cutler Co	N. Wilbraham.	19.09	14.50	4.52	4.00	—
Leavenworth Mill. Co., Leavenw'th,Kan.						
W. N. Potter & Co....	Charlemont....	16.28	15.19	4.15	3.85	—
Lee-Warren Milling Co., Salina, Kan.						
B. W. Brown	Concord.......	16.06	14.00	3.86	3.50	—
Lyon & Greenleaf, Wauseon, Ohio.						
C. S. Barber..........	Bernardston ..	15.14	—	4.29	—	—
Mystic Milling Co., Sioux City, Iowa.						
Mystic...........Bryant & Soule.......	Middleboro....	14.57	14.00	4.57	4.5	—
Northwest. Cons. Mill. Co., Minneapolis.						
Lamb Bros..........	Orange........	15.62	14.25	4.85	4.00	—
Ohio Cereal Co., Circleville, Ohio.						
Esmeraldo, ...C. W. Bowker & Co...	Worcester.....	14.74	14.40	4.19	3.45	—
Pillsburys Mills, Minneapolis.						
Pillsbury's,.......C. H. Smith.........	Dighton	14.39	13.00	5.02	4.00	—
Pillsbury's,.......C. B. Sawin & Son....	Southboro.....	14.00	13.00	5.21	4.00	—
Pillsbury's,.......E. O. Parker..........	Stoughton	14.13	13.00	4.94	4.00	—
Redfield Flouring Mills, Redfield, S. D.						
C. P. Washburn	Middleboro....	15.62	13.00	4.92	4.00	—
Red Wing Milling Co., Red Wing, Minn.						
Bixota,...........Daley Bros..........	Uxbridge......	14.62	15.00	4.43	4.00	—
Sleepy Eye Mill. Co., Sleepy Eye, Minn.						
Sleepy Eye, ...Hingham Grain Mill..	Hingham......	15.32	15.60	4.94	4.10	—
Sleepy Eye, ...Prentiss, Brooks & Co.	Holyoke.......	16.41	15.00	5.08	4.00	—
Southwest. Milling Co., Kansas City,Mo.						
A. D. Potter..........	Orange........	16.02	15.00	4.07	5.25	—
K. C. K.,.........P. J. Mitchell.........	Springfield	16.76	15.00	3.51	5.25	—
Geo. Tileson Mill. Co., St. Cloud, Minn.						
Brown Bros..........	Northbridge...	14.83	14.17	5.27	3.6	—
Valley City Mill.Co., Grand Rapids,Mich.						
Vimco, ...Wm. Baylies' Sons....	New Bedford..	14.09	—	3.58	—	—
Voight Milling Co., Grand Rapids, Mich.						
Voight's, ...Phillips, Bates & Co...	Marshfield	15.40	—	4.40	—	—
Watsons Mill Co., Wichita, Kan.						
U Knead It,......Ropes Bros...........	Salem	17.20	14.95	3.99	3.75	—
E. S. Woodworth & Co., Minneapolis.						
Snows Flaky,....Spring'd Flour & Gr.Co	Springfield	14.21	14.25	4.67	4.10	—

WHEAT BRAN—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Zenith Mill Co., Lake Park, Minn.						
Jaquith & Co.	Woburn	14.88	14.50	3.75	4.10	—
Unknown.						
J. Burkhardt	Beverly	17.34	—	4.67	—	—
Wachusett Grain Co.	Clinton	14.88	—	4 23	—	—
G. A. Stevens	Worcester	14.79	—	4.75	—	—
Wallace Grain Co.	Worcester	14.88	—	5.30	—	—
Highest		19 09	—	5.30	—	
Lowest		13.56	—	3.51	—	
Average		15.38	—	4.53	—	

DAIRY FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Ajax Milling & Feed Co., Buffalo.						
Unicorn Daily Ration, J. H. Nye & Co.	Brockton	26.85	26 00	6.12	6.00	10.71
Unicorn Daily Ration, S. L. Davenport & Son	N. Grafton	27.34	26.00	6.43	6.00	10.16
Unicorn Daily Ration, Marlboro Grain Co	Marlboro	25.98	26 00	5.79	6.00	9.66
Ames, Burns & Co., Jamestown, N. Y.						
A. B. C., Sykes Coal & Grain Co	North Adams	23.48	24.00	9.31	8.00	8.34
J. W. Biles Co., Cincinnati, Ohio.						
Union Grains, J. O. Ellison & Co.	Haverhill	24.22	24 00	6.90	7.00	8.87
Union Grains, S. L. Davenport & Son	N. Grafton	23 22	24.00	6.86	7.00	10.02
Buffalo Cereal Co., Buffalo.						
Creamery Feed, Tyler Grain Co.	Hyde Park	19.83	20.00	4.86	5.00	8.14
Husted Milling & Elevator Co., Buffalo.						
Husted, C. F. Pease	Chester	16.72	18.20	3.86	3-4	9.74
St. Albans Grain Co., St. Albans, Vt.						
Paragon, E. F. Wheeler	Stow	29.48	28-30	6.26	5-7	10.81

MOLASSES FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
American Milling Co., Chicago.						
Sucrene Dairy, J. H. Nye & Co.	Brockton	17 68	16.50	4.11	3.50	11.59
Sucrene Dairy, Merriam & Rolfe	Fitchburg	17.39	16.50	3.59	3.50	10.82
Sucrene Dairy, Bosworth & Wood	Leominster	18.34	16.50	4 45	3.50	9.24
Sucrene Horse, J. H. Nye & Co	Brockton	12 99	10.00	2.85	3.00	9 20
Sucrene Horse, W. L. Palmer	Medway	13.38	10 00	2.64	3.00	12.76
Ames, Burns & Co,, Jamestown, N. Y.						
A. B. C., Sykes Coal & Grain Co	North Adams	16.28	16.18	4.20	3.5-4.5	9.18

MOLASSES FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Great Western Cereal Co., Chicago.						
Daisy,............Phaneuf & Son.......	Fairhaven	11.63	14-16	1.08	3-4	14.14
Daisy,............W. W. Holmes	Webster.......	14.71	14-16	1.64	3-4	12.83
Daisy,........ ...C. E. Terry	W. Springfield.	11.84	14-16	0.80	3-4	12.10
Chas. A. Krause Mill. Co., Milwaukee.						
Badger, ...C. B. Sampson	Holyoke.......	15.62	18.00	4.59	4.50	—
Badger, ...C. B & F. H. Goss....	Melrose	15.18	18.00	4.10	4.50	10.55
Badger, ...J. B. Bridges & Co ...	S. Deerfield....	16.41	18.00	4.47	4.50	9.68
Milwaukee Grain & Feed Co., Milwaukee.						
XXX, ...F. F. Woodward	Fitchburg	18.87	17.50	2.35	2.00	10.34
Northwest Mills Co., Winona, Minn.						
Sugarota Dairy, ..Mackenzie & Winslow	Fall River.....	17.38	18.00	6.24	4.50	11.93
Sugarota Dairy, ..Livingston Grain Co..	Lowell	18.83	18.00	4.53	4.50	22.50
Sugarota Dairy, ..N. A. Seymour	S. Lancaster...	20.44	18.00	5.52	4.50	21.53
Sugarota Horse,..Livingston Grain Co..	Lowell	13.77	12.00	3.58	3.50	23.10
Sugarota Horse,..N. A. Seymour	S. Lancaster...	14.04	12.00	4.67	3.50	23.50
Quaker Oats Co., Chicago.						
Molac Dairy,.....A D. Potter..........	Orange........	14.92	15.5-17	3.82	3-4	15.36
Molac Dairy,.....W. R. Williams	Oxford	14.83	15.5-17	3.63	3-4	13.64
Molac Horse,.....S. B. Green & Co.....	Watertown	11.93	11-13	2.34	3-4	12.14
Western Dairy Feed Co., Milwaukee.						
Red Cow, ...H. L. Patrick	Hopedale	7.81	15-17.5	0.54	3.00	21.24
Western Grain Prod. Co., Hammond, Ind.						
Hammond Dairy,. F. G. Cover & Co	Lowell	16.50	17.00	4.01	3.00	10.55
Hammond Dairy,. Berkshire Coal & Gr. Co	North Adams..	16.50	16.00	4.20	3.00	8.94
Hammond Horse,. Berkshire Coal & Gr. Co	North Adams..	14.71	13.50	2.65	3.50	10.34

RYE FEEDS.

Blodgett Co., Janesville, Wis.						
N. Hatfield Grain Co..	N. Hatfield....	14.92	14.00	3.46	3.00	—
Boutwell Milling & Grain Co., Troy, N.Y.						
J. B. Garland & Son...	Worcester.....	14 62	13.50	2.95	3.00	—
Geo. T. Callahan, Castleton, N. Y.						
G. C. Turner	Chester	13.69	12.00	2.57	2.00	—
J. B. A. Kern & Son, Milwaukee, Wis.						
Prentiss, Brooks & Co.	Westfield......	15.62	15.00	3.32	3.00	—

RYE FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Washburn-Crosby Co., Minneapolis.						
W. Lord	Athol	15.67	14.00	3.51	3.00	—
J. N. Waite	Easthampton	15.97	14.00	3.56	3.00	—
Average		15.08	—	3.23	—	

CALF MEAL.

Quaker Oats Co., Chicago.						
Schumacher's....D. H. Craig	Plymouth	20.27	19-21	7.92	8-9.5	—

II. Starchy (Carbohydrate) Feeds.

CORN MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Buffalo Cereal Co., Buffalo.						
B, ... Wm. Baylies' Sons....	New Bedford..	8.60	—	4.34	—	—
Narragansett Mill. Co., E. Providence, R.I.						
W. P. Reynolds	Canton	7.81	—	2.87	—	—
Nathan Tufts & Sons, Boston.						
B................ J. B. Cover & Co......	Lowell	9.35	—	3.00	—	—

GROUND OATS.

Narragansett Mill. Co., E. Providence, R.I.						
J. T. Pitts............	Greenbush	11.19	—	3.47	—	8.14
Morse Bros., Southbridge.						
Morse Bros...........	Southbridge ...	11.37	—	3.75	—	9.64
Potter & Co., Athol.						
Potter & Co..........	Athol	10.84	—	3.73	—	8.96
J. F. Ray, Franklin.						
J. F. Ray.............	Franklin	11.98	—	3.93	—	7.70
Average.............	....	11.35	—	3.72	—	8.61

KAFFIR CORN MEAL.

Weld & Beck, Southbridge.						
Weld & Beck.........	Southbridge ...	8.43	—	3.74	—	2.16

HOMINY MEAL.

American Hominy Co., Indianapolis, Ind.						
Homco, ... C. L. Marsh..........	Webster.......	10.06	8.50	6.58	7.00	—
W. E. Bryant & Co ...	Brockton	10.06	8.50	7.79	7.00	—
American Rice & Cereal Co., Keokuk, Ia.						
Purity, ... Millbury Grain Co....	Millbury	11.54	10.12	8.83	9.82	5.99

HOMINY MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
M. F. Baringer, Philadelphia.						
Keystone, ...Potter Grain Co......	Shelburne Falls	11.23	9.00	9.15	6.00	—
Buffalo Cereal Co., Buffalo, N. Y.						
Potter Bros. & Co	North Adams..	9.48	10.25	6.78	8.00	—
Chapin & Co.. Boston.						
Niagara,..........A. Dodge & Son	Beverly	9.97	10-11	7.16	7-8	—
Chas. M. Cox Co., Boston.						
Paragon, ...Thatcher & Ireland ..	Littleton	9.77	10.5-12	7.86	7.5-9	—
Paragon, ...Butman & Cressey....	Lynn..........	10.40	10.5-12	8.16	7.5-9	—
Paragon, ...Curley Bros	Wakefield	9.83	10.5-12	7.76	7.5-9	—
Wirthmore,.......T. A. Holt Co........	Andover	9.48	9.5-12	7.33	7.5-9	—
Wirthmore,.......B. W. Brown	Concord.......	10.01	9.5-12	7.73	7.5-9	—
Wirthmore,.......H. C. Puffer Co.......	Huntington....	9.65	9.5-12	5.57	7.5-9	—
Wirthmore,.......F. A. Fales & Co	Norwood	10.06	9.5-12	7.96	7.5-9	—
Wirthmore,.......H. Bruckman.........	S. Lawrence ..	10.67	9.5-12	8.65	7.5-9	—
Yellow,.... ......F. Diehl & Son.......	Wellesley	10.49	10.0-12	7.22	7.0-9	—
Decatur Cereal Co., Decatur, Ill.						
OXO, ...Warner Bros.	Sunderland ...	10.40	11.02	8.45	7.70	—
OXO, ...Cutler Co............	Warren	10.71	11.02	9.30	7.70	—
OXO, ...W. W. Holmes	Webster.......	9.88	11.02	8.03	7.70	—
Deutsch & Sickert Co., Milwaukee, Wis.						
F. F. Woodward & Co.	Fitchburg	11.54	11.00	9.64	7.00	—
W. H. Haskell & Co., Toledo, Ohio.						
Bliss & Co.	Taunton.......	9.65	10.25	8.49	8.10	—
Hunter Bros. Milling Co., St. Louis.						
A. E. Lawrence & Son	Ayer	11.06	9.5-10.5	9.59	7-8.5	—
Husted Milling & Elevator Co., Buffalo.						
M. C. Richmond......	Adams	9.65	9-11	6.87	6-9	—
Miner-Hillard Mill. Co., Wilkes-Barre, Pa.						
C. W. Bowker & Co ..	Worcester	9.92	10-12	7.50	7.5-9	—
Wm. H. Payne & Son, New York.						
C. G. Burnham	Holyoke	9.97	11.49	6.98	8.00	—
A. B. Porter & Co., Philadelphia.						
C. S. Barber..........	Bernardston ..	10.14	8-11	7.82	6-9	—
P. Foisy.............	New Bedford..	9.56	8-11	7.60	6-9	—
J. E. Soper & Co., Boston.						
Blue Ribbon, ...Mackenzie & Winslow	Fall River	9.79	10.00	7.07	8.00	—
Blue Ribbon, ...A. S. Gurney & Co. ..	Wareham	9.70	10.00	6.87	8.00	—
Blue Ribbon, ...A. N. Whittemore&Co	Worcester	9.97	10.00	7.69	8.00	—
Blue Ribbon, ...C. H. Symmes........	Winchester....	9.83	11.00	7.26	8.00	—
Highest		11.54	—	9.87	—	—
Lowest............................		9.48	—	5.57	—	—
Average...........................		10.16	—	7.79	—	—

HOMINY MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Low Grade.						
Smith Northam Mill. Co., Hartford, Ct.						
O. F. Metcalf & Sons.	Franklin	8.12	—	3.95	—	2.51
Toledo Elevator Co., Toledo, Ohio.						
*Star Feed, ...B. W. Brown.........	Concord.......	8.74	7-10	5.93	6.5-8	10.95
*Star Feed,.......C. B. Sampson	Holyoke..	8.69	7-10	7.01	6.5-8	10.37
*Star Feed,.......Torrence, Vary & Co..	Lynn..........	8.39	7-10	6.29	6.5-8	10.53
*Star Feed,.......J. D. Norton	Warren	8.34	7-10	5.46	6.5-8	9.93

PROVENDER.

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Ham & Co., Woburn.						
Ham & Co............	Woburn	10.40	—	4.36	—	11.24
Smith Northam Mill. Co., Hartford, Ct.						
J. F. Ray.............	Franklin	9.13	9.00	3.48	4.00	4.71
Springfield Flour & Grain Co., Springfield						
Spring'd Flour and Grain Co.	Springfield	10.09	—	3.99	—	11.08
C. P. Washburn, Middleboro.						
C. P. Washburn	Middleboro....	9.77	—	3.75	—	5.59

CORN AND OAT FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
A. H. Brown & Bros., Boston.						
Queen, ...F. Diante	S. Braintree ...	9.35	10-12	5.89	4-5	6.77
Buffalo Cereal Co., Buffalo.						
Horse, ...G. B. Pope & Co	Waltham	11.72	12.00	4.06	4.50	9.36
Stock,............Beaver Coal & Grain Co	Norwood	9.09	9.00	4.51	4.50	6.14
Stock,............A. Culver Co.........	Rockland......	8.16	9.00	5.04	4.50	7.92
Chas. M. Cox Co., Boston.						
Wirthmore,.......W. P. Reynolds	Canton	9.97	10-12	7.67	4-5	7.54
Wirthmore,.......G. H. Turner.........	Charlemont....	9.18	10-12	6.17	4-5	7.14
Wirthmore,.......A. J. Richards & Son..	Quincy	9.74	10-12	6.83	4-5	6.05
Wirthmore,.......C. R. Conant.........	Whitman......	9.44	10-12	7.79	4-5	8.38
Elsworth & Co., Buffalo.						
De Fi,............B. F. Mills	Pittsfield	8.25	8.30	2.47	3.00	14.69
John Franks, New Bedford.						
Climax, ...Griffen Bros..........	Fall River	9.44	11-14	6.52	4-5	14.29
Climax, ...A. Altman............	New Bedford..	10.67	11-13	6.16	4-5	14.03

* Not sold as straight hominy meal.

CORN AND OAT FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
J. B. Garland & Son, Worcester.						
Red Tag A, ...J. B. Garland & Son ..	Worcester	11.63	12.00	4.88	3.50	14.44
Red Tag B, ...J. B. Garland & Son ..	Worcester	10.93	10.00	5.41	3.25	13.34
Great Western Cereal Co., Chicago.						
Boss, ...C. B. Benedict........	Gt. Barrington.	9.13	8-10	4.14	3.5-5	10.34
Boss, ...C. G. Burnham	Holyoke.......	9.18	8-10	5.82	3.5-5	8.50
Excelsior, ...Morse & Bosworth....	Foxboro	7.78	8-10	2.77	3.5-5	10.03
Excelsior, ...Stanley Grain Co.	Lawrence	8.30	8-10	2.24	3.5-5	10.24
Sterling, ...Scott Grain Co........	Amesbury	10.36	11-13	1.78	4-5	11.04
Sterling, ...Mackenzie & Winslow	Fall River.....	10.71	11-13	5.25	4-5	9.88
Sterling, ...C. A. Pierce..........	Hinsdale	9.92	11-13	3.02	4-5	11.43
W. H. Haskell & Co., Toledo, Ohio.						
Haskell's, ...Hathaway&Mackenzie	New Bedford..	9.52	8-10	6.29	4-5	5.35
Haskell's, ...W. P. Whittemore Co.	Roslindale.....	9.35	8-10	7.56	4-5	7.01
H-O Co., Buffalo.						
N. E. Stock, ...E. J. Adams..........	Gt. Barrington.	8.04	9.00	4.09	4.00	12.08
N. E. Stock, ...Jaquith & Co.	Woburn	9.74	9.00	4.75	4.00	10.20
N. E. Stock, ...E. A. Cowee..........	Worcester	8.16	8.00	4.87	4.00	11.84
Husted Milling & Elevator Co., Buffalo.						
Husted, ...C. F. Pease	Chester	9.00	8-10	4.90	4-6	7.42
Monarch, ...C. F. Pease	Chester	9.00	7.5-9	3.53	3.5-4.5	6.38
Monarch, ...Taunton Teaming Co.	Taunton.......	7.86	7.5-9	3.58	3.5-4.5	8.77
Regal, ...C. F. Pease	Chester	7.78	7-9	3.23	3-4	11.30
Imperial Grain Milling Co., Toledo, Ohio.						
Steam Cooked, ...C. G. Burnham	Holyoke	8.86	10.00	4.10	5.25	3.22
Quaker Oats Co., Chicago.						
Schumacher's, ...E. A. Cowee	Auburn	10.79	10-12	2.54	4-5	10.47
Schumacher's, ...E. F. Cole	Billerica.......	10.93	11-13	3.92	4-5	11.47
Schumacher's, ...J. F. Kirk............	New Bedford..	9.56	10-12	2.80	4-5	10.30
Victor, ...C. A. Pease	Hinsdale	7.33	7.5-9	2.56	3-4	12.03
Victor, ...P. Vigeant & Co.....	Lowell	8.60	7.5-9	2.88	3-4	11.34
Victor, ... Spring'd Flour & Grain Co...	Springfield	7.46	7.5-9	3.28	3-4	11.92
Victor, ...Mitchell Sawyer Co...	Sterling	7.33	7.5-9	3.43	3-4	13.57
Victor, ...J. Paull & Co.........	Taunton.......	7.73	7.5-9	3.39	3-4	7.70
Malden Grain Co., Malden.						
Excel (XL), ...Malden Grain Co.....	Malden........	9.97	12.73	.3.24	3.48	—
Noyes & Colby, Boston.						
New Era, ...E. W. Kenerson & Co.	Worcester	9.70	10-12	8.09	4-5	8.31
F. F. Woodward & Co., Fitchburg.						
Veribest, ...J. W. Kaymond.......	Concord.......	9.97	10-12	7.77	4-5	7.39

FORTIFIED STARCHY FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found	Fat. Guar.	Fiber.
		%	%	%	%	%
Buffalo Cereal Co., Buffalo.						
Horse, ... BeaverCoal & GrainCo	Norwood	12.51	12.00	4.31	4.50	7.56
Corno Mills, East St. Louis, Ill.						
Corno Horse,..... John Shea............	Lawrence	11.98	10.00	4.06	3.50	14.60
Green River Grain Co., Greenfield.						
O. K. Horse, ... W. N. Potter & Sons..	Greenfield	12.34	12.00	4.05	4.25	5.98
H-O Co., Buffalo.						
Algrane Horse,... J. O. Ellison & Co.....	Haverhill	12.20	12.00	4.25	4.50	11.09
Husted Milling & Elevator Co., Buffalo.						
Husted Horse,.... Taunton Teaming Co.	Taunton.......	13.34	12-14	4.38	4-5	6.20
Quaker Oats Co., Chicago.						
Quaker Dairy,.... G. B. Pope & Co......	Waltham	13.65	12-14	3.32	3-4	9.90

OAT FEED.

Chas. M. Cox Co., Boston.						
Wm. J. Meek.........	Fall River	5.97	6-8	3.11	2-4	24 69
J. Franks.............	New Bedford ..	6.28	—	3.30	—	23.40
H-O Co., Buffalo.						
Jim Dandy,........ Butman & Cressey....	Lynn	8.21	7.50	3.26	2.75	22.78
Jim Dandy,........ N. A. Seymour	S. Lancaster ..	7.78	7.50	3.05	2.75	22.50

MISCELLANEOUS STARCHY FEEDS.

A. H. Brown & Bros., Boston.						
Dried Grains,.. Bedford Coal & Grain Co.	Bedford	12.86	10.00	3.83	2.50	11.48
Potter Bros. & Co., North Adams.						
Corn Bran, ... Potter Bros. & Co	North Adams..	7.16	—	1.38	—	11 48

III. Poultry Feeds.

MEAT SCRAPS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
		%	%	%	%	%
First Grade.						
American Agric. Chem. Co., New York.						
Dresser, Hull Co	Lee	53.44	40-60	14.24	5-6	21.65
Bowker Fertilizer Co., Boston.						
Burbeck & Brett......	N. Abington...	55.46	40-60	14.85	5-6	18.39
Joseph Breck & Sons, Boston.						
M. H. Rolfe..........	Newburyport .	46.86	40-50	16.15	10-15	24.29
W. D. Higgins, South Framingham.						
Bosworth & Wood....	Leominster	46.50	45-65	14.91	20.00	27.35
N. E. Dressed Meat & Wool Co., Boston.						
S. B. Green & Co.	Watertown	52 82	53-57	12.75	10-15	25 14
Park & Pollard Co., Boston.						
Blue Ribbon......W. K. Gilmore & Sons	Wrentham	80.95	74-78	10.20	—	* 1.84
Pawtucket Rend. Co., Pawtucket, R. I.						
W. P. Barney.........	Seekonk.......	49 01	50.00	12.47	16.00	26.33
Springfield Rendering Co., Springfield.						
Harder Coal& GrainCo	Springfield	48.70	40-60	15.05	15-20	23.78
Average..............	....	54.22	—	13.83	—	23.85
Second Grade.						
J. C. Dow & Co., Boston.						
J. F. Kirk	New Bedford..	43.92	43-50	17.07	12-15	25.10
Hinckley Rendering Co., Somerville.						
G. B. Pope & Co	Waltham	39.49	40-40	10.73	15-20	37.63
Pilgrim Rendering Co., Plympton.						
J. Morton & Co.......	Plymouth	33 87	40-60	18.01	10-20	35.65
J. A. Torrey, Rockland.						
No. 1,.............A. Culver Co.........	Rockland......	42.96	46.00	14.18	19.00	28.69
Whitman & Pratt Rend. Co., Lowell.						
F. G. Morey..........	Billerica	42.11	40-50	13.72	10-15	32.81
J. Loring & Co	Watertown	41.59	40-50	12.60	10-15	32.56
Average..............	....	40.66	—	14.39	—	32.07

* Not included in average.

MEAT AND BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat Found.	Fat Guar.	Ash.
		%	%	%	%	%
Bowker Fertilizer Co., Boston.						
Animal Meal, ... E. F. Wilbur & Son ..	Mansfield	40.63	40.00	9.90	5.00	36.21
J. C. Dow & Co., Boston.						
Favorite, ... S. R. Carter	West Berlin ..	31.50	32-35	10.51	10-12	39.78
Geo. E. Marsh Co., Lynn.						
H. L. Patrick	Hopedale	35.94	36-46	6.61	8-12	46 94
Swift's Lowell Fertilizer Co., Boston.						
Eastern Grain Co.....	Bridgewater ..	46.50	40-50	11.76	8-15	31.42

MILK PRODUCTS.

Bent-Croissant Co., Antwerp, N. Y.						
Milk Albumen, ... N. A. Seymour	S. Lancaster...	45.07	43-50	0.46	1-15	28 08
Geo. L. Harding, Binghamton, N. Y.						
Granulated Milk, . A. E. Lawrence & Son	Ayer	36.86	43-50	7.14	15-20	27.46

POULTRY MASH AND MEAL.

Buffalo Cereal Co., Buffalo.						
G. H. Atkinson Co....	Reading	16.90	17.00	5.00	5.00	3.20
Chas. M. Cox Co., Boston.						
Wirthmore, ... F. W. Sawtelle & Co..	Hyde Park	20.18	20.00	2.55	3.00	12.08
Wirthmore, ... H. A. Crossman	Needham	21.11	20.00	3.87	3.00	8.81
J. W. Day & Co., Lynn.						
Meat Mash, ... J. W. Day & Co	Lynn..........	14.62	11.50	4.77	3.50	3 09
Green River Grain Co., Greenfield.						
W. N. Potter & Sons..	Greenfield	16.11	16.46	3.58	4.14	4.40
H-O Co., Buffalo.						
Algrane, ... G. F. Green Coal Co..	Campello	17.81	17.07	5.45	5.50	2.91
Algrane, ... W. J. Meek	Fall River	16.94	17.00	5.12	5.50	—
N. E. Poultry Supply Co., Springfield.						
Quality, ... N. E. Poultry Sup. Co.	Springfield	13.82	16-18	4.23	5-6	5.38
Park & Pollard Co., Boston.						
Dry Mash, ... F. A. Fales & Co	Norwood	20.09	20-23	2.09	3.00	20.69
Fattening Feed,... Pierce & Winn	Arlington......	10.58	10.00	3.24	3-4	2.95
Quaker Oats Co., Chicago.						
American, ... A. Beck..............	Fitchburg	13.12	12-14.5	5.55	3.5-4.5	3 00
American, ... D. H. Craig	Plymouth	12.81	12-14 5	5.31	3.5-4.5	2.91

POULTRY MASH AND MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
		%	%	%	%	%
G. T. Savage Poultry Supply Co., Boston						
Meat Cereal, ... E. F. Wilbur & Son ..	Mansfield	14.44	11.50	4.57	3.50	7.08
L. H. Southworth, West Stoughton.						
Special, ... L. H. Southworth	W. Stoughton .	19.09	15.00	4.35	4.50	8.20
C. W. Upham, North Foxboro.						
C. W. Upham	North Foxboro.	20.14	—	5.28	—	8.33

CHICK AND SCRATCHING GRAINS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
Chick.						
Geo. B. Pope & Co., Waltham.						
G. B. Pope & Co......	Waltham	10.97	9-11	2.27	3.00	1.89
Scratching Grains.						
W. H. Cunningham & Son, Malden.						
W. H. Cunningham & Son	Malden........	10.27	10.00	3.06	2.00	1.80
Great Western Cereal Co., Chicago.						
Sterling, ... C. B. Benedict........	Gt. Barrington.	10.67	12.00	2.90	3.00	3.45
Green River Grain Co., Greenfield.						
G. K., ... A. D. Potter..........	Orange........	10.01	10-11	3.02	3-4	1.63
H-O Co., Buffalo.						
Algrane.......... E. J. Adams..........	Gt. Barrington.	11.89	11.00	4.12	3.50	1.99
Algrane.......... A. Carr	Northboro	10.93	11.00	3.09	3.50	1.76
Husted Milling & Elevator Co., Buffalo.						
Husted, ... W. K. Gilmore & Sons	Walpole	10.23	11-13	2.75	4-5	1.60
N. E. Poultry Supply Co., Springfield.						
Quality Pigeon, ... N. E. Poultry Sup. Co.	Springfield	12.69	12-15	3.29	3.5-4.5	2.16
Purina Mills, St. Louis.						
Purina, ... L. H. Southworth.....	W. Stoughton .	10.23	11.00	3.51	3.60	1.79
Quaker Oats Co., Chicago.						
Schumacher's, ... J. Loring A Co.......	Watertown	10.53	10.50	2.79	3.00	1.88
Robinson-Danforth Co., St. Louis.						
Winner, ... L. H. Southworth.....	W. Stoughton .	10.36	9.00	2.85	3.00	1.67
C. W. Upham, North Foxboro.						
C. W. Upham	North Foxboro.	9.88	—	2.93	—	1.69

ALFALFA MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Kansas Pure Alfalfa Mill Co. Wichita, Kan.						
Malden Grain Co.	Malden........	15.44	16.00	1.11	2.02	31.19
Purina Mills, St. Louis.						
Purina, ... J. B. Garland & Son...	Worcester	15.09	15.00	1.42	1.50	30.01

A TALK ABOUT THE INSPECTION.

I. Protein Feeds.

Cottonseed and Linseed Meals. Pages 8-11.

The cottonseed meals reported in this bulletin represent with few exceptions the crop of 1907. As much more cottonseed is found on the market during the winter and spring than during the fall months, the cottonseed meals taken during the winter collection are reported together with those of the recent fall collection. Much of the 1906 meal, on account of adverse weather conditions was inferior and 75 per cent of the samples collected failed to maintain their nitrogen and protein guarantees. The 1907 crop has shown a decided improvement and of 44 samples here reported only 22 per cent have fallen below their guarantees and these but slightly. The Inter-State Cotton Crushers' Association grades cottonseed meal as follows: (Rules as amended and adopted May 18, 19, 20, 1908.)

"*Choice cottonseed meal* must be finely ground, perfectly sound and sweet in odor, yellow, free from excess of lint and by analysis must contain at least eight per cent of ammonia, or forty-nine per cent of combined protein and fat.

Prime cottonseed meal must be finely ground, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and by analysis must contain at least seven and one-half per cent of ammonia or forty-six per cent of combined protein and fat.

Good cottonseed meal must be finely ground, of sweet odor, reasonably bright in color and by analysis must contain at least seven per cent of ammonia, or forty-three per cent of combined protein and fat."

According to this classification *choice cottonseed meal* must contain at least 8 per cent of ammonia which is equivalent to 6.56 per cent of nitrogen or 41 per cent of protein. *Prime cottonseed meal* must contain at least 7.5 per cent ammonia which is equivalent to 6.17 per cent nitrogen or 38.57 per cent protein. *Good cottonseed meal* must contain 7 per cent of ammonia which is equivalent to 5.75 per cent of nitrogen or 36 per cent protein. According to the above rules a meal which, through faulty extraction or for some other reason, contained less than 41 per cent protein could be classed as choice providing the excess of fat was sufficient to make up the protein deficiency. It is believed that it is misleading and in Massachusetts illegal to present a combined protein and fat guarantee. Cottonseed meal for fertilizer purposes is purchased on an ammonia or nitrogen basis. For feeding, the protein content is considered of prime importance. An excess of fat is undesirable both for fertilizing and feeding purposes.

The experiment station has for some years classified and still continues to classify this material into three grades according to protein content. High grade or choice meal should contain 41 or more per cent, medium grade or prime meal 36 to 41 per cent, and low grade meal less than 36 per cent of protein.

It is stated on good authority that the 1908 crop of seed is of excellent quality, and that much of the resulting meal will test 46 or more per cent protein and further that many crushers are taking advantage of this condition by adding sufficient linters to reduce the protein content to 41 per cent. While the addition of some 10 per per cent of linters probably would not render the meal injurious to animals, such an admixture is not recommended and consumers are urged to give the preference to meal free from such an addition. The linters or short cotton fibers cause the meal to have a bulky appearance.

Humphreys, Godwin & Co., Memphis, Tenn. in addition to complying with all the requirements of the Massachusetts law also attach the following statement to goods bearing their name:

"If, through error in manufacture, the analysis of the meal in this shipment does not equal the guarantee within 1 per cent of protein as shown on the reverse side of this tag, we agree to refund on the basis of 50c per unit of protein . . . such claim supported by proper samples to be made within 10 days after arrival of car."

Nitrogen, Ammonia and Protein Equivalents.

Nitrogen, ammonia and protein are relative terms as both ammonia and protein are estimated from the nitrogen content of the meal.

One per cent of nitrogen equals 1.2 per cent ammonia equals 6.25 per cent protein.

One per cent ammonia equals .83 per cent nitrogen equals 5.2 per cent protein.

One per cent protein equals .17 per cent nitrogen equals .20 per cent ammonia.

PERCENTAGES.

Nitrogen.		Ammonia.		Protein.
5.75	equals	7.00	equals	36.00
6.10	"	7.40	"	38.00
6.25	"	7.60	"	39.00
6.40	"	7.80	"	40.00
6.56	"	8.00	"	41.00
6.70	"	8.20	"	42.00
6.90	"	8.40	"	43.00

AVERAGE ANALYSES AND RETAIL PRICES.

	High Grades. 1906.	Medium Grades. 1906.	High and Medium Grades. 1906.
No. Samples,	23	29	52
Protein,	42.19	34.98	40.68
Fat,	8.79	8.56	8.66
Price a ton,	$32.54	$32.53	$32.54

	High Grades. 1907.	Medium Grades. 1907.	High and Medium Grades 1907.
No. Samples,	20	56	76
Protein,	42.45	38.76	39.73
Fat,	9.11	9.05	9.07
Price a ton,	$33.00	$32.78	$32.84

	High Grades. 1908.	Medium Grades. 1908.	High and Medium Grades. 1908.
No. Samples,	31	10	41
Protein,	43.07	39.19	42.12
Fat,	9.27*	8.41†	8.94‡
Price a ton,	$32.18	$32.20	$32.19

Cottonseed meal is an economical concentrate for milk production. A satisfactory grade should be free from an excess of lint and hulls and of a light yellow color. Purchasers in buying should note the physical appearance as well as guarantee and they are especially warned against low grade meal guaranteed to contain about 25 per cent of protein. Such meal is decidedly inferior in feeding value not only

* Average 8 samples, Fall Collection.
† Average 5 samples, Fall Collection.
‡ Average 13 samples, Fall Collection.

on account of its low protein content but also because of the added hulls, which are quite indigestible. While it probably is good economy for the southern farmer to feed a combination of hulls and meal, the northern feeder cannot afford to do it.

Bibby's Cottonseed Cake and Bibby's Oil Cake Feed are compounded articles into which the entire cottonseed enters. They are imported products which have not assumed any great commercial importance in this country.

Linseed meal. The linseed meals collected were of good quality and free from adulteration. Much of the linseed cake made in this country is exported, it being a favorite feed stuff in England and on the continent. When sold at a price commensurate with other feeding stuffs it is always an economical concentrate and many feeders are willing to pay a little extra for it because of its satisfactory effect upon the general health and condition of the animal.

AVERAGE ANALYSES AND RETAIL PRICES.

New Process.

	1905.	1906.	1907.	1908.
No. of Samples,	6	7	7	6
Protein,	37.49	35.82	35.89	35.09
Fat,	2.49	2.51	3.16	3.28
Price a ton,	$31.50	$32.46	$32.67	$33.50

Old Process.

	1905.	1906.	1907.	1908.
No. of Samples,	15	19	12	9
Protein,	34.29	33.57	35.27	34.94
Fat.	7.91	7.76	7.71	6.73
Price a ton,	$33.87	$34.00	$34.64	$35.44

Flax Feed and Flax Flakes are ground flax screenings. Their composition is likely to vary greatly depending upon the quality of the seed from which they are separated. On account of the large amount of weed seeds present they have a decidedly bitter taste, which renders them quite unpalatable for most animals. The two lots reported were offered at a considerably lower figure ($26 and $27) than the ruling price for other concentrates. Their use, under most conditions, is not encouraged.

Gluten Feed.
Pages 11-12.

Gluten feed is—excepting the germ—the residual product in the manufacture of starch and glucose from corn. It is used extensively in dairy rations. and is considered one of the most satisfactory concentrates. During the past season considerable agitation has been caused because of the acid or sour taste of many lots of this feed stuff and because of its supposed coloration with an aniline dye. This station is now making, through Mr. P. V. Goldsmith, a somewhat extended investigation of the gluten feeds found in the Massachusetts markets. The results thus far secured may be stated briefly :

Acidity. Some lots of feed were found to be only slightly sour, while others were so sharply acid to the taste as to be considered unpalatable. As a very dilute solution of sulfurous acid is used to soften the corn in the process of manufacture, it was assumed by some that the sour taste was due largely to this acid. It was found, however, that sulfurous acid (sulfites) were present only in such very minute quantities as to be considered in no way injurious. Sulfuric acid was also present in such small amounts (probably as a sulfate or bi-sulfate) as not to be responsible for the greater part of the acidity. The evidence now at hand indicates that the sour condition is due principally to some form of phosphorous. While the amount of acid present is, in all probability, not injurious to animals, it is believed that a more satisfactory product would result if these feeds were treated in such a way as to leave only a minimum amount of acid evident to the taste.

Coloring Matter. A great many of the gluten feeds on the market were found to be artificially colored with an aniline dye. The manufacturers claim that coloring matter is added for two reasons, first, to make the feed more attractive and, second, because white or yellow corn being used, it is necessary to resort to coloring in order to obtain a uniform product. The amount of color used is evidently so small as not to be injurious. The practice of coloring, however, is to be regretted since it in no way improves the nutritive value of the feed. Buyers are urged to be governed *not by color* but by the guarantee and taste of the feed stuff.

Following is a tabulation showing the colored feeds found on the market and also the degree of acidity measured in terms of sulfuric acid. *This does not mean that the acid present was sulfuric (in fact very little of it was): sulfuric is simply used as a unit for measuring the combined acidity of the different substances which give a sour taste to the feed.*

GLUTEN FEED.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Acidity	Coloring.
		%	
American Maize Products Co., Chicago.			
Cream of Corn, ..G. B. Brown..........	Ipswich	0.84	Artificially colored.
Cream of Corn, ..J. W. Doon & Co.....	Natick	1.38	" "
Corn Products Mfg. Co., Chicago.			
Buffalo, ...T. A. Holt Co.........	Andover	0.44	" "
" ....W. E. Bryant & Co...	Brockton	0.55	" "
" ....G. F. Green Coal Co..	Campello	0.06	" "
" ....Haverhill Milling Co..	Haverhill......	1.06	" "
" ....H. K. Webster Co....	Lawrence	2.24	" "
" ....S. L. Davenport & Son	N. Grafton.....	0.03	" "
" ....Curley Bros...........	Wakefield	1.06	" "
" ....W. K. Gilmore & Sons	Walpole	0.06	No color detected.
" ....D. F. Howard	Ware	0.03	Artificially colored.
" ....A. S. Gurney & Co....	Wareham	1.48	" "
" ....Prentiss, Brooks & Co.	Westfield......	0.78	" "
" ....Ropes Bros...........	Salem	0.92	" "
Pekin,............Hathaway&Mackenzie	New Bedford..	0.79	" "
" ....J. S. Wolfe	Pittsfield	1.53	" "
" ....Taunton Teaming Co.	Taunton.......	0.77	" "
Corn Products Mfg. Co., New York.			
Diamond, ...F. E. Smith	Amherst	2.11	" "
" ....A. Dodge & Son......	Beverly	0.87	" "
Globe,............Potter & Co..........	Athol	1.60	" "
" ....W. N. Potter Grain Co	Gardner	1.09	" "
G. M. Foster	Lowell	1.11	" "
St. Louis Syrup & Pres. Co., St. Louis.			
A. J. Richards & Son .	Quincy	1.09	" "
Douglas & Co., Cedar Rapids, Mich.			
Cedar Rapids,....J. Franks............	New Bedford..	0.10	No color detected.
J. C. Hubinger Bros. Co., Keokuk, Iowa.			
J. W. Raymond	Concord.......	0.08	Artificially colored.
C. P. Washburn	Middleboro....	0.08	" "
Meech & Stoddard, Middletown, Conn.			
A. Altman...........	New Bedford..	0.14	No color detected.
Piel Bros. Starch Co., Indianapolis, Ind.			
Lexington Grain Co...	Lexington	0.06	" " "
J. E. Soper & Co., Boston.			
Bay State,........T. E. Borden	N. Westport...	0.06	" " "
Western Glucose Co., Chicago.			
Western, ...O. F. Metcalf & Sons.	Franklin	0.70	Artificially colored.
" ....J. B. Garland & Son ..	Worcester	0.50	" "
" ....Wilson & Holden.....	Worcester	0.18	" "

Cream of corn gluten feed. The two samples were artificially colored and unduly acid but maintained their guarantee.

Corn Products Co. Nineteen out of the 20 samples collected—Buffalo, Pekin, Diamond and Globe—were artificially colored. Many samples were rather too acid ; they practically all met their guarantees.

St. Louis Syrup & Preserving Co. One sample was artificially colored and possessed some acidity. It did not maintain its protein guarantee.

Cedar Rapids Gluten Feed. Sample collected was not artificially colored and no excess of acid was noted. It did not meet its protein guarantee by about four per cent, and also fell below in fat.

J. C. Hubinger Bros. Co. Two samples, artificially colored with practically no acidity. They did not maintain their guarantees.

Meech & Stoddard. Neither artificial color nor acidity detected. It fell below its protein guarantee some three per cent.

Piel Bros. No artificial color or acidity. It failed to meet its guarantee.

Bay State Gluten Feed. The sample examined contained no artificial color or acidity. It did not maintain its guarantee.

Western Glucose Co. The three samples collected were artificially colored. They did not maintain their protein guarantees.

AVERAGE ANALYSES AND RETAIL PRICES.

	1906.		1907.		1908.	
	First Grade.	Second Grade.	First Grade.	Second Grade.	First Grade.	Second Grade.
No samples,	13	19	52	16	46	31
Protein,	24.98	22.59	25.97	21.52	25.52	21.22
Fat,	3.21	4.72	3.23	4.53	2.83*	3.04
Price a ton,	\$28.00	\$26.94	\$30.76	\$31.83	\$32.48	\$32.66

Distillers' and Brewers' By-Products.
Pages 12-13.

Distillers' Dried Grains consist of the residue from the manufacture of distilled liquor and spirit from the cereals. They vary widely in protein content and may be divided into several classes depending upon the proportions of the several cereals from which they are derived. Those obtained in the process of manufacturing whiskey and alcohol from corn contain the highest percentage of protein and are the only class usually found on the Massachusetts market.

* Average of 21 samples.

During the past year distillers' grains have not been widely distributed. The better grades are excellent feeds, for in addition to their high protein content they are bulky, and hence can be used in the place of wheat bran for lightening the grain ration. Several of the ready grain rations on the market contain a considerable proportion of distillers' grains. In purchasing, the consumer should make sure that he is getting the quality desired by carefully noting the guarantee. They should be free from a strong acid or rancid taste (due to fermentation before drying) and should not have been unduly charred during the drying process.

AVERAGE ANALYSES AND RETAIL PRICES.

	1905. All Samples.	1906. First Grade.	1906. Second Grade.	1906. Average.
No. samples,	23	12	10	22
Protein,	32.00	32.28	26.92	29.85
Fat,	11.90	12.87	10.43	11.75
Price a ton,	$27.29	$28.23	$28.13	$28.18

	1907. First Grade.	1907. Second Grade.	1907. Average.	1908. First Grade.	1908. Second Grade.	1908. Average.
No. samples,	16	11	27	11	6	17
Protein,	32.30	29.75	31.03	32.07	26.79	30 21
Fat,	12.75	11.94	12.35	12.46*	7.68†	8.25‡
Price a ton,	$30.45	$31.00	$30.72	$33.23	$32.00	$32.89

Malt sprouts. But three samples of malt sprouts were taken during the fall collection. These were quoted at prices considerably below those asked for other concentrates having less feeding value. Massachusetts feeders do not seem to realize that malt sprouts are to be classed among the economical concentrates. At present, sprouts are scarce and high.

AVERAGE ANALYSES AND RETAIL PRICES.

	1905.	1906.	1907.	1908.
No. samples,	11	6	13	9
Protein,	26.52	27.66	25.91	27.61
Fat,	1.06	1.51	1.20	0.89§
Price a ton,	$22.55	$21.13	$23 56	$26.75

* Average of 6 samples.
† " 4 "
‡ " 10 "
§ " 3 "

Brewers' grains. But three samples of dried brewers' grains were collected. This feed stuff is extensively used abroad, and much that is produced in this country is exported. It is also used as a component of many molasses feeds. In feeding value brewers' grains are somewhat superior to wheat bran, and they can be used satisfactorily as a partial substitute for oats in feeding horses (by weight ¼ oats and ¼ brewers' grains, or ⅓ corn, ⅓ oats and ⅓ brewers' grains). The samples examined were of good quality and maintained their guarantees.

Wheat By-Products.
Pages 13-22.

Flour middlings. While a guarantee is not required on wheat by-products in Massachusetts, many of them bear guarantees in order to conform to feed laws in other states. The guaranteed brands averaged 17.32 per cent of protein, while those unguaranteed averaged 15.05 per cent. MORAL: It pays to buy guaranteed goods.

Flour middlings form an excellent source of digestible carbohydrates (starchy matter), as well as protein, and serve admirably to supplement the home grown supply of corn and as a component of most grain mixtures intended for dairy stock.

Standard middlings. The standard middlings were, as a whole, of good quality. Some samples, however, contained so many screenings as to give a decidedly bitter taste to the feed.

The United States Department of Agriculture, in its "Pure Food Decision 90," makes the following statement in regard to wheat bran which may apply with equal force to all wheat by-products:

"The Department has frequently received inquiries in regard to the labeling of bran, of which the following is a fair sample:

'Can the screenings of wheat, consisting principally of shrunken seed, etc., be put in the bran and it still be called bran, etc.'

Since the above is clearly in violation of those provisions of the law requiring that a food product be true to label, the Department is of the opinion that it will be necessary to label such a mixture as 'Bran and Screenings.'"

Ballard & Ballard's "Ship Stuff" bore the statement "Ground Screenings Included." The sample examined, however, was fully as good as some samples which gave no indication of their true content.

One sample of the Northwestern Consolidated Milling Co.'s brown middlings collected in the spring and two samples collected during the fall contained a marked amount of ground weed seed.

A sample of Gopher middlings and five samples of middlings marked "Aloras" contained an excessive amount of weed seeds and screenings. In a letter from the Brooks Elevator Co. of Minneapolis, who claim to handle a large portion of this feed, the following statement is made: "We are not selling this feed as standard middlings, but altogether on sample, and all buyers of it know that it contains a mixture of ground screenings." Granting the truth of this statement, it is nevertheless a fact that this feed has been offered and sold, in some cases at least, as pure wheat middlings, as is evident from the following letters received from Massachusetts dealers:

"I have sent you under separate cover a bag which contained these middlings so you can see just how they are marked. There is no tag to tell what they contain. . . . . . If there is anything further I can do to help you I will gladly do so, as I think the manufacturers should be looked after."

"We gave the order for a car of standard middlings, and these 'Aloras' middlings were what was shipped us. We supposed them to be straight wheat middlings. We do not now understand exactly what the screenings are. . . . . We realized some little time ago that these middlings were very poor, but did not know what the matter was with them."

In the following instance the goods were evidently sold on sample:

"We did not buy this for straight standard middlings, but just what card attached to each bag states."

The attached tag in this instance read as follows:

New Occidental Milling Co.
Minneapolis, Minn.

Aloras,	100 lbs.
Protein,	16 per cent.
Fat,	5 per cent.
Fiber,	7.5 per cent.

Guaranteed to contain no harmful ingredients. This feed is made of 90 per cent Pure Wheat Middlings and 10 per cent of carefully selected ground screenings consisting of broken flax, wheat and buckwheat, and entirely free from dirt or noxious seeds.

In addition to our own examination of the Aloras brands, samples were submitted to two different microscopists connected with the United States Department of Agriculture, who made the following reports:

"The sample contains not less than 10 per cent of screenings, which are mainly composed of weed seeds. An examination for poisonous weed seeds shows the presence of some corn cockle, but whether or not the corn cockle is present in sufficient amounts to be injurious, can only be settled by physiological experiments."

"I find that the sample contains, in addition to wheat middlings, a certain amount of foreign seeds, among which are the following: flax seed, cockle, mustard seed, foxtail and black bindweed. The latter seed, as you are well aware, is often known as wild buckwheat. Quite possibly the manufacturers refer to this when they state that the product contains buckwheat."

In the light of all the evidence furnished the Station has taken exception to the tag used as not conforming to the requirements of the Massachusetts feed law (Section 6), and upon correspondence the manufacturers have agreed to use a tag like the one reproduced below:

New Occidental Milling Co.
Minneapolis, Minn.

Aloras,	100 lbs.
Protein,	16 per cent.
Fat,	5 per cent.
Fiber,	7.5 per cent.

This feed is made of 90 per cent pure wheat middlings and 10 per cent of carefully selected ground screenings.

Wheat mixed feed should contain, with the exception of screenings, all the by-products of the flour mill. Occasional samples are noted which appear to be nothing more or less than wheat bran. There appeared to be a noticeable improvement in the quality of the mixed feed offered as to the amount of middlings incorporated, and with a few exceptions the feeds were comparatively free from screenings. A good quality of mixed feed has a feeding value somewhat higher than wheat bran.

Wheat bran was, with few exceptions, of the usual quality. Some samples contained an appreciable amount of screenings. Several manufacturers are now marking their bran, when screenings are added, as "Bran and Screenings," in accordance with the United States Department of Agriculture Pure Food Decision No. 90. While wheat bran is a comparatively expensive protein concentrate because of its relatively low digestibility, its other many desirable qualities commend it as a valuable component of the dairy ration.

AVERAGE ANALYSES AND RETAIL PRICES.

Wheat Middlings, Flour.

	1905.	1906.	1907.	1908.
No. samples,	21	26	16	28
Protein,	16.20	17.67	17.62	17.16
Fat,	4.20	4.83	4.76	4.69*
Price a ton,	$27.82	$25.79	$30.39	$32.80

Wheat Middlings, Standard.

	1905.	1906.	1907.	1908.
No. samples,	58	35	28	47
Protein,	15.93	17.30	16.78	17.14
Fat,	4.82	5.39	5.30	5.09†
Price a ton,	$24.39	$24.62	$28.50	$31.02

Wheat Mixed Feed.

	1905.	1906.	1907.	1908.
No. samples,	128	67	97	133
Protein,	15.09	16.29	16.35	16.19
Fat,	4.45	4.71	4.86	4.65‡
Price a ton,	$24.39	$23.99	$28.93	$31.12

Wheat Bran.

	1905.	1906.	1907.	1908.
No. samples,	36	31	58	52
Protein,	14.39	15.11	15.60	15.47
Fat,	4.55	4.77	4.89	4.53§
Price a ton,	$23.09	$23.18	$29.67	$29.40

Adulterated Wheat Feeds.

These feeds, as has been many times explained, consist of substantially 1400 to 1500 pounds of bran and 500 to 600 pounds of ground corn cobs. If the consumer is willing to buy such material, paying nearly the same price as for pure wheat feeds, with a full knowledge of what he is getting, it is his privilege to do so. The duty of the station is ended when it has seen that such feeds are properly branded and attention has been called to their true nutritive value.

AVERAGE ANALYSES AND RETAIL PRICES.

	Adulterated Wheat Feed.	High Grade Wheat Feed for Comparison.
No. samples,	5	133
Protein,	10.82	16.19
Fat,	3.01	4.65
Fiber,	15.57	8.20‖
Price a ton,	$29.80	$31.12

*Average 21 samples. †Average 33 samples. ‡Average 85 samples. §Average 41 samples. ‖ Average 732 samples.

Dairy Feeds. **Page 22.** Under the head of dairy feeds are classed those mixtures into which a number of commercial concentrates are incorporated in order to produce what is known as a "balanced" or ready ration.

"The requirements of a ready ration may be outlined as follows:

1. It should be bulky, palatable, and free from mould and rancidity.

2. It should contain from 16 to 18 pounds of digestible protein in 100.

3. It should contain approximately 70 pounds of digestible organic nutrients in 100, and not over 9 per cent of total fiber. The latter should not be derived from corn cobs or similar material. More than 9 per cent of fiber indicates an excess of grain hulls, which naturally renders the feed less digestible."†

Unicorn dairy ration. The manufacturers state that this feed consists of wheat gluten (glutola), corn gluten feed, cottonseed meal, hominy meal, linseed meal, malt sprouts and wheat bran. Our examination substantially confirms this statement. The average price for the three samples collected was $33.50 a ton. It is an excellent feed of its kind.

A. B. C. cattle feed, while it maintained a comparatively high percentage of protein, was decidedly musty and contained a considerable amount of salt, evidently added to make the feed more palatable. Musty feeds should not be purchased.

Union grains practically maintained their guarantee. The feed retailed for $33 a ton, and could not be considered very expensive. It is an excellent feed of its kind.

Buffalo creamery feed did not meet the requirements for an ideal dairy ration, and at the price asked for the one lot collected ($35) it could hardly be considered economical.

Husted dairy feed did not maintain its protein guarantee. In order to produce a well balanced ration it would be necessary to add some other concentrate containing a higher percentage of protein.

Paragon dairy feed contained about 60 per cent cottonseed meal, together with an admixture of material of lower grade. It is believed that a more satisfactory ration could be produced by mixing cottonseed meal and a good quality of wheat mixed feed (1/3 cottonseed and 2/3 mixed feed by weight.) The one sample collected retailed at $31 a ton.

† Dr. Lindsey, Bulletin 120.

Molasses Feeds. **Pages 22-23.** Molasses feeds, generally speaking, are made up of some absorbent materials such as ground alfalfa, oat residues, mill sweepings and partially ground grain screenings, with which is incorporated a considerable amount of cane or beet molasses, or a mixture of both. Malt sprouts and brewers' grains form a part of some molasses feeds, together in practically all cases with sufficient cottonseed meal or other high grade concentrates to raise the protein to the percentage guaranteed. Many of these feeds contain an excessive amount of weed seeds, which are an important component of the grain screenings, and when unground they must contribute to the weed crop of the farm. Many manufacturers are making a noteworthy attempt to grind the screenings fine enough to destroy both their identity and germinating power.

Sucrene feeds. The Sucrene feeds collected averaged as follows:

	Sucrene Dairy Feed.	Sucrene Horse Feed.
No samples,	3	1
Protein,	17.80	12.99
Fat,	4.05	2.85
Fiber,	13.02	9.20
Price a ton,	$29.33	$30.00

In every case the guarantee was practically maintained.

A. B. C. dairy feed, represented by one sample, fully maintained its guarantee.

Daisy dairy feed. Three samples were collected. This feed contains considerably less moisture than most other molasses feeds, and has a pleasant taste and odor. The fiber content is too high to allow the feed to be classed with the economical concentrates; it also fell below its guarantee.

AVERAGE ANALYSES.

	Found.	Guaranteed.
No. samples,	3	—
Protein,	12.73	14-16
Fat,	1.17	3-4
Fiber,	13.02	—
Price a ton,	$30.33	—

Badger dairy feed. The three samples reported failed to maintain their protein guarantees.

AVERAGE ANALYSES.

	Found.	Guaranteed.
No. samples,	3	—
Protein,	15.74	18.00
Fat,	4.39	4.50
Fiber,	10.12	—

XXX feed. The manufacturers of this feed claim that screenings are not used. The weed seeds found are probably due to the fact that malt sprouts, a component of this feed, often contain an appreciable amount.

Sugarota feeds contained a considerable amount of chopped hay or alfalfa, as indicated both by the microscope and by the fiber percentage. Their use could not be considered economical.

AVERAGE ANALYSES.

	Dairy Feed.		Horse Feed.	
	Found.	Guaranteed.	Found.	Guaranteed
No samples,	3	--	2	—
Protein,	18.88	18.00	13.91	12.00
Fat,	5.43	4.50	4.13	3.50
Fiber,	18.65	—	23.30	—
Price a ton,	$29.83	—	$30.00	—

Molac feeds contained an excess of oat hulls, as is indicated by the high fiber percentage.

AVERAGE ANALYSES.

	Dairy Feed.		Horse Feed.	
	Found.	Guaranteed.	Found.	Guaranteed.
No. samples,	2	—	1	—
Protein,	14.88	15.5-17	11.93	11-13
Fat,	3.73	3-4	2.34	3-4
Fiber,	14.50	—	12.14	—
Price a ton,	$28.00	—	$28.00	—

Red Cow dairy feed. It is understood that this feed is no longer on the market. It fell decidedly below its guarantee, and contained a noticeable amount of rice hulls, which are considered not only inferior but dangerous as a food for stock. It was guaranteed to contain 15 per cent protein and only 7.95 per cent were found ; the fat, guaranteed to be 3 per cent, showed only 0.53 per cent. This feed also contained 21.24 per cent of fiber, indicating it to be composed of decidedly inferior material.

Hammond feeds approximated their guarantees and did not contain an excessive amount of fiber.

AVERAGE ANALYSES.

	Dairy Feed.		Horse Feed.	
	Found.	Guaranteed.	Found.	Guaranteed.
No. samples,	2	—	1	—
Protein,	16.50	17.00	14.71	13.50
Fat,	4.11	3.00	2.65	3.50
Fiber,	9.75	—	10.34	—
Price a ton,	$27.00	—	$29.00	—

Rye Feeds. Pages 23-24.

Six samples of rye feeds and middlings are reported. They were of good quality, uniformly free from weed seeds and other foreign material, and contained about as much protein as the average wheat bran. They resemble standard wheat middlings in feeding value.

AVERAGE ANALYSES.

No. samples,	6
Protein,	15.08
Fat,	3.23
Price a ton,	$30.20

II. Starchy (Carbohydrate) Feeds.

Ground Grains. Page 25.

Corn meal. The sample of so-called "B" meal collected was dark colored and musty, and was evidently ground from damaged corn. Such meal cannot be considered desirable for horses or cattle, but if cooked or steamed can be utilized as a feed for swine.

Ground oats. The five samples reported were as represented, and in no case were added hulls detected.

Kaffir corn meal. The sample of Kaffir corn collected resembled in composition Indian corn, and is probably equal in feeding value.

Hominy Meal. Pages 25-27.

Hominy feed or meal is a by-product from the manufacture of hominy and brewers' grits. The corn bran and germ are removed by a machine known as the degerminator, and constitute about one-third in weight of the entire corn. A considerable amount of starchy matter is removed with the bran and germ, and this combined residue constitutes the hominy meal or chop feed. Good, unadulterated hominy should analyze from 10 to 12 per cent protein and from 7 to 10 per cent fat, and should not contain over 6 per cent fiber. It can be successfully used as a substitute for corn meal and has fully as much feeding value. Occasionally hominy feed is adulterated with ground corn cob, which decreases its digestibility, as well as the percentage of protein and fat. The Star brand is the only article of this description sold in Massachusetts.

AVERAGE ANALYSES AND RETAIL PRICES.

	1905.	1906.	1907.	1908.
No. samples,	70	63	40	47
Protein,	10.25	10.54	10.71	10.20
Fat,	8.09	8.48	8.25	7.79
Price a ton,	$24.41	$24.32	$27.50	$31.88

Hominy Meal with Admixtures. (Star Brand.)

No. samples,	4
Protein,	8.54
Fat,	6.17
Fiber,	10.45*
Price a ton,	$32.67

Corn and Oat Feeds. **Pages 27-28.**

Provender. Of the four samples of provender reported, two samples, manufactured by Ham & Co. and the Springfield Flour & Grain Co., contained an excessive amount of fiber, indicating that they were not straight corn and oats ground together, but contained, in addition, considerable oat hulls. Such an admixture must be guaranteed in accordance with the law.

The Springfield Flour & Grain Co. claim they do not intend to manufacture this feed, but that it was only an experiment. Ham & Co. make the statement that this material was a mixture intended for hogs, and that it was not sold as straight provender.

Corn and oat feeds, frequently called stock feeds, consist of corn or hominy meal ground together with oat hulls, light oats, oat middlings, and occasionally screenings. Sometimes small amounts of wheat middlings and other protein concentrates are added to increase the protein content. Many of these feeds closely approximate straight provender in fiber content, others contain two or three times as much. Such mixtures, to be considered worthy of attention by feeders, should possess the following qualifications:

1. They should be free from mould and rancidity and possess a sweet taste.

2. They should contain 9 per cent of protein and not over 10 per cent of fiber.

* Average fiber content for 120 samples pure hominy feed, 4.2 per cent.

†Average 31 samples.

The bitter, rancid taste so frequently noticed is due to the use of spoiled grain. *Such feeds should not be purchased except at a discount, and should be used only as a food for swine.*

Over 10 per cent of fiber is indicative of an excess of oat hulls and light oats. *Feeders ought to be wise enough not to be willing to help out the manufacturers by paying at the rate of $30 a ton for oat hulls.*

Some stock feeds have a higher percentage of fat than others, due to the use of hominy instead of corn. Those feeds containing 9 to 10 per cent of protein, and less than 10 per cent of fiber, are the most desirable, provided they are free from screenings and rancidity.

Schumacher's stock food differs somewhat from many in that it frequently contains some barley residue, and that rather more of its protein is derived from oat middlings. It is usually sweet, although the presence of so much fiber in the present samples (10.75 per cent) lessens its nutritive value. At $33 per ton it may be used as an oat substitute for horses, but it is decidedly expensive for other stock. It is believed that corn and hominy meals or mixtures of corn and wheat middlings are more economical for dairy stock and swine than any of the so-called stock foods. The better grades may often be used as an oat substitute for horses, provided the prices warrant it.

Fortified Starchy Feeds.
Page 29.

With one exception the fortified starchy feeds were intended as a feed for horses, and consisted of corn and oat residues, together with wheat middlings or similar material, which is used to increase the protein percentage. The more important brands collected were Quaker Dairy, Husted, O. K., Algrane and Corno. The remarks made relative to the corn and oat feeds, apply with equal force to the fortified feeds.

Oat Feeds.
Page 29.

The oat feeds collected averaged over 23 per cent in fiber content. By actual trial the poorer qualities of oat feeds have been found to contain only 40 pounds of digestible matter to the hundred, as against 89 pounds in case of corn meal. Why use oat feed at $28 a ton when corn meal can be bought for $30?

III. Poultry Feeds.

Animal By-Products. Pages 30-31.

Meat scraps. To be of good quality meat scrap should be comparatively free from taint, and should not contain an excessive amount of bone, fat or moisture. The most desirable should be coarsely ground and contain at least 45 per cent protein, and not over 15 per cent fat and 25 per cent ash. A high ash content is indicative of an excess of bone. This fact can be readily confirmed by consulting the table of analyses. Occasionally samples of so-called meat scrap are found which could more properly be classed with meat and bone meals.

Blue Ribbon meat scraps deserve special mention in that they are almost pure meat, containing some 81 per cent of protein.

Meat and bone meals contain considerably more bone than meat scraps, and sell at a somewhat lower figure. The four samples reported practically maintained their guarantees and were of good quality.

Milk By-Products. Page 31.

Bent's Milk Albumen maintained its protein guarantee. It had a characteristic gluey odor and an unattractive appearance.

Harding's granulated milk did not maintain its guarantee, but in appearance and odor was superior to the Milk Albumen. If sweet, such feeds may be used as a source of protein both for fowls and chicks.

Poultry Mashes and Meals. Pages 31-32.

The ready-to-use mixtures for poultry collected by the station sold at an average figure of about $2 a hundred. While, on account of the small lots usually sold it is believed that there is some justification in the high price asked, it is also believed that foods equally as satisfactory can be home mixed at a somewhat lower price.

The feeder should bear in mind that any mixture to form a complete food under winter conditions, or where fowls are confined, should furnish all the ingredients which would naturally be obtained under ideal conditions, i. e., on unlimited summer range. That is, any complete ration should furnish grain, in the whole or ground state, animal food, green food and grit. Following are several sample mashes which, in the writer's estimation, will prove equally as satisfactory as the commercial mixtures:

FOR MATURE BIRDS.

I.		II.	
20 lbs.	wheat bran,	50 lbs.	wheat bran,
40 "	corn meal,	100 "	corn meal,
10 "	fine middlings,	75 "	wheat middlings,
10 "	linseed meal,	75 "	cut clover or alfalfa.
10 "	gluten feed,		
10 "	meat scraps.		
Cost per hundred, $1.65.		Cost per hundred, $1.53.	

FOR YOUNG CHICKS.

60 lbs.	corn meal,	10 lbs.	linseed meal,
10 "	wheat bran,	10 "	beef scrap (fine).
10 "	flour middlings,		

Cost per hundred, $1.65.

Chick and Scratching Grains. **Page 32.**

But one sample of chick grain was collected. It maintained its guarantee, and contained, in addition to corn, Kaffir corn, charcoal and millet, an appreciable amount of weed seed.

In the feeding of the young chick, unless the poultryman is running an extensive plant and can afford to have special machinery for reducing grains to the proper mechanical condition, it will probably be necessary to rely upon some of the prepared grain mixtures until the chick becomes large enough to take whole grain. In selecting such a mixture care should be taken to avoid an excessive amount of weed seed, millet seed and grit. Grit can be furnished at a much lower cost in the form of finely crushed oyster shell, gravel or coarse sand than at grain prices.

The eleven samples of scratch grains reported practically maintained their guarantees. Scratch grains usually contain corn and wheat, with varying quantities of other cereal grains, and occasionally sunflower seed, rice and meat scrap. Weed seed is often present in objectionable amounts.

Finely broken corn, wheat and rice are the most suitable grains to be used for young chickens. For the mature fowl the writer has nothing better to suggest than a mixture by weight of ½ cracked corn, ¼ wheat and ¼ barley. Commercial mixtures containing a larger variety of grain are sometimes useful but relatively expensive.

Alfalfa Meals. **Page 32.** The two samples of alfalfa meal reported fell slightly below their guarantees. Their fiber content was rather high, indicating that some of the leaves must have been lost in curing, or that the alfalfa was late cut.

For special information on the raising and feeding of poultry, see Bulletin No. 122 of this station.

GRAIN SCREENINGS IN FEED STUFFS.

Grain screenings are composed of the light, immature grain separated from the good grain in the process of winnowing, together with such dirt, chaff, straw and weed seed as may be present in the grain as it comes from the field. It is quite obvious that screenings may be of very uncertain character, depending upon the kind of weed seed and other foreign matter present.

There is a growing tendency on the part of the manufacturers of certain feed stuffs to incorporate in their products such low grade material, having an excessive amount of weed seeds. It is, of course, not practicable to remove all weed seeds from commercial by-products, but they can be made sufficiently free for ordinary purposes. In case of malt sprouts and the by-products of wheat, it is not an uncommon practice to add the screenings after they have been once removed from the grain. This process cannot be too strongly condemned unless the addition is clearly stated upon the guarantee tag or label. Such a mixture should be labeled so as to represent the true character of the product.

Weed seeds having a known toxic effect should be absolutely prohibited from entering into any commercial feed stuff.

An increasing amount of screenings is being utilized as a component for molasses feeds and other compounded cattle feeds. The screenings from flax seed have been ground and put upon the market under attractive trade names which hardly indicate their true content. While screenings are a legitimate by-product and, if ground, of some feeding value, they are inferior to the grains from which they are derived and much inferior to the high grade protein concentrates. They are best utilized as a food for sheep, or possibly as a component of a grain ration for fattening cattle. Their addition to any prepared feed can only tend to cheapen it, and feeds on the market which contain any considerable amount should sell for a decidedly lower figure than the ruling price for unadulterated goods. Their use as a component of standard by-products is objectionable for the following reasons :

1. They are unpalatable, many of the seeds found in screenings being decidedly bitter, while others have a toxic effect.

2. They are likely to carry considerable fiber, due to the presence of straw, chaff and the tough hulls of the weed seeds. This fiber tends to decrease the digestibility of the entire mixture.

3. They are a prolific source of weeds on the farm.

4. They are offered in disguise by being mixed with feeds of better quality.

5. The price asked for feeds into which screenings enter is often out of proportion to their value.

THE DAIRYMAN AND THE GRAIN PROBLEM.

DR. J. B. LINDSEY.

Because of the high price of all concentrated feeds, dairymen are in doubt as to the kinds to be selected and the amount to be fed in order to secure the most economical returns for money invested.

Farmers selling cream to the creamery or located where there is not a quick demand for milk, probably will not find it economical to feed over three to five pounds of purchased grain daily, and will use maximum amounts of hay and silage. If the silage is well eared, one and one-half pounds each of cottonseed meal and flour middlings sprinkled over the silage to distribute it will prove helpful in maintaining the milk flow. If corn meal is a home product rather than silage, mix by weight ¼ bran, ½ corn and cob meal, and ¼ cottonseed meal or gluten feed (100 bran, 200 corn, 100 cottonseed meal), and feed five to six quarts daily.

Producers of market milk will find it advisable to feed somewhat more grain, and a few combinations are suggested which may be fed with hay and silage or with hay alone.

I.

125 lbs. bran,
100 " flour middlings,
100 " gluten feed.
Mix and feed 6 to 8 lbs. (7-9 qts.) daily.

II.

125 lbs. bran,
100 " corn or hominy meal,
100 " cottonseed meal.
Mix and feed 6 to 8 lbs (7-9 qts.) daily.

III.

75 lbs. bran,
150 " corn and cob meal.
100 " cottonseed meal.
Mix and feed 6 to 8 lbs. or qts. daily.

IV.

200 lbs. distillers' grains,
150 " flour middings,

Mix and feed 6 lbs. (7 qts.) daily.

V.

75 lbs. malt sprouts,*
75 " wheat bran,
200 " gluten feed.
Mix and feed 6 to 8 lbs. (7-9 qts.) daily.

VI.

200 lbs. dried brewers' grains,
100 " corn or hominy meal,
50 " cottonseed meal.
Mix and feed 6 to 8 lbs. (8-10 qts.) daily.

The cost of a pound of the several mixtures is from 1.45 to 1.6 cents. It is believed that the above selections are more economical, on the basis of their content of nutritive material, than most of the sugar feeds and other proprietary mixtures.

The quantity of grain to be fed daily naturally depends upon the size of the cow, the quantity of the daily milk yield, and the local market value of the milk. The richer the milk, the more food required to produce a given quantity, and vice versa. Seven pounds daily is a fair average amount for cows weighing 800–900 pounds, which produce ten quarts of 5 per cent milk. Grain prices continue high and feeders in localities where there is not a quick demand for milk may find it economy to use only five pounds of grain daily and a maximum amount of home grown coarse feeds.† Heavy milking cows weighing 1,200 pounds may require twelve or more pounds of grain daily, depending upon their ability to utilize it. It is not good economy to unduly force the cow, especially if it is desired to keep her in the herd from year to year.

The usual daily roughage ration to go with the above grain mixtures will consist of what hay the animal will eat clean (18-24 lbs.) or one bushel of corn silage and 10-16 lbs. of hay.

---

* Bran can be substituted for malt sprouts if desired.

† Early cut hay, hay of peas and oats cut when in blossom, clover hay, rowen and well-eared corn silage all aid in reducing the grain bill.

MARKET PRICES OF CATTLE FOODS FOR 1908.

FEED STUFFS.	Monthly Wholesale Ton Prices—1908.												Average.
	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Cottonseed Meal	$28.65	$28.63	$28.50	$28.80	$29.75	$29.94	$29.60	$29.38	$29.25	$29.70	$29.31	$29.30	$29.24
Linseed Meal (N. P. and O. P.)	30.82	31.50	31.50	31.50	30.88	30.88	30.50	31.63	32.81	32.50	31.69	32.15	31.53
Gluten Feed (sacked)	30.70	30.65	30.70	30.62	30.23	30.50	30.50	30.95	31.48	31.30	30.75	30.50	30.75
Gluten Feed (bulk)	28.90	28.90	28.90	28.90	28.95	29.40	29.40	29.90	30.40	30.20	29.40	29.40	29.39
Distillers' Dried Grains	32.50	32.00	32.50	32.50	32.25	31.88	31.88	32.00	32.25	32.50	32.50	32.50	32.27
Malt Sprouts (sacked)	25.78	24.79	24.66	22.95	21.50	—	22.95	22.87	—	—	—	—	23.64
Flour Middlings (Red Dog)	30.00	29.69	30.31	30.55	30.44	29.63	29.90	31.63	32.00	30.55	30.13	30.73	30.46
Standard Middlings (shorts)	26.63	26.82	28.35	28.23	28.43	26.82	26.58	27.76	27.39	26.35	26.47	26.48	27.19
Mixed Feed	28.45	28.22	29.22	29.05	29.50	27.85	27.60	28.04	27.97	27.38	27.44	27.10	28.15
Bran, Spring	26.35	26.31	28.06	27.55	27.81	25.38	25.00	25.13	25.06	24.25	24.63	24.38	25.83
Bran, Winter	27.00	26.94	28.63	28.10	28.38	25.75	25.60	25.44	25.13	24.45	24.51	24.85	26.23
Hominy Meal (sacked)	27.95	26.88	27.93	27.02	27.95	28.54	28.17	30.83	32.31	30.65	29.73	29.13	28.92
Hominy Meal (bulk)	26.43	25.66	26.84	25.69	27.16	27.05	26.86	29.10	31.47	29.11	28.15	28.19	27.64
Corn Meal	27.00	25.80	28.40	29.00	31.20	31.50	32.10	33.70	33.60	32.50	29.10	27.40	30.11
Corn, No. 2 yellow	26.66	24.50	26.79	27.68	30.61	30.54	30.70	32.57	32.52	31.82	28.16	25.79	29.03
Oats, No. 2 clipped white	37.09	37.94	38.31	37.31	38.44	38.13	39.59	38.25	36.31	35.44	36.25	36.56	37.55
Rye, No. 2	32.09	31.96	32.75	31.64	32.18	32.50	31.96	30.27	30.54	30.46	30.18	30.18	31.39
Feed Barley	37.08	36.25	35.79	35.17	31.73	28.54	28.58	29.50	29.58	27.29	28.29	28.46	31.36

BULLETIN No. 129. JUNE 1909.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

BEE KEEPING IN MASSACHUSETTS.

BY

BURTON N. GATES.

This bulletin, a reprint of No. 75 Part 7, of the Bureau of Entomology, is published through the courtesy of the U. S. Dept. of Agriculture. It is based upon careful study covering early history, existing conditions and possibilities. The bulletin calls attention to needed improvements in methods; discusses the different races of bees; types of hives usually regarded as best; and gives information as to the extent of the demand in the state for the products of the industry. It considers also the value of the different wild and cultivated plants for honey in various sections of the state; gives important information as to the most successful methods both of summer and winter management, and briefly considers the principal diseases and enemies of bees. It emphasizes the fact that the opportunities for bee keeping in Massachusetts are exceptionally good and concludes with a list of the more important articles on bee keeping in Massachusetts.

Requests for bulletins should be addressed to the AGRICULTURAL EXPERIMENT STATION, AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

Bee Keeping in Massachusetts

By Burton N. Gates,
Expert in Apiculture.

HISTORICAL SKETCH.

When, in 1620, the Pilgrims landed at Plymouth, this country knew no bees; the Indians in their languages had no equivalents for bee, honey, or wax. In Elliot's remarkable translation of the Bible he was obliged to use the English word for honey, with sometimes an Indian termination. Scarcely, however, had churches been erected, scarcely were clearings made in the wilderness for growing agricultural necessities, when the settlers turned their attention to securing honey bees from England. That such remarkably early trans-Atlantic shipments of bees were successful there can be no doubt. Josselyn, who visited New England twice, once in 1638 and again in 1663, speaks of "the honey-bee, which are carried over by the English and thrive there exceedingly,"[a] but he does not tell when the first attempts to secure bees were made. Belknap,[b] however, wrote "that the first person who brought a hive of bees to this country [New England] was rewarded with a grant of land; but the person's name, or the place where the land lay, to whom the grant was made, I have not been able to learn." Unfortunately the records of the Colonies were not available to Belknap.

Newbury, a coast town north of Boston, was established in 1635. There the first effort to promote bee keeping in the New World was made. Furthermore, the importance of the industry was of municipal moment to the extent of holding out to one John Eales, who was

[a] Josselyn, John. 1675. An Account of Two Voyages to New England, p. 120. Second edition. London. "The second edition is the first, with a new title page merely."—Sabin. Reprinted in Massachusetts Historical Society Collections, Vol. III, third series, p. 292, and by William Veazie, Boston, 1865.

[b] Belknap, Jeremy. 1792. A Discourse Intended to Commemorate the Discovery of America * * * to which are added, four dissertations * * * 3. On the Question, Whether the Honey-bee is a Native of America? * * * Boston, Belknap & Hall, 132 pages.

then living in what is now Hingham, Mass., an inducement to come to Newbury for the purpose of teaching the settlers how to make hives and to care for bees. In August, 1644, Eales came "to one John Davis a Renter of a farm with ye expectation of his doing service which the Towne was not acquainted with."[a] Apparently, however, John Eales was not, financially or otherwise, a success. He was later arrested and put in jail in Ipswich, according to the record, and, on May 14, 1645, "It is conceived John Eales should be placed in some convenient place where he may be implied in his trade of bee-hive making, etc.: & ye town of Newbury to make up what his work wanteth of defraying ye charge of his livelyhoode."[b]

There can be little doubt that John Eales is the man to whom Belknap refers and to whom credit is due as the earliest bee keeper in the colonies.[c]

Further convincing evidence of the very early introduction of bees into New England is the date of their importation which Haydn[d] gives. According to this author, "bees were introduced into Boston, New England, in 1670, and have since spread over the continent." The source of his information is not given, but it is probably in some of the port records and can not refer to the first importation.

From these early times until more than a century later little or nothing is known of bee keeping in the State. In fact, during this epoch apiculture in the Old World was not well developed. It was not until the middle of the eighteenth century that writings on bees began to appear in Europe in any considerable number. Bees were receiving some attention in Massachusetts at this time, as is

---

[a] Massachusetts Archives, Vol. L, pp. 4–5. [Manuscripts in the State House, Boston.]

[b] 1853. Records of the Governor and Company of the Massachusetts Bay in New England. Boston. Vol. 2, p. 101. [Period covered, 1642–1649.] John Eales was "Freeman made att the Generall Court, May 14, 1634." Ibid., Vol. 1, p. 369.

[c] See also: Adams, George W. 1906. Massachusetts Bee Keeping in 1644. American Bee Keeper, Vol. XVI, pp. 280–281.

Gerstäcker, A. 1862. Über die geographische Verbreitung und die Abänderungen der Honigbiene nebst Bemerkungen über die Ausländischen Honigbienen der alten Welt. (Zur XI. Wanderversammlung Deutsche Bienenwirthe zu Potsdam am 17, 18, und 19 September, 1862.) Potsdam. According to Von Buttel-Reepen this paper was given as "a card of admission" to those attending the Potsdam meeting. It has apparently become lost, excepting one copy from which Von Buttel-Reepen reprinted it as a part of his paper, "Apistica."

Von Buttel-Reepen, Dr. H. 1906. Apistica. Beiträge zur Systematik, Biologie, sowie zur geschichtlichen und geographischen Verbreitung der Honigbiene (*Apis mellifica* L.), ihrer Varietäten und der übrigen Apis-arten. Mittheilungen aus dem Zoologischen Museum zu Berlin, III, Heft 2, 8 fig., pp. IV+121–201. Issued also as a separate.

[d] Haydn, Joseph. 1904. Haydn's Dictionary of Dates and Universal Information. 23d edition. New York. Also other editions.

shown by a letter of a father to his son, dated, "Sutton [Massachusetts] June the 2d, 1788."[a] Besides speaking of sending to his son some homespun clothes the father adds, "as for news we have no grate to rite to you our bees have swormed yesterday and they flew of today."

New England is reputed to have suffered severely from attacks of bee moths in the early part of the nineteenth century. There appears to have been a period of general devastation by this enemy from about 1800 to 1850. It handicapped the industry considerably, and, according to some, completely wiped it out in certain localities. Writing from Greenfield in 1853, L. L. Langstroth says:[b] "The present condition of practical bee keeping in this country [meaning the whole of New England and New York] is known to be deplorably low. From the great mass of agriculturalists * * * it receives not the slightest attention." There is room for considerable doubt, however, whether the moth was the primary cause of this devastation, as is explained below under the headings, "Enemies" and "Disease."

At the middle of the nineteenth century Langstroth, who had been experimenting for several years, brought out his invention, the movable-frame hive. As is explained under the head of "Hives," this revolutionized the industry; at that time modern bee keeping began.

Considering the very early date of the first introduction of bees to what is now Massachusetts, and that from this locality as a center much of the present-day bee keeping[c] spread westward with the home seekers, it is not a little surprising to discover so few extensive bee keepers in Massachusetts, while there are many in New York and Vermont. Compensating, however, for the lack of extensive bee keepers, there is a vast number of small apiaries; their number in proportion to the territory is probably greater than in any other State in the Union. There are at least 2,100[d] who derive some profit from their bees. Were these 2,100 to keep twenty-five colonies each

---

[a] A photograph of this letter is in the possession of the writer.

[b] Langstroth, L. L. 1853. Langstroth on the Hive and the Honey-Bee, a Bee-Keeper's Manual. Northampton. First edition.

[c] The details of the present status of bee keeping in this paper are based upon the returns from a series of questions sent to every known bee keeper in Massachusetts. The method of securing the statistics was described in the author's paper read before the Association of Economic Entomologists, Baltimore, Md., December 29, 1908. This paper is published in the Journal of Economic Entomology, Vol. II, No. 2, pp. 117–120, April, 1909.

[d] By actual count, the recorded bee keepers for Massachusetts number 2,127. This exceeds the number recorded in the 1900 census by 328, which, considering that the author's work was accomplished through mail while the federal census is the result of a house-to-house canvass, suggests a deficiency in the figures of the federal census reports. Of the 2,127, 1,050 reported.

and were their apiaries properly distributed over the State, there might not be forage enough to support them; but such is far from reality. The average is only five and a half colonies per bee keeper, which is evidently too small. In this is a key to the bee-keeping situation of the State; if the resources are to be fully utilized, more bees must be kept, not by more bee keepers, for there are too many small ones at present, but by several hundred proficient and energetic bee men properly distributed.

EXPERIENCE OF BEE KEEPERS IN MASSACHUSETTS.

Although there are too few bees kept, it is interesting to ascertain how experienced the Massachusetts bee keepers now are. In order to gain this information, a question, "How long have you kept bees?" was included in the list of questions circulated throughout the State. By thus knowing the length of time these men have been keeping bees, some idea of their proficiency may be reached. Of those who reported to the author, 38 per cent have had less than five years' experience and must consequently be classed as amateurs. While this array of amateurs, at first glance, appears high, it becomes more significant upon considering that 32 per cent, having successfully passed their apprenticeship, report from five to fifteen years' experience, or, in other words, have persisted and succeeded in bee keeping. On the other hand, roughly estimating, 50 per cent of the bee keepers who undertake this branch of agriculture discontinue it within their first five years' trial. This is not due to lack of possibilities in the bee-keeping industry, but must be attributed in a large measure to sensational presentation, in the popular press and elsewhere, of the ease of managing and the huge profits to be derived from bees. This overstimulation of the bee industry is a positive detriment to the bee-keeping interests. The number of persons who have taken and will take time for a proper study of bee culture is exceedingly limited in proportion to the number who undertake the work uninstructed. Consequently a 50 per cent weeding-out process during the first five years of attempted bee culture is a stroke of fortune for the industry. After fifteen years' experience, and before the twenty-five-year mark of service is passed, there is another falling off. The figures of this census show that 16 per cent of those reporting have kept bees from fifteen to twenty-five years, which, when it is considered that a bee keeper is well along in life by that time and often must necessarily relieve himself of care and work, is exactly what might be expected. No less interesting is the fact that 16 per cent continue after twenty-five years of service. These are the truly old bee keepers, many of whom remember Langstroth and his experimenting. While they may not be exactly up-to-date, they are to be respected for their persistency.

For purposes of comparison divide the State into two sections, the eastern section to include Worcester County and all other eastern counties save Barnstable County, which is not at all comparable either in population or from an agricultural point of view. If these two sections be contrasted, there will be found an obvious difference in their population. In the eastern section the cities and towns are large and the population concentrated, while in the western part the population is less dense and is thus far less influenced, on the whole, by large communities than the eastern section. It is in the large communities that bee keeping is usually promoted by supply houses and conventions, and it is there also that the majority who seek rural recreation along lines promoted by popular agricultural papers reside. Consequently, it is to be expected that the progress and stimulation of bee keeping, either as a recreation or an industry, should first be felt in and adjacent to these communities. This is precisely what is noticeable in Massachusetts. Back in the country of the more strictly rural section of the State, where population acquires but slowly the progressive impulses which are first launched in the larger communities, there are fewer new or amateur bee keepers than in the more thickly populated eastern section. In this western section the ratio of beginners to advanced bee keepers is as 30 to 70; while in the eastern section, where are found two bee-keepers' societies, the proportion of beginners is larger, with a possible ratio of 41 to 59. Aside from the influence of societies in the eastern section, supply houses have had a noticeable effect in stimulating popular interest and in promoting new and improved methods. As is pointed out above, sensational stimulation is unfavorable to the industry.

TABLE I.—*Proportion of amateurs to practiced bee keepers in the eastern and western sections of Massachusetts.*

Section of State.	Amateur bee keepers (5 years and less).		Practiced bee keepers.				Total number of bee keepers reporting.
			5 to 15 years.	15 to 25 years.	25 years and over.	Per cent.	
	Number.	*Per cent.*	*Number.*	*Number.*	*Number.*		
West of Worcester County	95	30	105	56	67	70	323
Worcester County and east, exclusive of Barnstable County	302	41	209	104	94	59	709
Barnstable County	3		8	6	1		18
Total for the State	400	38	322	166	162	62	1,050

NUMBER OF COLONIES PER BEE KEEPER.

There are but two bee keepers in the State who report more than 100 colonies, but several have nearly this number.

TABLE II.—*Location of Massachusetts' largest apiaries, as reported for 1906.*

County.	50 to 75 colonies.	75 to 100 colonies.	100 colonies and over.	County.	50 to 75 colonies.	75 to 100 colonies.	100 colonies and over.
Barnstable		1		Middlesex	4	1	
Essex	1			Plymouth	1		a2
Franklin		1					
Hampden	2			Total	9	3	2
Hampshire	1						

[a] One of these bee keepers writes that he increased from 55 to 133 colonies in 1906.

It is a peculiar fact that in Worcester County, where more bees are to be found than in any other county and where bee keeping is progressive, none reports 50 colonies and few have even 25. The two largest bee keepers in the State are located in Plymouth County. That there are so few large bee keepers in Massachusetts is due, in the writer's estimation, to the heretofore unrecognized ravages of disease. This is discussed elsewhere in this paper and in another publication of this Bureau.[a] In Middlesex County, for instance, where, so far as at present known, disease is not prevalent, the greatest number of large bee keepers is found and also the second greatest number of colonies.

DISTRIBUTION OF BEES IN MASSACHUSETTS.

In the eastern section, exclusive of Barnstable County, with its high ratio of novices, there are practically as many colonies of bees per bee keeper as in the western section. According to the figures for 1906, the following table presents the conditions:

TABLE III.—*Distribution of bees in Massachusetts.*

Section of State.	Spring.		Fall—Number of colonies.
	Number of colonies.	Colonies per bee keeper.	
West of Worcester County	1,760	5.4	2,530
Worcester County and east, exclusive of Barnstable County	3,897	5.5	5,595
Barnstable County	182	10.0	227
Total for the State	5,839	5.5	8,352

From the foregoing table it will be seen that the minimum number of colonies is in direct disproportion to the large number of bee

[a] Gates, Burton N. 1908. Bee Diseases in Massachusetts. Bulletin No. 75, Part III, Bureau of Entomology, U. S. Department of Agriculture. Washington. Bul. 124, Mass. Agr. Exp. Station.

keepers. The large population might account for this in the east, but this does not explain why the western bee keepers have not enlarged their apiaries, which without question should ultimately result. Again, disease is beginning to exert its influence, and a more general understanding of its nature and remedies should benefit the industry.

INCREASE IN NUMBER OF COLONIES.

The figures on increase which the writer obtained show an increase from 5,839 colonies in the spring to 8,350 colonies in the fall of 1906, a gain of 2,413 colonies, or 42 per cent. This is below normal and suggests the prevalence of bee diseases.

PRODUCTION OF HONEY AND WAX.

The subject of first importance to every bee keeper is the crop—How much honey and wax do the bees produce? Unfortunately, however, the majority do not go beyond this and ask how much ought the yield to be?

HONEY CROP.

The honey production of the State is little more than one-tenth what it might be. The markets demand much more honey than is produced in the State. As nearly as can be ascertained, some 80 tons of honey are annually harvested. Most of this is not shipped, but is consumed by the producer or his neighbors. There is no evidence that any honey is shipped out of the State; on the contrary, much comb and extracted honey is annually imported from Vermont, New York, and sometimes from the far West and South.[a]

Approximately 100 tons represents the total consumption during 1906. This consumption varies greatly from year to year, depending on the crop, as, for instance, in 1907, when scarcely any honey was obtainable in the market. The man who shipped $5\frac{1}{2}$ tons from Vermont the previous year sent less than 1,000 pounds in 1907. None was received from New York, as in the previous year. But the estimate for 1906 of 100 tons is only one-half the amount estimated as consumed in 1904.[b] That year 200 tons, divided among the

[a] In 1906, $5\frac{1}{2}$ tons came to Worcester from Vermont; from New York State $2\frac{1}{2}$ tons. In Boston the imports, according to this authority, were approximately the same. It may be roughly estimated, therefore, that for 1906 at least 16 or at most 20 tons were received from points outside of the State. This information was kindly furnished the writer by Hon. W. H. Blodget, in a letter dated Worcester, Mass., April 11, 1908.

[b] Gates, Burton N., and Dr. C. F. Hodge. 1904. Bee Keeping; How to meet its dangers and difficulties. Mass. Crop Rept., vol. 17, No. 6, pp. 30–40, Boston. October. Also Fifty-second Ann. Rept. of the Secretary of the Mass. St. Bd. of Agric., pp. 411–426, Boston, 1905.

inhabitants of the State, would have allowed less than two tablespoonfuls per capita as a year's ration. Since then, however, the population has increased to more than 3,000,000,[a] and with the estimated crop of 100 tons in 1906 would have afforded each person less than one tablespoonful. Too little honey is available in Massachusetts. This is borne out by the common experience of those who try to buy extracted honey in convenient amounts or even in bulk for table use. The writer's experience is that it is almost impossible to purchase at retail a 60-pound can of good honey or even of a poorer grade at any price. As for being able to buy a gallon or a quart, it is impossible unless the purchaser is willing to pay a high price for a lot of small, fancy bottles, which may or may not contain good-grade honey. With these facts in mind, it is evident that much may be done to improve the retail trade in extracted honey. Comb honey, on the other hand, is usually available either from a producer or a retail store.

The crop in Massachusetts for 1906, as reported by something less than half the number of bee keepers recorded, was 145,257 pounds, approximately 73 tons; but since only a little over half the recorded bee keepers were heard from, 80 tons would be a conservative estimate, as is shown below. It is somewhat surprising that this study should show the largest recorded crop, and especially so in view of the fact that the investigation was carried on through the mails, while census data are obtained by personal canvass. This at least suggests that the census figures probably do not justly represent the industry.

Although 145,257 pounds of honey, of which 108,660 pounds was comb and 36,597 was extracted, is the heaviest crop recorded for the State, the product looks pitifully small when it is remembered that single apiarists in the West frequently produce in a season a fourth to a third more honey than Massachusetts' annual crop. If the actually recorded crop is divided by the number of colonies reported in the spring of 1906, this is an average of but 24 pounds per colony. Conservatively estimating from experience and reports of large practical apiarists in New York State and the West, the average yield, considering all classes of bee keepers, should be about 35 pounds. This would have made Massachusetts' crop, merely from the recorded number of colonies, spring count, 204,330 pounds, or 102 tons. Consequently the estimate of 80 tons, assumed for convenience, is safe. The question is, however, a larger one. The possibilities of the forage and the number of colonies which it would support is more vital than criticism of the present discrepancy. The writer has already

---

[a] Mass. Census, 1905, population 3,003,680.

stated[a] that Massachusetts can support approximately 40,000 colonies of bees. This number, producing an average of 35 pounds of honey to the colony, would supply 1,400,000 pounds, or 700 tons, of honey a year, contrasted with 73 tons. This crop would not be especially burdensome, and, divided among the people, each would have less than a half pound a year. Furthermore, there is no immediate danger of the production of any such amount.

Table IV.—*Honey and wax production reported in Massachusetts.*

Date.	Honey.	Wax.	Sources of data.
	Pounds.	*Pounds.*	
1839		1,196	U.S. Census Rept. for 1840.
1849		[a]59,508	U.S. Census Rept. for 1850.
1855	73,677	2,324.5	3d Ann. Rept. Sec. Mass. Bd. Agric. for 1856.
1859	59,125	3,289	U.S. Census Rept. for 1860.
1865	80,356	2,451	13th Ann. Rept. Sec. Mass. Bd. Agric. for 1866.
1869	25,299	1,195	U.S. Census Rept. for 1870.
1879	49,397	2,463	U.S. Census Rept. for 1880.
1889	90,929	1,690	U.S. Census Rept. for 1890.
1899	109,050	6,250	U.S. Census Rept. for 1900.
1906	[b]145,257	1,289	The author's census.

[a] Includes both honey and wax product.
[b] Extracted, 36,597 pounds; comb, 108,660 pounds.

WAX CROP.

It is customary for bee keepers to save their old combs from year to year before rendering them, which produces an annual variation in the product. Futhermore, outbreaks of bee diseases cause much more comb to be rendered. Severe winters, which frequently result in a loss of bees, usually produce a relative increase in the wax output the following year. It is therefore difficult to calculate a representative annual product of wax. The commercial importance of the wax crop, and the relative returns from it as compared with honey, are gradually becoming more and more realized; therefore, as the honey product increases it is to be expected that the wax output will proportionally increase. Table IV presents all the recorded information on wax production in Massachusetts.

SOURCES OF HONEY.

Too little attention is given the nectar-yielding flora, even among those who seek a livelihood in the production of honey. Although it is sometimes difficult to learn the sources from which bees get

[a] U. S. D. A., Bur. Ent. Bul. 75, Pt. III, p. 23. Allowing an average of 100 to 125 acres to support a colony of bees, based on experience of large bee keepers who maintain a series of outyards, and eliminating 500 square miles as probably unavailable for bee pasturage, there remain 7,814 square miles, or 5,000,960 acres, for forage in Massachusetts, which would support approximately 40,000 to 50,000 colonies of bees.

their stores, a bee keeper should have some knowledge of the honey plants of his locality and their honey value.

White clover.—Among the several clovers, white clover ranks first. It is found in nearly all quarters of the State, but flourishes best on limed or limestone soils, and is particularly abundant in the northern and western parts of the State. Just over the line in the Champlain Valley of Vermont the chief source of honey is white clover, which grows there in tangles and mats. White clover honey ranks high in the market; its color and flavor make it one of the finest of American honeys.

Alsike clover.—This is frequently sown for forage, and is becoming more and more renowned as a honey source. Under favorable conditions it yields not only a good quality of nectar, but large quantities of it. It rivals the red clover, on which bees work to a limited extent, but in which the vast stores of nectar are too deep in the flower tubes to be within reach of the bee's tongue. Alsike blooms with white clover and will bloom a second time when white clover has ceased, thus prolonging the honey flow from clover.

Red clover.—This is also a more or less continuous bloomer, which, inasmuch as the second flowering brings smaller, shorter-tubed heads, is somewhat accessible to bees.

Sweet clover.—There are two species, white and yellow, but neither is abundant in Massachusetts. It is a bountiful source of honey elsewhere, and may become so in this State.

Crimson clover.—As a honey plant this is of slight importance as far north as Massachusetts.

Golden-rod and asters.—These plants, as reported in this State, rank close to the clovers in nectar secretions. Both begin to flower in July and continue until frost. The early bloom, however, is not visited by bees to any extent, and it is not until September that the flow begins, when the hive takes on a characteristic strong and pleasant odor. The honey, though rather dark and thick, has a rich, aromatic flavor, which many people consider superior. In Massachusetts a marketable surplus is frequently taken in September.

Fruit bloom.—Apple, pear, cherry, plum, peach, etc., which are found in abundance throughout the State, are next in importance. Fruit bloom is the source of early stores upon which the colonies build up for the clover harvest. Insufficient numbers of bees at this season and unfavorable weather make it difficult to secure a surplus from this source, but the fortunate bee keeper who does secure a crop should realize that he has a superior product. The body is heavy, the color is clear and light (usually an amber), and the flow comes with a rush which insures handsome sections; but best of all is the exquisite aroma of the apple blossom, which places fruit-bloom honey in a class by itself.

Linden or basswood.—Cutting for lumber has tremendously reduced the number of basswood trees in the State. It was once generally distributed in the forests, but at present occurs largely only in the northern and western woods. This is doubtless the most valuable tree honey plant in Massachusetts and, together with its value for timber, merits cultivation. It makes a fine shade tree. The honey has quite a characteristic flavor and aroma, but requires to be well ripened before its delicious qualities are appreciable.

Buckwheat.—This is a famous honey plant in New York State and is reported from all counties of Massachusetts. Here, however, it is far less extensively grown than across the line. Some bee keepers say they plant small fields for the sake of their bees, but there is great doubt if the bees benefit materially by it except in cases of extreme scarcity of nectar. The honey is dark, with a brownish or purplish cast, a heavy body, and a strong, rank flavor to those who are accustomed to more delicate honeys, such as clover or fruit bloom. Many in New York State, however, often prefer buckwheat to clover honey. Especially if extracted, it usually commands a good price.

Wild raspberry and blackberry.—In the highland pastures wild raspberry and blackberry abound. The nectar flow is of long duration, beginning soon after fruit bloom has ceased, and thus is an important stimulant for the clover harvest to follow. Cultivated varieties are quite as valuable for forage as the wild species.

Sumac.—There are several species of sumac which are important honey sources, but which are greatly underestimated by the majority of bee keepers. They are free bloomers and flourish in nearly all parts of the State. Apparently, however, the nectar yield is somewhat erratic. The writer recalls seasons in Worcester County when bees paid no attention to the great heads of greenish flowers. Sumac honey, although not light, has a clear and firm body with a pleasant flavor.

Locust.—Like the basswoods, locusts have been largely cut from the woodlands. There are several species now found to a limited extent by roadsides and in pasture walls, where they are valuable forage for bees. In Colrain, Franklin County, one bee keeper attempted to cultivate locust for his bees, but met with no great returns for his efforts. Another bee keeper reports that locust is sporadic, yielding nectar only once in three years.

Maple.—A considerable number of bee keepers report that maple is a honey plant. It is, to be sure, one of the best sources of pollen in early spring, which doubtless has confused the bee keepers and caused them to report it as a honey plant. Swamp maple is especially valuable in early brood rearing. Maple is probably of less importance as a honey source than, for instance, the mints, strawberry, and milkweed, which were reported but a few times.

Clethra.—This is also known as black alder and sweet pepper bush, and is a valuable honey-secreting plant, largely confined to a belt paralleling the eastern coast, where it thrives in profusion. The aroma, a sweet smell, powerful and penetrating, may be perceived a long distance from the bush. Bees work upon it freely, and unquestionably produce considerable surplus honey, which is of good body and light color.

These, so far as bee keepers' observations afford, are the most prominent honey plants. Of the remaining list—each reported from one to fifteen times—milkweed, wild cherry, knotweed, dandelion, strawberry, chestnut, mints, gill-over-the-ground, and mustard are of most importance. No one of these taken alone is a source of surplus honey in Massachusetts, but all are important in the total yield. The writer has observed, in the spring when fruit trees are in bloom, a perceptible effect of dandelion nectar upon the delicate flavor of fruit-bloom honey, producing the characteristic bitterish taste.

Milkweed.—Where milkweed occurs in large quantities it is a valuable honey plant. In Berkshire County, Mr. Dewey, of Great Barrington, reports that milkweed is an important source of nectar.

One bee keeper in Hampshire County reports the Tartarian honeysuckle as important and very productive. Sunflowers are valuable but must occur in considerable numbers to make a perceptible difference in the crop.

Most of these plants are quite as important, so far as the economy of the bee is concerned, for their pollen as for their nectar. For instance, the willow and skunk cabbage, while they are reported as honey plants, are far more important as pollen yielders, because at their season of bloom pollen is scarce. The chestnut and, to a certain extent, the dandelion are more valuable for the pollen which they yield than for the honey.

THE MORE IMPORTANT HONEY PLANTS IN MASSACHUSETTS.

TABLE V.—*List of the more important honey plants in Massachusetts.*

[Arranged according to frequency of report.]

Name.	Times reported.
Clovers:	
White (*Trifolium repens*)	626
Alsike (*T. hybridum*)	37
Red (*T. pratense*)	7
Crimson (*T. incarnatum*)	3
Sweet (*Melilotus alba* and *M. officinalis*)	3
Yellow (*T. agrarium*)	1
	677
Golden-rods (*Solidago* spp.)	330
Asters (*Aster* spp.)	99
	429

TABLE V.—*List of the more important honey plants in Massachusetts*—Cont'd.

Name.	Times reported.
Fruit bloom (includes pear (*Pyrus* spp.), apple, cherry, peach, plum (*Prunus* spp.), etc.	337
Linden or basswood (*Tilia* spp.)	160
Buckwheat (*Fagopyrum* spp.)	144
	641
Raspberry (*Rubus* spp.)	103
Blackberry (*Rubus* spp.)	23
	126
Sumac (*Rhus* pp.)	89
Locust[a] (*Robinia* spp.)	43
Maple (*Acer* spp.)	36
Clethra (*Clethra alnifolia*)	24

[a] Does not yield every year; "Once in three years," one bee keeper says.

LIST OF PLANTS REPORTED RELATIVELY FEW TIMES.

(Reported from one to fifteen times.)

Alder (*Alnus* spp.).
Arnica, white flowering (*Arnica montana*).
Barberry (*Berberis* spp.).
Blueberry (*Vaccinium* spp.).
Burdock (*Arctium lappa*).
Buttercups (*Ranunculus* spp.).
Button bush (*Cephalanthus occidentalis*).
Cherry, wild (*Prunus* spp.).
Chestnut (*Castanea dentata* (marsh)).
Columbine (*Aquilegia canadensis*).
Cowpeas (*Vigna catjang*).
Cranberry (*Vaccinium* spp.).
Cucumber, cultivated (*Cucumis* spp.).
Cucumber, wild (*Micrampelis lobata*).
Dandelion (*Taraxacum* spp.).
Elderberry (*Sambucus* spp.)
Elm (*Ulmus* spp.).
Gentian, fringed (*Gentiana crinita*).
Geranium, wild (*Geranium* spp.).
Gill-over-the-ground (*Glecoma hederacea*).
Gooseberry, wild and cultivated (*Ribes* spp.).
Hickory (*Hicoria* spp.).
Honeysuckle, Tartarian[a] (*Lonicera tatarica*).
Horse chestnut (*Æsculus* spp.).
Huckleberry (*Gaylussacia* spp.).
Knotweed (*Polygonum* spp.).
Milkweed (*Asclepias* spp.).
Mints, catnip, etc. (*Mentha* spp.).
Mustards, wild (*Brassica* spp.).
New Jersey tea (*Ceanothus americanus*).
Radish (*Raphanus* spp.).
Shad bush, wild (*Amelanchier botryapium*).
Skunk cabbage (*Spathyema fœtida*).
Strawberry, wild and cultivated (*Fragaria* spp.).
Sunflowers (*Helianthus* spp.).
Syringa (*Philadelphus* spp.).
Thyme[b] (*Thymus serpyllum*).
Viburnum (*Viburnum* spp.).
Willow (*Salix* spp.).
Witch-hazel (*Hamamelis virginiana*).

PERIODS OF NECTAR SECRETIONS IN DIFFERENT LOCALITIES.

Through the courtesy of several bee keepers the writer is able to present with considerable detail the periods of nectar secretion of

[a] Reported of importance and very productive in Hampshire County.
[b] Jackson, Joseph J. 1894. Through Glade and Mead. Jackson (p. 293) lists it for Worcester County. It was also reported to the writer three times from Berkshire County.

the more important honey plants in several sections of the State. It should be remembered, however, that the dates of nectar yielding must necessarily vary from year to year and at different elevations in the same territory; consequently the data here presented may be slightly at variance with other observations.

BERKSHIRE REGION.

(Furnished by E. H. Dewey, of Great Barrington, Mass.)

Pussy willow, April 1 to 15. Pussy willow in sheltered places will bloom as early as the 15th of March and be visited by bees for pollen. Whether they get honey as early as that from this source I do not know. Just when pussy willow begins to yield honey I can not positively state, for bees work on it very early, but I have seen them with tongues extended in search of honey as early as the dates indicated.

Soft maple, April 1 to 8.

Hard maple, April 20 to May 5.

Fruit bloom, May 1 to 25.

Raspberry, June 5 to 30.

Locust, June 5 to 15.

Wild mustard. Wild mustard, I am told, appears about six weeks after cultivation. It is most frequently seen here from the middle of June to the 1st of July.

Clover, June 5 to July 25.

White sweet clover, July 10 to August 25.

Sumac, July 10 to 20.

Basswood, July 1 to 15.

Milkweed, July 5 to 20.

Chestnut, July 10 to 15.

Buckwheat, August 1 to 25.

Smartweed, September 5 to frost.

Brook sunflower (*Bidens lævis*), September 5 to —. It is fairly covered with bees. I have seen three or four working on a single blossom. Grows on low land and margins of water.

Golden-rod, August 20 to frost. One variety of golden-rod appears here the middle of August, but never secretes honey.

Asters, September 1 to frost.

Tag alders, September 1 to frost. In my immediate locality tag alders are not common, but can be found in swampy places a few miles from here.

CENTRAL REGION.

(Furnished by Dr. James B. Paige, Massachusetts Agricultural College, Amherst, Mass.)

Fruit bloom, May 12 to 30. Cherry, plum, and peach are the earliest. Apple lasts the longest.

Clover, June 10 to August 1.

European linden, June 15 to July 1.

Raspberry, June 6 or 7 to about June 20.

American linden, July 21 or 25 and lasts ten days to two weeks.

Buckwheat, latter part of July or August 1. Lasts nearly a month, according to quality of soil and location.

Golden-rod and asters, September 1, lasting until frost.

Smartweed, August 25 until frost. Does not appear to secrete after frost comes.

Wild clematis, July 25 to September 1. Cultivated variety (*Clematis paniculata*) blooms early in September, but I doubt if it secretes honey; it is sparingly visited for pollen.

Thoroughwort, ceases about 1st of September.

About the 1st of April we get soft maple, willow, skunk cabbage, alder and some elms, and cultivated plants, such as crocuses, etc., which, I suspect, supply more pollen than nectar.

CAPE COD REGION.[a]

(Furnished by Mr. Allen Latham, Norwich, Conn.[b])

Dandelion, in May.

Huckleberry, in late May.

Blackberry,[c] in late May.

White clover, in June and July.

Common locust (in Truro), June.

Sumac (*Rhus copallina*) (occasionally), in July.

White alder (*Clethra alnifolia*), July to August.

Fireweed (*Erechtites hieracifolia*), August to September.

Cut-leafed water hoarhound (*Lycopus americanus*), August to September.

Burr-marigold, August to September.

Pink knotweed, August to September.

Various golden-rods, August to September, especially *Solidago sempervirens*, a gigantic variety of golden-rod which thrives in the sand along the beach.

Various asters, like those which are common all over New England, September to October.

Cranberry, flourishes and blooms for a long period. This may yield nectar.

Strawberry, grows wild by the acre and the children and women carry bushels upon bushels of these berries home every June. Possibly in that region this plant yields nectar.

The beach plum is an old settler and is found all about the Cape whitening all the beach and dunes with its blooms in May. Whether the bees get any honey from that bloom I do not know.

Wild cherry, both the black or "rum" and the "choke," grow in abundance. As these yield practically nothing inland, I judge they furnish the bees no nectar there.

Listed in the order of their importance to the bee keeper:

1. Huckleberry.—Without this one could not be sure of a crop of honey oftener than every other year, and possibly not one year in three.

2–3. Hoarhound and fireweed.—Probably the hoarhound should rank ahead of fireweed.

4. Fall flowers, golden-rod and asters especially.

The fall flowers will always furnish a crop if the weather permits the bees to gather it, but too often the weather is foggy or high winds blow, or else it is

---

[a] A good account of bee keeping in this region is found in the following paper: Miller, Arthur C. 1906. A Unique System. How an Ingenious School Teacher Harvests Crops of Honey from a Desert. American Bee Keeper, Vol. XVI, pp. 206–210, October. Illustrated.

[b] Mr. Latham specifies that the data relate to the "plants known to yield honey near Provincetown," the extreme end of Cape Cod, about 50 miles direct by sea from Boston and 25 miles from Plymouth.

[c] It is possible that blackberry is very important. I do not know its honey, and the flavor may be lost in the honey from huckleberry bloom.

too cold. I have never had such crops of fall honey here (Norwich, Conn.) as I have had down among those sand dunes, once in three or four years, strong colonies laying upward of a hundred pounds.

5-6. White clover and Clethra, about equal.

7. Sumac.

RACES OF BEES.

Among the bees of Massachusetts are found representatives of those kept in all parts of the United States. They occur only in relative degrees of purity, due to the fact that young queens often mismate. "Hybrid" means any cross between recognized races, but more particularly and generally the cross between Italians and Germans.

ITALIAN BEES.

According to the data at hand, 594 bee keepers say they have Italians. This does not mean pure Italians in every instance, but it does indicate that practically half of the bee keepers who reported have Italians, a highly encouraging condition. Furthermore, 342 report that they have hybrids, which may almost universally be interpreted as a cross between Italians and Germans. By adding this to the number who report Italians, it makes 936, or about 80 per cent, of those reporting who have some Italian in their hives. This clearly demonstrates the popularity of the race.

There are several strains of Italians, such as "long-tongued," or "red-clover," and "golden," or "five-banded," and the like. Although these strains are all found in Massachusetts, data concerning them is not sufficient to decide their relative merits or popularity.

GERMAN BEES.

Pure German or black bees are exceedingly scarce. In the county of Worcester the writer has seen what he believed to have been the pure-blooded Germans; but these colonies are seldom met with. Although, as is shown in the table below, 196 persons report that they have German bees, there is as much or even more doubt that these are strictly pure as there is doubt that all of the Italians reported are pure. This race, at least in Massachusetts, is destined to be supplanted by the Italians, although some bee keepers still complain that their Italians are constantly being crossed with blacks.

CARNIOLAN BEES.

This race, from Carniola, Austria, is not generally used in Massachusetts. Many who were interested when it was first introduced into America tried it and since discarded it; but 34 persons, or 3 per cent, reported having it in 1906.

OTHER RACES.

Practically every other race of bees known in the United States is on trial in Massachusetts. Several mention the newly introduced Caucasians. The Punic, Cyprian, and Banat bees are also reported.

Considering the races by localities in the State, it is difficult to see that either the Italians or the Germans are more common to any one section than to another. Italian blood tends to predominate. Personal observation, however, shows that hybrids or the more purely German are found in the back country, where newer methods of bee keeping usually receive less attention; the pure Italians and more recently introduced races are found near the large communities.

TABLE VI.—*Prevalence of different races of bees.*

	Italian.	Hybrids.[a]	Black or German.	Carniolan.	Other races.
Number reporting	594	342	196	34	....
Percentage	50	30	16	3	1

[a] Hybrids are largely an admixture of Italian and German races.

HIVES.

In 1852 Langstroth patented his movable-frame hive, which marked the beginning of modern bee keeping. In the same year he moved from Philadelphia, Pa., to Greenfield, Mass. Bee keeping was then in a deplorable condition, as he remarked, most of the hives in use being those impractical devices classed under the names of "box hives," "patent hives," and the like. According to the writer's observations, these old-fashioned hives are fast being replaced by frame hives; colonies in box hives in the country are being exterminated by disease; they are also bought up for transferring and for use in cucumber greenhouses; at present, bee keepers seldom, if ever, start with anything but frame hives. Of those who reported the kind of hive which they use, 10 per cent have exclusively box hives and 8 per cent more acknowledge having a few. Moreover, there are a thousand persons who did not reply, and it is fair to presume that a considerable percentage of these have box hives. It will, consequently, not be exaggerating to estimate that 25 per cent, and possibly 30 per cent, of the bee keepers of Massachusetts still use these hives to some extent. Lamentable, too, is the fact that the apiaries in Berkshire County, against the New York State line, are perhaps in worse condition, so far as the box-hive problem is concerned, than other apiaries of the State, for figures show that one-third of the bee keepers of Berkshire County are using the old-fashioned hive. This circumstance is particularly unfortunate because the flora promises good honey production; and again because this is a border-line county, which may serve, with its high percentage of box hives in which diseases are controlled with difficulty, as a source of bee diseases in both States.

The condition on the whole is hopeful—90 per cent of those reporting have largely or exclusively frame hives, which shows a progressive tendency.

It is not, however, within the province of this paper to discuss the relative merits of the various frame hives which are in use. The several makes and patterns in principle are the same; they vary only in detail of construction and proportion. Climatic conditions, the methods of the bee keeper, whether for comb or extracted honey—in a word, the needs of the individual should govern his selection.

By far the most popular hive is the one generally used in the United States, perfected by Langstroth. In its simplicity and proportions it has proven satisfactory to the climate of Massachusetts. Two sizes, the 8 and the 10 frame hives, are popular. According to the statistics, the 8-frame hive is more common (340 bee keepers report having it) than the 10 frame (260 bee keepers). There is a rather strong tendency, judging from remarks in the reports, toward the 10-frame hive.

Another 10-frame hive, devised in Franklin County, has a shorter and deeper frame[a] than the standard, and is second in popularity. Its use is rather local, however, being confined largely to central and western Massachusetts, where 100 bee keepers report having it.

There is but one "closed-end frame" hive in use to any extent. Seventy-seven bee keepers are using it.

Besides these three types and the box hive, there are a great many homemade contrivances and a few patent hives with some merit.

WINTERING.

METHODS.

Bees are wintered in two ways. By far the most common and at the same time least laborious and less efficient in the latitude of Massachusetts is on the summer stands. The writer has seen bees go through a winter in Massachusetts unprotected, without bottom board and the corners of the hive rotted away. All manner of devices for protecting the bees on the summer stands are used. They are packed, put in winter cases, and wrapped in paper. But the safest method in a climate as famous for severe and variable weather as that of

---

[a] The frame is 14 inches long and 10¾ inches deep, with a top bar one-half inch thick, 1 inch wide, and 16⅛ inches long, with the corners clipped at each end. The ends of the frames are one-half by seven-eighths inch, and the bottom bar is one-fourth by seven-eighths inch.

Massachusetts is to winter in the cellar. Unfortunately, many of those who attempt it are not altogether proficient. Of those who have reported their method of wintering only 13 per cent winter their bees in a cellar. It is well established that by proper cellar wintering the loss in northern countries may be reduced to a minimum. In order to do this properly the bee keeper must be painstaking and observing; he must use a dry cellar and maintain as nearly a uniform temperature as possible.

MORTALITY.

In New England and the Northern States loss during severe winters may run as high as 70 per cent. This loss is greatly reduced in favorable winters, when it is as low as 10 per cent. Were all the bee keepers competent and careful, this loss might generally be reduced to 2 or 3 per cent.

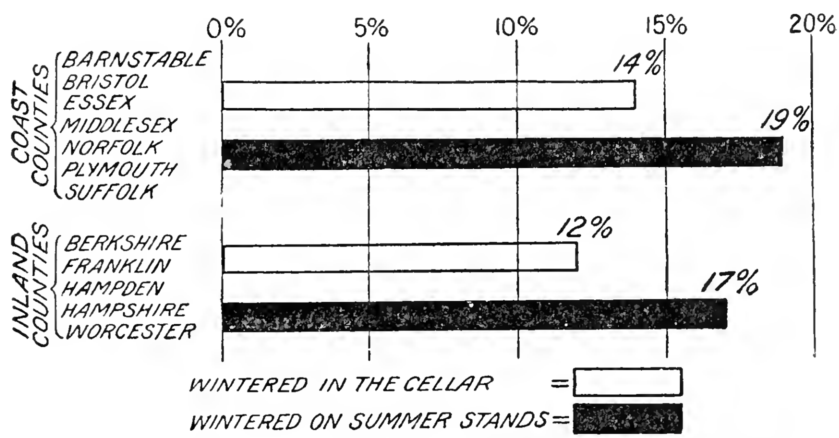


FIG. 1.—Proportionate loss of bees wintered in cellars and on summer stands. (Original.)

In the winter of 1906–7, which was not especially severe, the damage amounted to 16 or 17 per cent (see fig. 1); although this was not disastrous, it was too great a loss. It taxed the bee keepers of the State $4,886, valuing each colony at $3.50. With plenty of stores and proper protection it would not be expected that one-sixth of all the bees in the State, 1,396 colonies, should succumb during winter. The loss was most severe in localities where disease is now known to exist, which suggests that the excessive loss in a measure resulted from the depletion of colonies by disease.

BEES IN GREENHOUSES.

The use of bees in cucumber greenhouses is one of the many phases of bee keeping, perhaps the most prosperous or certainly that most peculiar to Massachusetts. The industry is little known outside of this State, yet growers in other Atlantic and Central States have undertaken it to some extent. Originating in Worcester County, it has assumed large proportions through the eastern part of Massachusetts. The accompanying map (fig. 2) shows the approximate location of the industry. It is a difficult task to obtain satisfactory data on this phase of apiculture. Market gardeners who grow cucumbers under glass do not consider themselves apiarists; on this ground they largely disregard requests for information. Only through a personal canvass among the growers has information been obtained.

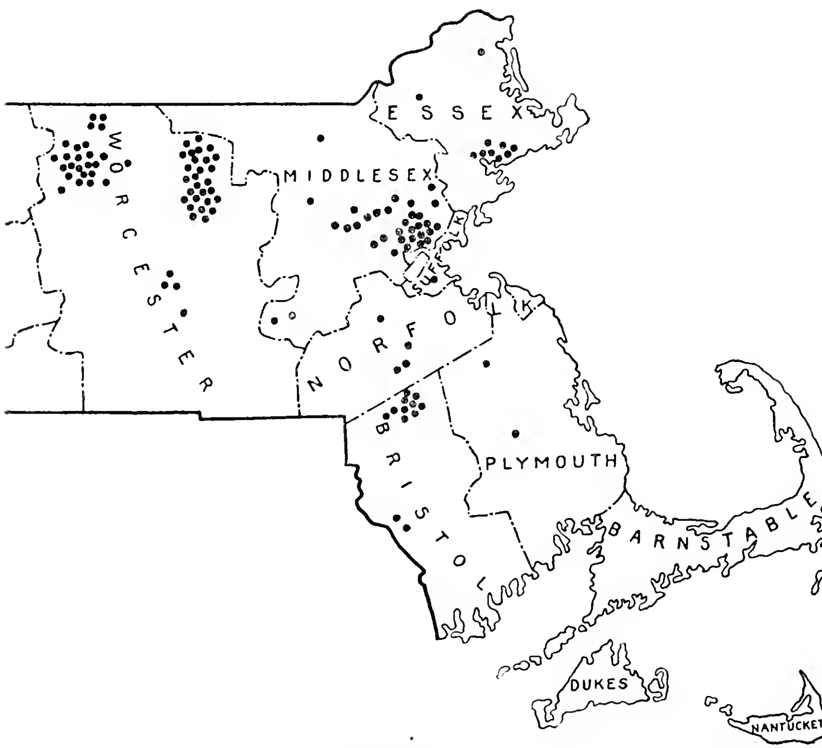


FIG. 2.—Approximate location of greenhouses in which bees are used for the pollination of cucumbers. (Original.)

There are at least 118 greenhouse cucumber growers. Only 73 of these, however, have furnished definite figures. These growers, including some of the largest and many of the smaller producers, use on an average 8 colonies of bees a year to set the crop. If the 118 known growers, which is not by any means the total number, require on the average 8 colonies each, nearly a thousand hives of bees would be utilized annually and, if the statistics from every grower were at hand, the writer feels sure several hundred colonies more than a thousand would be needed. When it is considered that practically all of these colonies are totally ruined while in the greenhouses and that the demand for bees is on the increase each year, it may be readily seen what excellent opportunity there is of producing bees for greenhouse use. Considering the recorded sale of bees in 1906, which amounted to 1,027 colonies, it is probable that these sales must have been largely a result of the demand for greenhouse use. In illustration of the extent to which bees are used for this purpose it may be mentioned that one grower who picks 10,000 bushels annually requires 80 colonies of bees; another having 40 acres under glass requires 35 to 40 colonies; a great many of the smaller growers use from 5 to 20 colonies. Cucumber growers, as a class, know little of bee-keeping methods, but they are anxious to learn. They feel that they must, in the stress of competition and high expenses, reduce the cost and loss in bees.

Bees are introduced into the greenhouses as soon as the cucumber vines begin to bloom. If the houses are large, two or more hives, according to the area of the house, are placed on boxes on the beds or hung in the gables of the house. Various other methods of introducing the hives are also employed. Not being able to secure sufficient stores in the winter, the colonies dwindle or become depleted in seven or eight weeks or less. It is a common practice among the growers to feed their bees sugar sirup or other sweets. Besides not being able to secure nectar to any extent from the cucumber blossoms, the bees are also unable to gather much pollen, which is probably a factor in the rapid depletion of the colonies. During the spring and summer, however, bees in the houses fare better, because they are able to escape, through ventilators and lights of glass removed for their exit, to the fields, where they secure nectar and pollen. Even under these circumstances the writer has seen colonies with no stores, with only a handful of bees and with scattered and half-starved brood. It is not surprising under such conditions that bee moths are such a great annoyance. To an experienced bee keeper the reason for their presence is obvious; when a colony becomes weakened the moth gains headway on the combs. No remedy for the moth in dwindled colonies can be suggested save killing the larvæ as they appear in the hive. A means of keeping the colonies strong must first be looked for, which will relieve the bee-moth nuisance. Without doubt, however, the pest could be reduced if the greenhouse men would be more careful in disposing of hives in which the bees have died. The moths breed by thousands in discarded hives, and later are at hand to infest fresh material. Under no circumstance should discarded combs be cast outside on the rubbish heap to be devoured by the bee moths. Such a practice is a menace to bee keepers for miles around.

TABLE VII.—*Distribution of greenhouse cucumber growers and record of bees used in greenhouses.*

County.	Number known to be engaged in cucumber growing.	Number reporting.	Number of colonies of bees known to be used annually.
Bristol	12	7	140
Essex	10	2	15
Middlesex	33	21	244
Norfolk	4	1	50
Plymouth	2	1	20
Suffolk	1	1	15
Worcester	56	40	100
Total	118	[a]73	[b]584

[a] Average of those reporting, 8. [b] Estimated total, 944.

THE BEE MARKET.

It is doubtful whether in any other State in the Union more colonies of bees are sold, in proportion to the number on hand in the spring, than in Massachusetts. As is pointed out, the cucumber industry has much to do with this. Although there are many small, more or less amateur bee keepers in the State who customarily sell their surplus colonies, the trade is not at all confined to them. The supply houses and commercial bee keepers sell heavily, which is remarkable in a region where there is so little bee keeping on a large scale. Peculiarly, every county in the State shares in the trade about equally, in proportion to their respective number of colonies. The table, arranged from the statistics of 1906, shows that the bee keepers of Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, and Worcester counties sold approximately one-fifth of all the colonies on hand in the spring. Plymouth County, however, took the lead, selling 39 per cent, while in the remote counties of Barnstable and Berkshire, and in the metropolis county, Suffolk, the sale was relatively light.

TABLE VIII.—*Number of colonies sold as compared with colonies on hand in spring of 1906.*

County.	Number of colonies of bees.		County.	Number of colonies of bees.	
	Spring of 1906.	Sold in 1906.		Spring of 1906.	Sold in 1906.
Barnstable	185	1	Hampshire	408	46
Berkshire	495	29	Middlesex	962	142
Bristol	321	80	Norfolk	364	72
Essex	531	107	Plymouth	463	170
Franklin	491	102	Suffolk	57	3
Hampden	366	73	Worcester	1,199	202

PRICES OF BEES.

Figured on a basis of $5 a colony, which is an exceedingly low average price, the total sales reported for 1906 would have amounted to $5,135; at $6 per colony they would have amounted to $6,162, which more justly represents transactions. Colonies of bees sell as low as $2, or, if they are in a nail keg or soap box, for $2.50; at about $3 if in a regular box hive; and from $4 to $10, according to the race, strength, and season, if in frame hives of standard patterns; a usual price is $6. The customer sometimes furnishes an empty hive to the bee keeper, in which to hive a swarm. Such swarms bring about $3.

THE QUEEN TRADE.

Besides a trade in colonies of bees, there are several persons interested in commercial queen rearing. All but three of these, however, do a relatively local business. On account of late and cold springs, Massachusetts is handicapped in producing early queens for market which shall compete with those raised in the South. The prices prevailing throughout the country—75 cents, $1, and up—are charged for queens produced in Massachusetts. It is difficult to calculate just how many queens are reared for sale, but an estimate of 500 may not be far from correct.

ENEMIES.

The only enemy which is formidable in all parts of the State, but which is not detrimental to progressive bee men, is the bee moth, *Galleria mellonella* L. This insect, however, has been credited by all the early apiarists, Langstroth included, with devastating, crippling, and practically annihilating the bee-keeping interests throughout New England. According to Edmund Smith,[a] it first took hold in eastern Massachusetts about 1800. In 1805 it reached Connecticut. Thence it spread westward. Writers—as, for instance, Smith—were formerly inclined to consider the moth as a formidable enemy. Smith says: "For a time, wherever it appeared it nearly destroyed the bees. At first it was more fatal than it has been since." The inroads of the moth led to all sorts of claptrap devices in the form of "patent hives" to protect the bees from the pest. But there is serious doubt, in view of recent discoveries of the relation of moths and bee disease, if this historical disaster was really due to the moth. There is good reason to believe moths were secondary, while disease, not then understood, was primary. This matter is more fully discussed in a former

---

[a] Smith, Edmund, Chairman. 1864. Bee Culture, Essex. From the report of the Committee on Bread and Honey. Abstract of the returns of the agricultural societies of Massachusetts. Bound together with Eleventh Annual Report of Secretary of Massachusetts Board of Agriculture, pp. 221–229.

paper.[a] The moth does not materially damage strong, healthy colonies, but is a menace only to persons who are inattentive to their bees or who are careless, leaving empty combs about their hives and bee yards, and who fail to recognize and to treat bee diseases. Combs not in use or not covered by bees should be fumigated with carbon bisulphid and sealed in tight boxes for storage.

DAMAGE TO THE BEE-KEEPING INDUSTRY BY THE GIPSY MOTH (PORTHETRIA DISPAR) AND BROWN-TAIL MOTH (EUPROCTIS CHRYSORRHŒA).

Numerous complaints came from eastern Massachusetts, where gipsy and brown-tail moths are doing tremendous damage to forest and shade trees, that they were causing a loss to the apiarist as well. Damage is done both directly to the bees and indirectly to the honey flora.

From Cliftondale, Essex County, one bee keeper says that they have bothered during June and July by trying to crawl in at the entrance of his hives. Another speaks of the caterpillars having eaten up all the plants which the bees commonly forage upon, save golden-rod and burdock, and have thus caused a loss of his bees. Failure of his honey crop in 1906 is attributed to severe ravages of gipsy and brown-tail moths. The basswood of New England was formerly a good honey producer and could be counted upon for a crop, is a report from Melrose, but since the brown-tail and gipsy moths defoliated the trees it can no longer yield much. A Medford bee keeper contributes this interesting note:

> Gipsy and brown tails have so spoiled the fruit bloom, an important factor in spring building, that colonies fail to become sufficiently strong for the harvest. The willow, maple, and elm, early pollen yielders, have also suffered from the moths, which has consequently damaged bee keeping.

Another peculiar case is reported from Cliftondale. Brown-tail and gipsy moths were so thick on the trees when a number of swarms came out that the bees did not stay near the apiary.

> The trees were covered with them so that the bees would not stay to be hived. * * * In regard to the honey plants, the moths destroyed all the blossoms on the fruit trees and wild plants. Every place was covered with them each year from 1904 to 1906; the result is that there was no honey this year (1906), owing to so many of the fruit trees and honey plants being destroyed by the pest.

BEE DISEASES.

This subject has already been treated with some detail in a former paper.[b] Since the appearance of that paper, however, the extent of diseases and the damage they are doing have become more fully real-

---

[a] Gates, Burton N. 1908. Bee Diseases in Massachusetts. Bul. No. 75, Part III, Bureau of Entomology; Bul. 124, Mass. Agr. Exp. Station.

[b] Ibid, pp. 23–32; also Bul. No. 124, Agr. Exp. Station, Amherst, Mass.

ized. Consequently their general distribution has been found to be even greater than was then believed.

BEE KEEPERS' ORGANIZATIONS.

Bee keepers' societies, fairs, institutes, conventions, and the course of instruction in bee keeping at the Massachusetts Agricultural College at Amherst are strong factors in the advancement and progress of apiculture in Massachusetts. The societies bring together the practiced and proficient bee keepers in several sections of the State. The instruction at Amherst reaches a few, largely beginners, each year; conventions and institutes bring together the new and the old bee keepers from over a large area for consideration of present-day problems; the State and county fairs and agricultural shows educate the public and benefit the industry.

There are at present two societies organized in the interest of promoting bee keeping. The oldest is the Worcester County Bee Keepers' Society, organized April 14, 1900. Meetings are held monthly throughout the winter months. At least once each summer there is a field meeting and institute. Since 1906, in the fall of each year, a "bee show" or fair is held at Worcester, where are held competitive exhibits of bees, products, supplies, etc. There is usually a series of lectures in connection with the fair.

The other society is the Massachusetts Society of Bee Keepers, which was organized March 24, 1906, when the Massachusetts Apicultural Society was disbanded. Meetings are held in Boston once each month during the winter.

Another society, to be called the Franklin, Hampshire, and Hampden Bee Keepers' Association, was provisionally organized at an institute meeting of the Massachusetts State Board of Agriculture at Ludlow, Mass., July 21, 1908.

INSTRUCTION IN BEE KEEPING.

At the Massachusetts Agricultural College, Amherst, there is given each year, beginning the fourth Wednesday in May and continuing two weeks, a course in apiculture, which is free to those who enroll. The course includes excursions to apiaries of peculiar interest, lectures, and practical demonstration and practice.

CONVENTIONS.

The Massachusetts State Board of Agriculture is exceedingly interested in promoting bee keeping and holds several institutes each year, usually with the bee keepers' societies. Several papers on bee keeping, enumerated in the appended bibliography, have been published by the board.

SUMMARY.

As early as 1644 the colonies made a beginning in apiculture in Massachusetts. More than two centuries passed, however, before modern bee keeping began, which came with the invention of the frame hive by Langstroth in 1853. To-day there are more than 2,100 persons in the State who derive some profit from their bees. The bee keepers who reported in the spring count of 1906 had 5,839 colonies, or an average of 5.5 colonies. Massachusetts needs fewer but more proficient bee keepers, who will undertake their work along business lines. The major part of Massachusetts is quite as inviting and promising as Vermont and New York State, where bee keeping is more profitably conducted.

There are but three persons who report 75 to 100 colonies in their yards, and but two who have more than 100 colonies. The number of amateur bee keepers is reduced through the dropping out of 50 per cent of the beginners during the past five years.

In the production of honey and possibly of wax the effect of an excess of semiproficient bee keepers is again apparent. In 1906 the honey crop reported was 145,257 pounds, which is the largest recorded for the State. But this is small when it is remembered that in the West single individuals frequently produce in a single year from a quarter to a third more honey than Massachusetts' total annual harvest. The crop would have been materially heavier if those who reported had even approached the standard average of 35 pounds instead of having harvested only 24 pounds. This lowering of the average crop is in a large measure due to the great number of non-progressive small bee keepers and to the presence of bee diseases.

The more important honey sources, as reported by the bee keepers in all parts of the State, are clovers, golden-rod and asters, fruit bloom, basswood, wild raspberry and blackberry, sumac, and locust. Some other plants, such as clethra and huckleberry, are of local importance and some listed as of minor importance are probably underestimated.

The Italian race in varying degrees of purity is most popular. The German or "black" still persists, but is rarely found pure.

Twenty-five per cent of the bee keepers still use box hives to some extent. The presence of box hives is most noticeable in the back country, where modern methods penetrate less rapidly. Of the frame hive types, the one standard for the country, the Langstroth, is most generally used.

The loss in the winter of 1906–7 was 16 to 17 per cent, which taxed the bee keepers nearly $5,000. By far the majority winter their bees on summer stands, protected in various ways or unprotected. A few take advantage of cellar wintering, but most of those who follow this practice are not especially proficient.

A thousand colonies or more are annually used in cucumber greenhouses. Since practically all of these colonies are useless after coming out of the houses, there is a constant demand and sale for bees. Several greenhouse men use from 40 to 80 colonies a year. The average number reported is 8 colonies. In the sale of bees the several counties, exclusive of Barnstable, Berkshire, and Suffolk, sold in 1906 approximately one-fifth of all their bees, spring count. In Plymouth County the sale amounted to 39 per cent. The total income amounted to between $5,000 and $6,000. The queen-rearing industry is limited to a few persons and late springs make it difficult to compete with southern producers.

The chief enemy reported is the bee moth. There is great doubt, however, if the damage attributed is really and primarily due to it. There is, on the other hand, sufficient reason to believe that disease is primary and that destruction by the moth is secondary. Gipsy and brown-tail moths are also reported as interfering severely with apiculture in the eastern part of the State.

Massachusetts is particularly fortunate and in some ways in advance of other communities in her bee keepers' institutions. Not alone do local societies aim to promote bee keeping, but the State Board of Agriculture, State Experiment Station, and Agricultural Station as well, are deeply interested in the advancement of apiculture.

A LIST OF THE MORE IMPORTANT ARTICLES ON BEE KEEPING IN MASSACHUSETTS.

——— ———.

1906. Massachusetts field meeting. American Bee-Keeper, XVI, pp. 188–189.

——— ———.

1908. Worcester County (Mass.) convention. American Bee-Keeper, XVIII, p. 43.

——— ———.

1908. Has annual meeting. Worcester County Bee Keepers' Association Elects Officers. American Bee-Keeper, XVIII, pp. 40–41.

ADAMS, GEO. W.

1906. Farm bee keepers [in Massachusetts]. American Bee-Keeper, XVI, pp. 88–89.

1906. Massachusetts bee keeping in 1644. Supply manufacturing before the days of new-fangled fixtures. American Bee-Keeper, XVI, pp. 180–181.

BABCOCK, L. B.

1855. Bees. Norfolk [County]. The agriculture of Massachusetts as shown in returns of the agricultural societies, 1854. Prepared by Charles L. Flint. Bound with Second Annual Report of the Secretary of Massachusetts Board of Agriculture. Boston. Pp. 403–405.

BROOKS, JENNIE.

1909. Memories of Langstroth by one who knew him in her childhood. Bee Keepers' Review, XXII, No. 2, pp. 39–42.

CANNING, JOSIAH D., Chairman; COWLES, DAVID S.; WRIGHT, ASAHEL.

1854. Bees and honey. The agriculture of Massachusetts, as shown in the returns of the agricultural societies, 1853. Prepared by Charles L. Flint. Bound with First Annual Report of the Secretary of Massachusetts Board of Agriculture. Boston. Pp. 390–393.

DEWEY, E. H.
1907. E. H. Dewey's doings. American Bee-Keeper, XVII, p. 85
1908. Yes; Relegate the box hive. American Bee-Keeper, XVIII, pp. 42–43.
EDDY, DR. HENRY.
1858. Bee culture. Abstracts of returns of the agricultural societies of Massachusetts, 1857; edited by Charles L. Flint. Bound with Fifth Annual Report of the Secretary of Massachusetts Board of Agriculture. Pp. 278–289. Illustrated. Boston.
ELLSWORTH, J. LEWIS.
1909. Bee keeping in Massachusetts. Annual Report of the Secretary of Massachusetts State Board of Agriculture, 1908.
ESTABROOK, A. H.
1908. Worcester County bee keepers' meeting. American Bee-Keeper, XVIII, p. 176.
[ESTABROOK, A. H.]
1907. Schedule of the bee show of the Worcester County Bee Keepers' Association, Sept. 13 and 14, 1907. American Bee-Keeper, XVII, pp. 189–190.
FLINT, CHARLES L.
1866. Thirteenth Annual Report of the Secretary of Massachusetts Board of Agriculture for 1865. Boston. Pp. 314–320. Apicultural statistics by counties in Part II of the Report, Abstracts of Returns of the Agricultural Societies of Massachusetts, 1866.
GATES, BURTON N., and HODGE, C. F.
1904, 1905. Bee keeping: How to meet its dangers and difficulties. Mass. Crop Report, XVII, No. 6, October, 1904, pp. 30–40. Fifty-second Annual Report of the Secretary of Massachusetts State Board of Agriculture. Pp. 411–426. Boston: 1905.
GATES, BURTON N.
1906. The first annual bee show of the Worcester Co. (Mass.) Bee Keepers' Association. American Bee Journal, XLVI, pp. 946–947.
1906. An interesting meeting. Report of the first of the series of winter meetings of the Worcester County (Mass.) Bee Keepers' Association. American Bee-Keeper, XVI, pp. 260–261.
1906. Worcester County Association. American Bee-Keeper, XVI, pp. 97–99.
1907. Status of bee keeping in Massachusetts in 1906. American Bee-Keeper, XVII, pp. 79–81.
1907. March meeting of the Worcester County (Mass.) Bee Keepers' Association. American Bee-Keeper, XVII, pp. 88–90.
1907, 1908. Bee keeping: Some suggestions for its advancement in Massachusetts. Massachusetts Crop Report, XX, No. 4, August, 1907, pp. 26–36. Fifty-fifth Annual Report of the Secretary of Massachusetts State Board of Agriculture, 1907. Boston: 1908. Pp. 370–383.
1907. Relegate the box hives. American Bee-Keeper, XVII, pp. 271–273.
1908. Bee diseases in Massachusetts. Bulletin 75, Part III, Bureau of Entomology, U. S. Department of Agriculture; Bulletin 124, Massachusetts Agricultural College. 12 pp.
1909. A method of securing apicultural statistics. Journal of Economic Entomology, II, pp. 117–120.
LATHAM, ALLAN.
1908. Is it well to relegate the box hive? American Bee-Keeper, XVIII, pp. 2–4.
MILLER, ARTHUR C.
1906. A unique system. American Bee-Keeper, XVI, pp. 206–210.
1906. Worcester County bee keepers' show. American Bee-Keeper, XVI, pp. 231–233.
1907. The Wiswell-Richardson apiary. West Medford, Mass. American Bee-Keeper, XVII, p. 8.
1907. The Massachusetts society. American Bee-Keeper, XVII, pp. 100–101.
1907. The Massachusetts field meet. American Bee-Keeper, XVII, p. 206.
1907. The Massachusetts meeting. American Bee-Keeper, XVII, pp. 220–221.
1907. Profitable meeting at Worcester, Mass. American Bee-Keeper, XVII, pp. 239–241.
1907. Obadiah Brown Hadwen. American Bee-Keeper, XVII, p. 282.
1908. Massachusetts bee keepers. American Bee-Keeper, XVIII, p. 103.

[MILLER, ARTHUR C.]
1908. Good work in Massachusetts. American Bee-Keeper, XVIII, pp. 137–138.

PAIGE, JAMES B.
1903, 1904. Bee keeping: Its pleasures and profits. Massachusetts Crop Report, Bul. No. 3, July, 1903, pp. 30–40. Fifty-first Annual Report of the Secretary of Massachusetts State Board of Agriculture. Boston: 1904. pp. 399–411. Illustrated.
1906. Wood's bee disease. American Bee-Keeper, XVI, pp. 69–70.
1906. Death of James Fitts Wood, of Athol, Mass. American Bee-Keeper, XVI, pp. 73–74.
1907. The first principles of bee keeping. Nature Leaflet No. 34, Massachusetts State Board of Agriculture. 10 pp. Illustrated.

RICE, DAVID, Chairman.
1861. Bee culture. Hampshire [County] Abstract of the returns of the agricultural societies of Massachusetts for 1860. Bound with Eighth Annual Report of the Secretary of Massachusetts Board of Agriculture for 1860, pp. 229–234. Boston.

SMITH, JEROME V. C., M. D.
1831. An essay on the practicability of cultivating the honey bee, in maritime towns and cities, as a source of domestic economy and profit. Boston: Perkins and Marvin; New York. Frontispiece and cuts. 106 pp.

SMITH, EDMUND, Chairman.
1864. Bee culture. Essex [County]. Abstract of returns of the agricultural societies of Massachusetts, 1863. Edited by Charles L. Flint. Bound together with the Eleventh Annual Report of the Secretary of Massachusetts Board of Agriculture, pp. 221–229. Boston.

THACHER, JAMES, M. D.
1829. A practical treatise on the management of bees: And the establishment of apiaries, with the best method of destroying and preventing the depredations of the bee moth. Boston. 164 pp.

WRIGHT, W. D.
1908. Equipment and manipulation of an apiary for comb honey. Delivered at the Worcester County Massachusetts bee keepers' association, April 11, 1908. American Bee-Keeper, XVIII, pp. 115–116.

[WRIGHT, W. D.]
1908. Foul brood. Worcester Telegram, April 12. American Bee-Keeper, XVIII, pp. 120–121.

CONTENTS.

ILLUSTRATIONS.

BULLETIN No. 130. JUNE 1909.

MASSACHUSETTS
AGRICULTURAL EXPERIMENT STATION.

A Summary of Meteorological Observations

BY

J. E. OSTRANDER

This bulletin gives summaries of the meteorological observations made at this station for the twenty-year period, 1889 to 1908. It includes also records of such available and at the same time apparently reliable precipitation and temperature records as were made in Amherst previous to 1889. Most of these records were made by the late Professor E. S. Snell of Amherst College and his daughters (1836-1883), while others were made in the old State Experiment Station of which Dr. C. A. Goessmann was Director. (1883-1888).

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

CHARLES A. GOESSMANN, PH.D., LL.D.	*Honorary Director and Consulting Chemical Expert.*
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
JOSEPH B. LINDSEY, PH. D.,	*Chemist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. S.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
EDWARD B. HOLLAND, M. S.,	*Associate Chemist* (Research Div.).
HENRI D. HASKINS, B. SC.,	*Chemist in Charge* (Fertilizer Div.).
PHILIP H. SMITH, B. SC.,	*Chemist in Charge* (Feed and Dairy Div.).
FRED C. SEARS, M. SC.	*Pomologist.*
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist.*
ROBERT D. MACLAURIN, PH. D.,	*Research Chemist.*
LEWELL S. WALKER, B. SC.,	*Assistant Chemist.*
GEORGE H. CHAPMAN, B. SC.,	*Assistant Botanist.*
PHILIP V. GOLDSMITH, B. SC.	*Assistant Chemist.*
JAMES C. REED, B. SC.	*Assistant Chemist.*
J. K. SHAW, M. SC.,	*Assistant Horticulturist.*
JOHN N. SUMMERS, B. SC.,	*Assistant in Entomology.*
F. A. JOHNSON, B. SC.,	*Assistant in Entomology.*
WILLIAM K. HEPBURN,	*Inspector.*
ROY F. GASKILL,	*Assistant in Animal Nutrition.*
R. C. LINDBLAD,	*Observer.*

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

LOCATION AND EQUIPMENT.

The meteorological observatory is located in the tower at the southeast corner of South College at an elevation of about 50 feet above the ground. It was equipped with a number of Draper self-recording instruments and the records date from Jan. 1, 1889. The location is on a gravel ridge with an open exposure to the north, west and southwest, with slightly higher ground about a mile to the south and a ridge considerably higher about half a mile to the east.

The top of the tower is 72 feet above ground, and the exposure is good in all directions. The anemometer, anemoscope, wind pressure instrument and electrical sunshine recorder are mounted from 3 to 5 feet above the top of the tower and the recording apparatus is in the room below. The thermometer shelter and rain gauges are on the campus about 300 feet southwest from the tower and on slightly lower ground.

The observatory is in latitude 42° 23′ 48.5″ N., longitude 72° 31′ 10″ W., and the base of the tower is 223 feet above mean low water, Boston harbor, as determined by levels connecting with those of the Boston and Maine railroad. The standard barometer is of U. S. Weather Bureau pattern, reading to 1-500th of an inch, and the cistern is 273½ feet above sea level. The Draper self-recording barometer is mounted one foot higher.

The sunshine recorder of the Draper pattern was replaced by an electrical one from Friez in 1906, and the Draper anemometer by one of U. S. Weather Bureau pattern, at about the same time. The records are received on a triple register, which also records the rainfall. The rain gauges are about two feet above ground and 218 feet above sea level. A U. S. Weather Bureau gauge is used in determining the precipitation, and the tipping bucket electrical recording gauge in determining the time and rate.

The Draper self-registering thermometer, Weather Bureau pattern, maximum and minimum thermometers and hygrometer are in a standard shelter about four feet above ground and 220 feet above sea level.

On Jan. 1, 1904, the time of making observations was changed from 7 A. M., 2 P. M. and 9 P. M., to 8 A. M. and 8 P. M., so as to conform with the practice of the U. S. Weather Bureau. This change should be noted in comparing the dew point and relative humidity before and after that date. Other data are probably not affected by the change.

Mean Barometer.

(Readings are reduced to freezing and sea level.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean Annual.
1889..	30.11	30.24	29.84	29.80	29.92	29.96	29.91	30.01	30.00	30.05	30.04	30.14	30.00
1890..	30.19	30.10	29.99	30.10	29.96	29.98	30.02	30.00	30.12	29.88	30.01	30.01	30.03
1891..	29.96	30.04	30.10	29.92	29.98	29.92	29.99	29.96	30.11	30.03	30.12	30.08	30.02
1892..	29.96	30.11	29.90	29.97	29.94	29.92	29.99	30.02	30.10	29.90	29.99	30.01	29.98
1893..	29.95	30.11	30.06	30.09	29.90	30.06	29.97	30.00	30.06	30.13	30.12	30.12	30.05
1894..	30.18	30.16	30.09	30.05	30.00	30.00	30.01	30.03	30.14	30.02	30.08	30.15	30.08
1895..	30.05	29.92	30.00	30.12	30.10	30.17	30.03	30.02	30.10	30.08	30.19	30.15	30.08
1896..	30.16	29.86	29.99	30.14	29.98	29.95	29.97	29.99	30.00	30.01	30.14	30.14	30.03
1897..	30.04	30.06	30.04	30.04	29.92	29.90	29.94	29.94	30.09	30.12	30.03	30.04	30.01
1898..	29.98	30.05	30.20	29.93	29.94	29.95	30.02	29.96	30.01	30.09	30.01	29.96	30.01
1899..	30.11	29.98	29.94	30.04	30.00	29.98	29.93	29.98	30.02	30.19	30.01	30.03	30.02
1900..	30.03	29 97	29.95	29.96	29.91	29.91	29.91	29.99	30.04	30.15	29.99	30.03	29.98
1901..	29.95	29.79	29.90	29.97	29.88	29.95	29.93	30.02	30.03	30.08	29.93	30.03	29.96
1902..	30.04	29.78	29.91	29.88	29.84	29.84	29.96	29.92	30.04	30.03	30.06	30.06	29.95
1903..	29.91	29.98	30.20	29.87	29.94	29.94	29.88	30.00	30.10	30.00	30.01	29.97	30.00
1904..	30.08	30.11	30.11	29.97	30.02	30.02	29.98	30.03	30.08	30.08	29.95	30.02	30.03
1905..	30.08	30.12	30.12	29.85	29.93	29.93	29.95	29.98	30.05	30.10	30.01	30.08	29.94
1906..	30.09	30.20	30.09	29.98	29.94	29-94	29.98	30.02	30.09	30.09	30.04	30.12	30.05
1907..	30.23	30.09	30.08	29.88	29.93	29.93	29.87	30.00	30.02	30.05	30.05	30.02	30.02
1908..	29.97	30.08	30.10	29.92	30.03	30.03	30.04	30.03	30.10	30.17	30.01	30.04	30.04
Mean.	30.05	30.04	30.03	29.97	29.95	29.96	29.97	30.00	30.07	30.06	30.04	30.06	30.01

Range of Barometer (in inches).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Range.
1889..	1.62	1.51	1.58	1.16	.75	.97	.68	.66	.98	.96	1.31	1.75	1.81
1890..	1 50	1.35	1.08	1.08	.81	.58	.63	1.10	.69	1.09	.98	1.20	1.76
1891..	1.93	1.36	1.21	1.42	.79	.53	.74	.61	.73	1.11	1.56	1.22	2.05
1892..	1.38	1.65	1.16	1.02	.96	.84	.97	.55	.96	.98	1.00	1.01	1.65
1893..	1.53	1.83	1.27	1.25	1.16	.67	.68	.93	.81	1.37	1.16	1.53	1.92
1894..	1.89	1.65	1.04	.86	.93	.75	.57	.44	1.11	1.19	1.22	1.23	2.01
1895..	1.46	1.88	1.24	1.40	.84	.66	.51	.53	.68	1.09	1.47	1.78	2.27
1896..	.97	1.77	1.52	.96	.75	.83	.79	.59	.85	1.10	1.23	1.57	2.22
1897..	1.57	1.15	1.74	1.10	.76	.55	.72	.61	.73	1.12	1.48	1.42	1.76
1898..	1.43	1.63	1.17	.86	.76	.95	.81	.60	.82	1.19	1.25	1.39	1.75
1899..	1.70	1.41	1.54	.90	.60	.59	.51	.56	.88	.76	1.10	1.58	1.82
1900..	1.58	1.89	1.52	1.01	.99	.67	.73	.53	1.03	1.07	1.71	1.53	1.89
1901..	1.68	.97	1.17	1.19	.77	.61	.59	.51	1.00	1.22	1.14	1.13	1.68
1902..	1.49	1.41	1.55	1.04	.94	1.27	.58	.67	.78	1.25	1.12	1.34	1.89
1903..	1.49	1.55	1.19	1.15	.85	.97	.57	.77	.78	1.08	1.32	1.56	1.77
1904..	1.50	1.36	1.58	1.00	.75	.81	.73	.73	1.20	1.23	1.84	1.43	2.23
1905..	1.37	1.28	.89	1.15	.85	.83	.58	.72	.66	1.16	1.22	1.53	1.64
1906..	1.53	1.28	1.64	1.05	1.08	.77	.90	.72	1.03	1.41	1.05	1.30	1.70
1907..	1.34	1.27	1.39	1.42	.67	.71	.76	.71	.91	1.24	1.59	1.46	1.79
1908..	1.73	1.89	1.22	1.35	1.11	.65	.66	.68	.73	1.17	1.14	1.31	1.97
Mean.	1.53	1.50	1.34	1.12	.86	.76	.69	.66	.87	1.14	1.29	1.41	1.88

Maximum Barometer.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Maximum
1889..	30.82	30.97	30.66	30.54	30.40	30.54	30.35	30.45	30.40	30.52	30.67	30.96	30.97
1890..	30.94	30.72	30.56	30.57	30.32	30.28	30.27	30.28	30.42	30.41	30.35	30.61	30.94
1891..	30.62	30.69	30.57	30.56	30.44	30.22	30.37	30.27	30.45	30.67	30.74	30.55	30.74
1892..	30.67	30.72	30.45	30.53	30.43	30.39	30.50	30.24	30.42	30.43	30.44	30.53	30.72
1893..	30.61	30.83	30.63	30.65	30.32	30.36	30.25	30.30	30.45	30.65	30.70	30.92	30.92
1894..	30.77	30.89	30.57	30.52	30.50	30.33	30.31	30.24	30.63	30.42	30.73	30.53	30.89
1895..	30.61	30.44	30.52	30.70	30.55	30.51	30.33	30.29	30.41	30.67	30.73	30.83	30.83
1896..	30.56	30.49	30.62	30.60	30.48	30.42	30.49	30.39	30.40	30.62	30.86	30.94	30.94
1897..	30.77	30.70	30.88	30.61	30.36	30.28	30.33	30.18	30.40	30.67	30.60	30.60	30.88
1898..	30.61	30.64	30.76	30.34	30.33	30.35	30.44	30.26	30.41	30.46	30.53	30.52	30.76
1899..	30.92	30.53	30.49	30.39	30.29	30.25	30.24	30.31	30.47	30.50	30.54	30.66	30.92
1900..	30.67	30.75	30.59	30.48	30.38	30.19	30.16	30.25	30.35	30.52	30.64	30.51	30.75
1901..	30.69	30.34	30.43	30.52	30.20	30.24	30.29	30.28	30.51	30.66	30.37	30.58	30.69
1902..	30.66	30.27	30.50	30.28	30.43	30.46	30.29	30.26	30.38	30.52	30.48	30.75	30.75
1903..	30.62	30.48	30.65	30.46	30.54	30.39	30.17	30.42	30.42	30.40	30.70	30.60	30.70
1904..	30.90	30.67	30.96	30.50	30.37	30.35	30.26	30.42	30.62	30.57	30.57	30.54	30.96
1905..	30.70	30.62	30.60	30.37	30.38	30.19	30.15	30.27	30.41	30.58	30.63	30.86	30.86
1906..	30.78	30.95	30.92	30.45	30.49	30.35	30.46	30.38	30.50	30.63	30.42	30.77	30.95
1907..	30.75	30.78	30.59	30.41	30.34	30.22	30.18	30.35	30.39	30.60	30.59	30.45	30.78
1908..	30.59	30.83	30.59	30.52	30.31	30.40	30.26	30.34	30.45	30.59	30.45	30.61	30.83
Mean Max.	30.71	30.68	30.63	30.50	30.39	30.34	30.31	30.31	30.44	30.55	30.59	30.67	30.84

Minimum Barometer.

YEAR.	January.	February.	March	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Minimum
1889..	29.20	29.46	29.08	29.38	29.65	29.57	29.67	29.79	29.42	29.56	29.36	29.21	29.08
1890..	29.44	29.37	29.48	29.49	29.51	29.70	29.64	29.18	29.73	29.32	29.37	29.41	29.18
1891..	28.69	29.33	29.36	29.14	29.65	29.69	29.63	29.66	29.72	29.56	29.18	29.33	28.69
1892..	29.29	29.07	29.29	29.51	29.47	29.55	29.53	29.69	29.46	29.45	29.44	29.52	29.07
1893..	29.08	29.00	29.36	29.40	29.16	29.69	29.57	29.37	29.64	29.28	29.54	29.39	29.00
1894..	28.88	29.24	29.53	29.66	29.57	29.58	29.74	29.80	29.52	29.23	29.51	29.30	28.88
1895..	29.17	28.56	29.28	29.30	29.71	29.85	29.82	29.76	29.73	29.58	29 26	29.05	28.56
1896..	29.59	28.72	29.10	29.64	29.73	29.59	29.70	29.80	29.55	29.52	29.63	29.37	28.72
1897..	29.20	29.55	29.14	29.51	29.60	29.63	29.61	29.57	29.67	29.55	29.12	29.18	29.12
1898..	29.18	29.01	29.59	29.48	29.57	29.40	29.63	29.66	29.59	29 27	29 28	29.13	29.01
1899..	29.22	29.12	28.95	29.49	29.69	29.66	29.63	29.75	29.56	29.74	29.44	29.10	29.10
1900..	29.08	28.86	29 06	29.47	29.39	29.51	29.42	29.72	29.32	29.42	28.93	28.98	28.86
1901..	29.01	29.37	29.26	29.33	29.43	29.63	29.70	29.76	29.51	29.44	29.23	29.42	29.01
1902..	29.17	28.86	28.95	29.24	29.49	29.24	29.61	29.59	29.60	29.27	29.36	29.41	28.86
1903..	29.13	28.93	29.46	29.31	29.69	29.42	29.60	29.65	29.69	29.32	29.38	29.04	28.93
1904..	29.40	29.31	29.38	29.50	29.62	29.54	29.53	29.69	29.42	29.28	28.73	29.11	28.73
1905..	29.33	29.34	29.71	29.22	29.53	29.36	29.57	29.55	29.75	29.42	29.41	29.33	29.22
1906..	29.25	29.67	29.28	29.40	29.41	29.58	29.56	29.66	29.47	29.22	29.37	29.47	29.25
1907..	29.41	29.51	29.29	28.99	29.69	29.51	29.42	29.64	29.48	29.36	29.00	29.05	28.99
1908..	28.86	28.94	29.37	29.27	29.20	29.75	29.69	29.66	29.72	29.42	29.31	29.30	28.86
Mean Min.	29.18	29.16	29.29	29.39	29.54	29.57	29.61	29.65	29.58	29.41	29.29	29.25	28.96

Mean Temperature (in degrees F.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Mean.
1889*.	—	—	—	—	—	—	—	—	—	—	—	—	—
1890*.	29.2	32.0	31.0	45.8	56.3	65.3	68.4	67.2	60.4	48.2	37.2	21.8	46.9
1891*.	26.4	27.6	32.7	47.5	55.6	65.2	66.3	69.0	64.9	48.7	38.1	36.9	48.2
1892*.	23.6	26.1	31.4	45.2	56.0	69.3	69.3	68.9	59.3	48.6	37.8	26.3	46.8
1893*.	16.1	22.9	30.4	43.0	55.8	66.9	68.1	69.2	55.8	52.6	38.2	25.5	45.4
1894*.	26.4	21.6	39.6	46.7	57.3	67.8	72.9	68.0	65.5	51.5	34.8	26.9	47.9
1895*.	23.2	19.5	31.2	45.6	59.7	69.1	67.6	69.7	64.1	45.6	40.7	30.5	47.2
1896*.	20.7	25.0	29.2	48.3	61.1	65.0	71.3	68.8	59.5	47.0	42.2	25.6	47.0
1897*.	24.7	25.4	33.1	47.1	56.8	62.0	71.6	66.8	60.1	49.8	36.2	28.3	46.8
1898*.	21.8	26.1	39.7	42.4	55.3	66.1	70.9	70.2	63.6	51.1	37.5	25.9	47.5
1899†.	23.3	21.8	30.6	46.1	55.7	67.4	70.1	68.0	59.7	51.1	37.0	30.8	46.8
1900†.	25.5	24.6	29.5	46.9	55.4	67.1	70.6	70.1	63.8	54.5	41.3	30.6	48.3
1901†.	23.7	20.1	33.1	46.8	56.2	68.0	72.5	69.9	62.1	50.1	33.4	26.4	46.9
1902†.	22.9	25.5	40.5	47.3	57.0	63.5	67.8	66.1	60.3	50.7	42.8	23.5	47.3
1903†.	24.3	27.3	42.6	46.9	59.2	59.6	68.9	62.0	61.3	51.1	34.3	22.5	46.7
1904†.	14.3	17.7	31.0	42.5	60.1	65.0	69.8	66.4	59.8	47.2	33.0	19.6	43.9
1905†.	20.4	17.7	33.1	45.6	56.9	64.4	71.1	65.8	59.1	49.9	36.3	29.8	45.8
1906†.	29.6	23.8	28.3	45.1	56.7	66.1	70.1	70.5	64.0	50.5	38.5	24.2	47.3
1907†.	22.4	16.5	35.2	41.5	51.8	63.9	70.0	66.1	61.3	45.6	37.6	30.5	45.2
1908†.	25.7	20.5	34.7	45.1	59.2	67.6	72.5	66.6	62.9	51.3	38.0	27.1	47.6
Mean.	23.4	23.3	33.5	45.6	57.0	65.7	70.0	67.9	61.2	49.2	37.7	26.9	46.8

* Mean of Daily Maximum and Minimum.
† Mean Hourly.

Range of Temperature (in Degrees F.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Range.
1889..	—	—	—	—	—	—	—	—	—	—	—	—	—
1890..	57.0	54.5	69.0	57.5	48.5	47.5	54.0	47.0	52.0	52.0	51.0	48.5	100.5
1891..	52.5	60.0	57.5	61.5	62.0	60.0	48.5	47.5	55.5	69.0	60.5	51.5	100.0
1892..	66.5	53.5	54.5	58.5	56.0	54.0	52.0	44.0	49.0	54.5	53.0	47.0	104.5
1893..	63.0	54.5	48.0	48.5	57.0	52.5	49.5	57.0	51.0	57.0	52.0	64.0	109.0
1894..	52.0	66.0	56.0	63.0	56.0	55.5	50.0	54.0	56.0	43.0	55.0	55.0	115.0
1895..	50.0	55.0	44.0	56.0	62.5	51.0	54.0	52.0	64.0	51.0	57.0	68.0	105.0
1896..	53.0	67.0	52.0	67.5	62.5	51.0	41.0	55.0	57.5	49.0	54.0	62.0	111.0
1897..	51.0	59.0	60.5	60.0	48.0	47.5	36.0	43.0	59.5	63.5	58.0	62.5	102.5
1898..	65.5	73.0	45.5	54.0	46.0	50.0	56.5	46.5	58.5	59.5	56.0	60.0	115.5
1899..	70.5	61.0	42.0	61.0	55.5	51.0	47.0	51.0	51.5	61.5	40.5	59.0	114.5
1900..	56.0	64.0	46.0	59.0	67.5	54.0	51.0	53.0	53.5	61.0	55.0	57.5	104.0
1901..	55.0	48.5	57.0	58.5	50.5	57.5	52.0	33.5	59.0	51.0	54.0	70.5	111.0
1902..	47.5	49.0	48.5	57.5	61.0	49.0	45.0	44.0	51.5	51.5	47.5	64.0	106.0
1903..	57.5	68.0	57.0	62.0	68.0	48.5	52.5	42.0	60.5	55.0	68.5	61.5	109.0
1904..	66.0	56.0	68.0	50.5	48.0	51.5	48.0	49.5	58.5	59.5	49.0	47.0	120.5
1905..	64.0	59.5	76.0	57.0	50.5	54.0	47.0	47.5	53.0	59.0	50.0	51.5	106.0
1906..	56.5	57.5	60.5	53.5	58.5	50.5	43.5	43.0	59.5	53.5	43.5	48.5	98.5
1907..	78.0	61.5	74.0	49.0	65.0	57.0	46.0	55.0	49.0	52.5	40.5	50.5	119.5
1908..	58.5	68.0	62.0	66.0	55.0	55.5	50.0	51.5	55.0	67.5	39.5	63.5	108.0
Mean.	58.8	59.8	56.6	57.9	56.7	52.5	48.1	48.3	55.5	56.3	52.0	54.6	108.4

Maximum Temperatures (in Degrees F.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Maximum
1889..	—	—	—	—	—	—	—	—	—	—	—	—	—
1890..	61.5	57.5	62.5	79.5	80.0	88.0	94.0	88.5	80.5	78.0	62.5	43.5	94.0
1891..	52.0	54.0	56.5	79.5	87.0	94.0	90.0	92.5	91.5	89.0	64.0	60.5	94.0
1892..	57.0	46.5	60.5	78.5	84.0	95.0	94.0	94.0	80.0	77.5	67.0	46.0	95.0
1893..	50.0	50.0	52.0	67.5	87.0	94.0	90.5	96.0	81.0	80.0	63.0	52.0	96.0
1894..	53.0	49.0	73.0	79.0	85.0	93.0	98.0	91.0	91.0	75.0	65.0	51.0	98.0
1895..	45.5	45.0	49.0	81.0	92.0	95.0	90.0	90.0	97.0	71.0	72.0	65.0	97.0
1896..	41.0	53.0	57.0	88.5	94.5	90.0	91.0	97.0	88.5	72.0	69.0	52.5	97.0
1897..	51.0	48.0	59.0	80.5	79.5	85.5	91.0	85.0	91.5	84.0	63.0	59.0	91.5
1898..	50.0	54.0	60.0	71.0	78.5	89.5	96.5	91.0	93.0	86.5	62.0	48.0	96.5
1899..	49.0	51.0	52.0	82.0	88.5	93.0	90.0	92.0	84.0	82.0	58.0	61.0	93.0
1900..	51.5	56.0	49.0	80 0	91.5	94.0	95.5	96.0	89.0	83.0	67.0	58.0	96.0
1901..	47.0	44.0	56.5	86.5	82.0	98.5	100.5	86.5	92.0	75.0	60.0	60.0	100.5
1902..	47.0	54.0	65.0	83.0	91.0	89.0	90.0	87.0	86.5	74.0	65.0	49.0	91.0
1903..	45.5	57.0	76.0	84.0	92.5	86.5	97.0	84.5	91.0	77.5	74.5	52.0	97.0
1904..	40.0	48.0	65.0	70.5	85.0	92 5	94.5	89.5	84.5	77.5	56.5	43.5	94.5
1905..	51.0	48.5	77.0	79.0	82.5	90.0	93.0	89.0	85.0	80.5	61.0	54.5	93.0
1906..	60.0	52.5	53.0	74.5	90.0	87.5	88.5	90.5	91.0	77.5	62.0	45.5	91.0
1907..	54 5	43.0	79.5	70.5	90.0	95.0	90.0	96.0	85.0	73.0	60.0	60.5	96.0
1908..	53.0	56.0	67.0	84.0	88.5	91.5	96.0	88.5	88.0	90.5	58.0	65.5	96.0
Mean.	50.5	50.9	61.4	78.9	86.7	91.7	93.2	90.8	87.9	79.1	63.7	50.8	95 1

Minimum Temperatures (in Degrees F.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Minimum
1889..	—	—	—	—	—	—	—	—	—	—	—	—	—
1890..	4.5	3.0	-6.5	22.0	31.5	40.5	40.0	41.5	28.5	26.0	11.5	-5.0	-6.5
1891..	-0.4	-6.0	-1.0	18.0	25.0	34.0	41.5	45.0	36.0	20.0	3.5	9.0	-6.0
1892..	-9.5	-7.0	6.0	20.5	28.0	41.0	42.0	50.0	31.0	23.0	14.0	-1.0	-9.5
1893..	-13.0	-4.5	4.0	19.0	30.0	41.5	41.0	39.0	30.0	23.0	11.0	-12.0	-13.0
1894..	1.0	-17.0	17.0	16.0	29.0	37.5	48.0	37.0	35.0	32.0	10.0	-4.0	-17.0
1895..	-4.5	-10.0	5.0	25.0	29.5	44.0	46.0	38.0	33.0	20.0	15.0	-3.0	-10.0
1896..	-12.0	-14.0	5.0	21.0	32.0	39.0	50.0	42.0	31.0	23.0	15.0	-9.5	-14.0
1897..	0.0	-11.0	-1.5	20.5	31.5	38.0	55.0	42.0	32.0	20.5	5.0	-3.5	-11.0
1898..	-15.5	-19.0	14.5	17.0	32.5	39.5	40.0	44.5	34.5	27.0	6.0	-12.0	-19.0
1899..	-21.5	-10.0	10.0	21.0	33.0	42.0	43.0	41.0	32.5	20.5	17.5	2.0	-21.5
1900..	-4.5	-8.0	3.0	21.0	24.0	40.0	44.5	43.0	35.5	22.0	12.0	0.5	-8.0
1901..	-8.0	-4.5	-0.5	28.0	31.5	41.0	48.5	53.0	33.0	24.0	6.0	-10.5	-10.5
1902..	-0.5	5.0	16.5	25 5	30.0	40.0	45.0	43.0	35.0	22.5	17.5	-15.0	-15.0
1903..	-12.0	-11.0	19.0	22.0	24.5	38.0	44.5	42.5	30.5	22.5	6.0	-9.5	-12.0
1904..	-26.0	-8.0	-3.0	20.0	37.0	44.0	46.5	40.0	26.0	18.0	7.5	-3.5	-26.0
1905..	-13 0	-11.0	1.0	22.0	32.0	36.0	46.0	41.5	32.0	21.5	11.0	3.0	-13.0
1906..	3.5	-5.0	-7.5	21.0	31.5	37.0	45.0	47.5	31.5	24.0	18.5	-3.0	-7.5
1907..	-23.5	-18.5	5.5	20.5	25.0	38.0	44.0	41.0	36.0	20.5	19.5	10.0	-23.5
1908..	-5.5	-12 0	5.0	18.0	33.5	36.0	46.0	37.0	33.0	23.0	18.5	2.0	-12.0
Mean.	-8.3	-8.9	4.8	20.9	30.1	39.3	45.1	42.5	32.4	22.8	11.8	-3.4	-13.4

Mean Dew Point (in Degrees F.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889..	26.3	21.2	30.4	43.8	52.8	61.1	62.7	59.5	56.9	39.4	38.3	30.9	43.6
1890..	23.8	25.2	26.5	35.6	58.0	57.9	61.5	57.2	55.8	41.0	29.7	14.7	40.6
1891..	20.7	21.7	22.6	36.3	44.6	57.0	58.5	62.4	58.1	40.6	30.4	28.2	40.1
1892..	18.8	20.9	21.5	33.0	44.9	62.3	60.9	62.1	51.9	41.0	32.1	20.5	39.2
1893..	13.9	17.3	24.0	31.4	45.7	58.3	58.8	59.9	49.1	44.2	29.9	21.9	37.9
1894..	21.6	17.9	31.1	34.2	52.6	57.9	62.4	58.6	56.2	44.6	27.3	22.3	40.5
1895..	19.2	17.1	26.2	35.8	48.7	59.6	59.3	60.4	54.8	35.4	34.4	23.6	39.5
1896..	14.3	22.0	25.6	35.9	48.3	53.9	62.4	61.7	54.5	42.4	37.7	19.6	39.9
1897..	18.0	18.1	26.9	35.7	48.0	53.3	64.6	59.7	52.7	39.0	31.8	24.2	39.6
1898..	18.4	21.8	30.5	34.2	48.8	59.3	64.6	64.6	56.9	46.6	32.7	20.8	41.6
1899..	16.6	17.0	25.5	36.5	48.6	59.5	62.5	59.4	51.5	48.8	29.8	25.1	40.1
1900..	18.1	17.8	19.3	34.9	43.7	57.0	62.3	62.0	54.7	47.1	32.0	21.7	39.2
1901..	16.6	10.6	24.7	35.6	45.7	56.2	63.4	62.3	54.5	39.9	24.1	17.9	37.6
1902..	12.3	15.1	32.2	36.3	44.0	53.5	57.3	57.8	53.7	40.5	34.2	15.0	37.7
1903..	16.0	21.0	34.6	34.1	44.9	53.7	59.3	54.7	52.5	39.2	25.6	16.1	37.6
1904..	9.3	9.5	22.4	31.5	48.4	56.6	61.5	59.0	52.7	37.5	25.1	12.6	35.5
1905..	12.8	9.2	24.8	33.5	45.7	56.5	63.2	59.0	52.4	40.3	26.8	23.8	37.3
1906..	20.8	15.2	19.3	34.7	46.4	58.3	63.1	63.6	55 2	42 9	27.7	16.5	38.6
1907..	13.4	9.0	25.8	32.0	42.2	55.0	61.0	56.5	54.6	37.1	32.0	23.7	36.9
1908..	16.5	14.7	26.9	31.9	50.1	56.2	63.7	58.3	53.5	41.8	30.1	18.6	38.5
Mean.	17.4	17.1	26.0	41.7	52.0	58.9	61 6	59.9	41.5	51.4	30.6	20.9	39.1

Mean Relative Humidity.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889..	79.0	90.0	75.0	78.3	73.8	79.1	78.2	80.4	83.3	75.7	75.4	75.2	78.6
1890..	68.2	74.8	77.3	64.7	67.1	71.3	70.1	74.9	80.9	68.2	67.8	67.2	71.1
1891..	72.2	69.4	63.7	60.1	59.3	65.3	66.1	70.3	72.1	65.5	68.7	68.7	66.8
1892..	73.7	72.8	64.1	54.5	60.3	68.9	65.6	74.9	70.7	65.5	71.0	70.3	67.7
1893..	80.2	74.7	71.4	64.8	66.0	71.1	64.8	70.7	72.8	67.0	68.8	80.9	71.1
1894..	78.8	77.5	67.5	60.5	65.8	68.1	68.2	69.9	74.4	82.7	70.8	79.0	71.9
1895..	82.5	83.9	80.6	68.1	65.0	68.5	72.7	72.7	73.7	69.2	80.5	75.4	74.4
1896..	73.3	87.5	85.3	62.0	62.5	67.3	73.1	79.9	84.0	85.0	82.3	79.8	76.9
1897..	77.1	75.7	78.9	68.2	71.5	73.3	80.1	79.6	76.6	68.7	83.2	83.9	76.4
1898..	85.2	83.1	72.6	72.1	78.4	77.1	79.3	82.1	80.0	83.6	83.4	80.2	79.8
1899..	77.7	82.5	79.1	69.2	70.3	74.0	75.2	74.1	74.0	75.9	76.2	79.4	75.6
1900..	75.1	77.4	67.8	64.7	65.5	69.5	71.1	75.9	73.1	77.0	75.9	74.9	72.3
1901..	74.3	68.5	70.8	68.1	68.1	65.5	72.3	76.3	76.8	70.5	71.1	69.8	71.0
1902..	66.2	66.8	72.3	67.1	63.4	70.8	77.2	76.3	79.1	70.9	75.6	72.5	71.6
1903..	72.0	77.7	76.4	64.7	61.3	81.1	71.4	78.2	75.0	74.5	73.5	76.5	73.5
1904..	85.5	77.7	74.4	70.8	69.7	77.0	77.7	80.5	81.8	74.0	77.5	77.8	77.0
1905..	77.2	75.1	76.7	66.7	68.2	78.8	79.1	82.5	83.2	75.9	73.5	80.6	76.5
1906..	74.8	77.4	73.9	70.3	70.9	79.1	82.4	82.9	80.1	84.1	72.2	77.0	77.1
1907..	76.1	80.2	73.4	74.1	75.3	76.9	76.4	74.9	83.0	77.7	85.9	80.4	77.9
1908..	73.8	84.8	77.9	64.3	74.8	66.2	76.6	79.0	79.1	79.0	79.6	75.1	75.8
Mean.	76.1	77.9	74.0	66.7	67.9	72.4	73.9	76.8	77.7	74.5	75.6	76.2	74.1

Mean Per Cent. of Cloudiness, from Tri-, or Semi-Daily Observations.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889........	55	40	63	55	42	53	54	43	65	60	68	61	55
1890........	52	66	66	50	59	50	56	57	59	64	47	53	57
1891........	61	59	55	49	54	47	54	58	50	54	50	51	53
1892........	63	55	45	42	66	50	35	53	29	46	58	45	49
1893........	52	57	46	55	55	58	44	45	46	40	49	54	50
1894........	53	53	55	53	52	54	50	44	53	44	50	44	50
1895........	51	39	55	54	46	48	58	44	42	42	61	45	49
1896........	43	63	54	39	40	47	50	40	52	63	59	42	49
1897........	46	51	56	46	47	47	64	42	39	39	71	68	51
1898........	66	64	53	68	65	57	53	60	48	62	60	66	60
1899........	53	58	66	42	54	54	50	57	47	60	53	52	54
1900........	52	62	47	46	54	49	48	49	54	64	72	62	55
1901........	58	45	68	75	70	48	63	67	51	48	65	65	60
1902........	60	63	66	68	58	62	66	50	57	51	62	60	60
1903........	61	53	63	50	36	71	52	63	42	58	41	49	53
1904........	55	42	57	52	45	59	55	47	54	42	43	57	51
1905........	58	31	46	43	56	61	55	56	48	36	42	56	49
1906........	51	44	49	49	47	54	53	50	32	52	53	66	50
1907........	58	41	44	33	68	50	42	36	64	30	48	51	49
1908........	37	42	48	42	50	28	47	45	27	37	46	49	41
Mean.......	54.3	51.4	55.1	50.6	53.2	52.4	52.5	50.3	48.0	49.6	54.9	54.8	52.3

Hours of Bright Sunshine by Sun Thermometer.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Possible hrs.	294	296	371	402	453	457	462	429	373	341	293	283	4,454
1889	134	183	138	191	270	277	182	194	120	129	84	108	2,010
1890	112	131	160	245	225	264	289	199	166	129	143	131	2,194
1891	126	124	195	240	226	248	222	204	224	150	141	143	2,245
1892	128	138	196	244	183	218	287	201	234	178	101	144	2,261
1893	130	111	172	166	188	209	259	225	185	182	133	112	2,072
1894	120	121	150	174	208	180	237	237	176	160	128	159	2,051
1895	153	187	172	188	243	246	192	251	254	197	111	169	2,363
1896	157	168	210	258	297	263	260	254	189	115	105	172	2,448
1897	144	154	188	239	236	248	214	274	221	209	90	108	2,325
1898	132	138	200	168	200	270	236	201	218	157	105	113	2,159
1899	151	147	134	280	221	235	259	206	200	140	130	142	2,245
1900	167	120	216	227	235	259	260	226	177	136	86	108	2,216
1901	117	172	93	103	159	254	208	160	215	178	100	107	1,866
1902	120	138	144	139	210	179	185	209	149	164	109	119	1,864
1903	114	145	138	199	311	102	247	169	236	154	182	129	2,126
1904	144	173	172	182	256	256	274	292	204	183	148	115	2,401
1905	119	178	216	247	286	247	263	242	186	209	156	128	2,477
1906	126	183	225	269	288	316	278	266	254	189	155	111	2,660
1907	130	200	245	268	209	217	297	217	110	177	125	122	2,317
1908	154	200	220	277	282	362	308	268	242	186	111	133	2,743
Mean.	134	156	179	215	237	243	248	225	198	166	122	129	2,252
Mean per ct.	45.7	52.7	48.2	53.5	50.1	53.2	53.7	52.5	53.1	47.6	41.6	45 6	50.5

Precipitation.

(in inches.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889..	*3.50	*1.46	*1.02	*3.22	*4.18	*5.40	10.52	2.72	3.17	4.58	6.04	3.57	49.38
1890..	2.61	4.20	5.37	1.73	5.39	1.53	5.63	4.88	5.85	7.13	1.32	2.86	48.50
1891..	6.75	4.23	2.99	2.66	1.97	4.75	5.28	4.18	2.66	2.94	2.99	5.40	46.80
1892..	5.85	1.90	2.40	0.76	6.28	3.46	4.41	6.47	2.16	0.66	4.98	1.01	40.34
1893..	3.33	5.75	3.66	4.41	5.02	3.32	2.59	3.49	2.82	4.88	2.81	4.86	46.94
1894..	2.16	1.74	1.77	1.83	4.00	3.13	1.55	0.31	4.63	4.85	3.14	3.53	32.64
1895..	3.87	1.05	2.71	5 56	2.07	2.76	3.87	3.46	5.04	4.77	5.36	3.94	44.46
1896..	1.07	4.67	6.11	1.32	2.58	2.57	4.96	3.84	5.41	3.23	3.03	0.87	39.66
1897..	3.00	2.52	3.53	2.42	4.38	6.65	14.51	4.29	1.94	0.73	5.85	7.23	57.05
1898..	7.15	3.80	1.63	3.73	5.61	3.69	4.09	6.85	3.65	6.27	5.48	2.30	54.25
1899..	2.80	3.56	7.13	1.79	1.28	4.13	4.89	2.00	7.90	1.84	2.17	2.00	41.49
1900..	1.81	0.62	5.66	5.95	6.91	0.87	3.86	6.14	4,17	3.88	2.08	7.77	51.67
1901..	4.08	8.12	5.76	1.85	3.78	3.65	4.67	4.11	3.67	3.72	5.87	2.40	51.67
1902..	1.72	3.54	5.29	3.31	2.32	4.54	4.66	4.65	5.83	5.59	1.27	4.27	46.99
1903..	3.28	4 27	6.40	2.30	0.48	7.79	4.64	4.92	1.66	2.72	2.04	3.95	44.45
1904..	4.74	2.45	4.48	5.73	4.55	5.35	2.62	4.09	5.45	1.74	1.35	2.75	45.30
1905..	3.90	1.70	3.66	2.56	1.28	2.86	2.63	6.47	6.26	2.27	2.06	3.15	38.80
1906..	2.18	2.73	4.90	3.25	4.95	2.82	3.45	6.54	2.59	5.69	1.98	4.42	45.45
1907..	2.73	1.92	1.82	1.98	4.02	2.36	3.87	1.44	8.74	5.00	4.50	3.89	42.27
1908..	2.25	3.53	2.86	1.97	4.35	0.76	3.28	4.27	1.73	1.57	1.06	3.05	30.68
Mean.	3.44	3.19	3.96	2.92	3.77	3.62	4.80	4.25	4.27	3.70	3.27	3.66	44.84

* Kindly furnished by Miss S. C. Snell,

Wind Movement.

(in Miles.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889..	5,101	4,828	7,068	5.648	4,056	4,056	4,032	2,811	4,310	4,762	2,589	4,445	53,706
1890..	4,914	4,616	5,395	5.032	5,284	3,776	3,976	4,116	3,507	4,143	4,228	5,673	54,648
1891..	4,954	4,759	6,261	5,484	4,610	3,713	3,907	3,324	3,201	4,319	5,215	5,465	55,212
1892..	5,059	3,438	7,046	5,370	5.056	4,500	3,365	3,390	3,672	4,071	5,231	4,522	54,720
1893..	4,056	5,242	5,757	5,384	4,833	3,572	3,640	4,126	3,508	4,198	4,179	3,916	52,411
1894..	4,193	4,865	4,406	4,105	2,180	1,838	1,109	1,920	1,414	2,540	4,179	3,508	36,257
1895 :	2,896	3,920	4,360	4,098	4,071	3,050	2,934	3,397	3,444	4,029	4,156	5,506	46,861
1896..	4,943	6,445	8,182	4,674	4,838	3,926	4,048	2,968	4,686	4,544	4,654	5,290	59,198
1897..	5,501	4,493	5,363	5,523	5,603	4,208	4,007	3,452	3,506	3,938	4.558	4,068	54,220
1898..	3,494	3,699	3,864	5,477	4,769	4,162	3,377	3,111	2,787	3,999	4,856	4,830	48,425
1899..	4,926	4,427	5,275	3,984	4,219	3,814	3,891	2,522	3,967	2,582	3,361	4,142	47,110
1900..	4,904	5,016	5,602	5,039	4,381	4,101	3,701	2,322	3 042	3,315	4,877	4,203	50,503
1901..	5,224	5,484	5,482	6,211	4,525	3,647	2,763	2,144	2,358	3,652	4,583	4,280	50,353
1902..	4,078	5,199	6,601	4,642	4,328	4,102	2,929	2,386	2,680	4,398	3,077	4,018	48,438
1903..	4.254	4,529	4,169	5,125	3,908	3,130	3,087	2,105	2,890	4.703	3,362	4,994	46,256
1904..	4,112	4,910	4,444	4,902	3,830	3,127	3,268	3,232	3,602	4,160	3,470	3,940	46.994
1905..	5,180	4,503	3,006	4,855	5,004	3,108	3,464	3,030	2,527	3,397	4,317	4,051	46,442
1906..	5,706	4,565	5,686	4,777	3,766	1,409	3,773	3,412	4,249	4.398	5,978	5,554	53,273
1907..	4,987	5,272	5,718	7,096	5,946	4,223	4,114	3.928	3,582	5,111	4,773	5,266	60,016
1908..	7,770	5,511	5.759	8,208	5,818	4,571	3,815	3,802	3.757	3,643	5,485	5,432	63.571
Mean.	4,812	4,786	5,472	5,281	4.551	3,602	3,460	3,075	3.335	4,045	4,356	4,655	51,430

Maximum Wind Pressure.

(in Pounds per Square Ft.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Maximum.
1889..	26.0	24.0	16.7	15.5	9.0	11.5	10.0	6.5	9.7	12.2	14.5	29.0	29.0
1890..	27.7	17.5	13.5	11.5	16.5	10.0	9.2	13.0	5.0	11.0	9.5	24.5	27.7
1891..	16.2	13.5	10.5	14 0	10.7	10.5	4.5	2.5	4.0	9.5	15.7	14.0	16.2
1892..	10.5	11.5	20.5	16.7	15.7	20.5	11.5	7.5	15.5	12.5	16.0	13.5	20.5
1893..	12.0	20.0	18.5	24.5	24.7	9.0	13.0	37.5	14.5	23.0	14.0	18.5	37.5
1894..	20.0	22.5	11.5	15.5	14.5	14.0	9.5	9.5	13.0	10.0	18.0	15.0	22.5
1895..	13.0	25.0	20.0	10.0	7.0	8.0	8.0	5.5	43.0	14.0	22.0	24.0	43.0
1896..	15.0	24.5	19.0	18.0	25.0	7.7	8.5	12.5	19.0	12.0	15.0	12.0	25.0
1897..	18.5	10.0	13.5	14.0	22.0	7.0	12.0	14.0	20.0	11.5	20.0	12.0	22.0
1898..	22.5	15.5	15.5	10.0	18.0	8.5	17.5	13.0	30.5	12.0	19.0	28.0	30.5
1899..	20.0	15.0	22.0	9.5	10.5	7.5	12.0	5.5	6.5	6.5	11.0	15.5	22.0
1900..	20.5	30.5	16.0	13.0	22.0	12.5	23.0	16.0	17.0	10.0	18.0	13.0	30.5
1901..	12.5	10.5	10.5	13.5	11.5	7.5	14.5	2.0	24.0	9.0	17.5	14.5	24.0
1902..	12.0	24.0	24.0	14.0	10.0	15.0	7,5	8.0	4.0	8.0	9.5	12.5	24.0
1903..	12-5	22.0	8.0	12.5	9.5	9.0	15.5	3.0	7.5	3.0	9.5	17.0	22.0
1904..	11.0	23.5	14-5	15.5	11,0	6.0	11.0	6.5	14.5	23.5	11.5	9.5	23.5
1905..	23.5	18.0	16.5	18.0	9.5	6.0	9.0	7.0	7.0	9.0	9.0	14.0	23.5
1906..	8.0	8.5	7.0	10.0	7.5	5.0	6.5	4.5	4.5	9.0	8.5	12.0	12.0
1907..	14.0	20.0	27.0	12.0	6.5	6.0	32.5	4.5	6.0	9.0	8.5	18.5	32.5
1708..	16.0	23 0	10.0	32.0	13.0	7.0	10.0	4.0	9.0	9.0	9.5	7.5	32.0
M'x'm	27.7	30.5	27.0	32.0	25.0	20.5	32.5	37.5	43.0	23.5	22.0	29.0	43.0

Maximum Velocity of Wind.

(in Miles per Hour.)

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Maximum.
1889........	72	69	58	56	42	48	45	36	44	50	54	76	76
1890........	74	59	52	48	57	45	43	51	32	47	44	70	74
1891........	57	52	46	53	46	46	30	23	28	44	56	53	57
1892........	46	48	64	58	56	64	48	39	56	50	57	52	64
1893........	49	63	61	70	70	42	51	87	54	68	53	61	87
1894........	63	67	48	56	54	53	44	44	51	45	60	55	67
1895........	51	71	63	45	37	40	40	33	93	53	66	69	93
1896........	55	70	62	60	71	39	41	50	62	49	55	49	71
1897........	61	45	52	53	66	37	49	53	63	48	63	49	66
1898........	67	56	56	45	60	41	59	51	78	49	62	75	78
1899........	64	55	66	44	46	39	49	33	36	36	47	56	66
1900........	64	78	57	51	66	50	68	57	60	45	60	51	78
1901........	49	46	46	52	48	39	54	20	69	42	59	54	69
1902........	49	69	69	53	45	55	39	40	28	40	44	50	69
1903........	50	66	40	50	44	43	56	24	39	40	44	58	66
1904........	47	69	54	56	47	35	47	36	54	69	48	44	69
1905........	69	60	57	60	44	35	43	37	37	43	43	53	69
1906........	45	41	37	45	39	32	36	30	30	42	41	49	49
1907........	53	63	74	49	36	35	81	30	35	42	41	61	81
1908.... ...	56	68	45	80	51	37	45	28	42	42	44	39	80

Snow, Frost and Weather.

YEAR.	Last Snow.	First Snow.	Total Snowfall. (inches).	Last Frost.	First Frost.	Number of Days .01 Precipitation.	Number of Clear Days.	Number of Fair Days.	Number of Cloudy Days.
1889..	April 2,	Oct. 13,	26.0	May 26,	Sept. 21,	119	94	110	161
1890..	April 8,	Oct. 19,	43.5	May 12,	Sept. 25,	141	137	105	123
1891..	May 5,	Nov. 26,	54.2	May 19,	Oct. 12,	112	145	103	117
1892..	April 10,	Nov. 5,	42.5	May 10,	Sept. 30,	108	123	109	134
1893..	April 21,	Nov. 4,	74.3	May 8,	Sept. 3,	143	101	96	168
1894..	April 12,	Nov. 5,	71.5	May 22,	Aug. 22,	125	107	83	175
1895..	April 3,	Oct. 20,	61.0	May 17,	Aug. 22,	119	118	110	137
1896..	April 7,	Nov. 14,	44.0	May 1,	Sept. 24,	108	132	192	132
1897..	April 27,	Nov. 12,	52.8	May 8,	Sept. 22,	127	108	109	148
1898..	April 6,	Nov. 24,	69.5	April 27,	Sept. 21,	125	78	138	149
1899..	April 16,	Oct. 12,	52.0	May 4,	Sept. 14,	110	91	139	135
1900..	April 9,	Nov. 9,	37.0	May 29,	Sept. 15,	131	83	144	138
1901..	April 3,	Nov. 11,	52.3	May 6,	Sept. 26,	135	81	105	179
1902..	April 2,	Oct. 29,	57.0	May 14,	Sept. 6,	144	73	113	179
1903..	April 4,	Oct. 26,	33.5	May 2,	Sept. 25,	116	119	98	148
1904..	April 20,	Oct. 12,	59.5	April 23,	Sept. 22,	126	142	96	128
1905..	May 1,	Nov. 9,	40.0	May 24,	Sept. 15,	122	130	128	107
1906..	April 23,	Nov. 11,	56.2	May 20,	Sept. 25,	121	130	140	95
1907..	May 11,	Nov. 24,	54.5	May 22,	Sept. 27,	122	95	155	115
1908..	April 20,	Nov. 5,	38.5	June 3,	Sept. 16,	109	143	130	93

Summary for the Twenty Years 1889-1908.

Barometer (Pressure in Inches).

Maximum, reduced to freezing, Feb. 26, 1889., 11 A. M.	30.650
Minimum, reduced to freezing, Feb. 8, 1895, 7 A. M.	28.240
Maximum, reduced to freezing and sea level, Feb. 26, 1889, 11 A. M.	30.970
Minimum, reduced to freezing and sea level, Feb. 8, 1895, 7 A. M.	28.560
Mean	30.009
Total range	2.410
Greatest annual range, 1895	2.270
Least annual range, 1905	1.640
Mean annual range	1.880
Greatest monthly range, January, 1891	1.930
Least monthly range, August, 1894	.440
Mean monthly range	1.100

Air Temperature (in Degrees F.)

Highest, July 2, 1901, 1:30 P. M.	100.5
Lowest, Jan. 5, 1904, 7:30 A. M.	−26.0
Mean	46.8
Total range	126.5
Greatest annual range, 1903	120.5
Least annual range, 1905	98.5
Mean annual range	108.9
Greatest monthly range, Jan., 1907	78.0
Least monthly range, Aug., 1901	33.5
Mean monthly range	54.8
Greatest daily range, Dec. 10, 1902	54.0
Least daily range, June 2, 1907	2.0

Humidity.

Mean dew point	39.1
Mean relative humidity	74.1

Precipitation (in Inches).

Total rain or melted snow	896.84
Total snowfall	1,019.9
Greatest annual precipitation, 1897	57.05
Least annual precipitation, 1908	30.68
Mean annual precipitation	44.84
Greatest monthly precipitation, July, 1899	14.51
Least monthly precipitation, Aug., 1894	.31
Mean monthly precipitation	3.74

Wind (in Miles).

Total movement	1,028,604
Greatest annual movement, 1908	63,571
Least annual movement, 1894	36,257
Mean annual movement	51,430
Greatest monthly movement, April, 1908	8,208
Least monthly movement, July, 1894	1,109
Mean monthly movement	4,286
Greatest daily movement, Nov. 27, 1898	675
Least daily movement, Sept. 29, 1894, March 7, 1890, Jan. 6, 1904	0
Mean daily movement	141

Maximum pressure per square foot, 43 pounds, = 93 miles per hour, Sept. 11, 1895, 3 P. M.

Weather.

Mean cloudiness observed	52.35 per cent.
Total cloudiness by the sun thermometer	49.5 "
Number of clear days	2,230
Number of fair days	2,313
Number of cloudy days	2,761

Gales of 75 or more miles per hour: 1889, Dec. 26, 76, N.W.; 1893, Aug. 29, 87, S.W.; 1895, Sept. 11, 93, N.E.; 1898, Sept. 7, 78, S.W.; Dec. 4, 75, E.S.E.; 1900, Feb. 22, 78, W.N.W.; 1907, July 20, 81, W.; 1908, April 11, 80, N.N.W.

The following summary was abstracted from meteorogical records taken in Amherst prior to the establishment of the meteorological observatory at the college in 1889.

The records from 1836 to 1883 are from the observations of the late Prof. E. S. Snell of Amherst College. These records were taken at his house, about one and a half miles south of the location of the meteorological observatory at the Massachusetts Agricultural College, and at practically the same elevation above sea level.

The precipitation records are believed to be fairly comparable with the records of this station, although perhaps slightly affected by the difference of topography surrounding the two places. As Prof. Snell changed his time of taking temperatures and used different methods of deducing the mean temperatures, in conformity with the current practices at different dates, the comparison with those of this station should be made with more caution. The maximum and minimum temperatures of the earlier years were not all taken with self-registering instruments, and this fact should be taken into consideration when comparisons are made.

The records from 1883 to 1889 were taken at the State Experiment Station, on the college grounds, under the direction of Dr. C. A. Goessmann, at that time the director of the State Agricultural Experiment Station, and are fairly comparable with the records of that station.

Mean temperature for 72 years:

$$\frac{46.8 \times 20 + 46.7 \times 52}{72} = 46.7 \text{ degrees.}$$

Mean precipitation for 73 years:

$$\frac{44.36 \times 53 + 44.84 \times 20}{73} = 44.49 \text{ inches.}$$

Record of the Rainfall in Inches.

From 1836 to 1888, inclusive.

Year.	Jan.	Feb.	Mar.	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1836..	4.21	3.83	3.13	1.98	2.59	3.45	6.02	0.96	2.28	3.02	3.49	5.80	40.76
1837..	1.75	2.42	2.65	4.33	5.76	4.49	7.35	2.57	1.07	2.06	1.90	2.35	38.70
1838..	2.45	1.67	1.69	2.02	3.63	4.90	2.27	3.95	6.38	4.12	5.77	0.96	39.81
1839..	1.66	1.75	1.69	4.14	3.49	3.30	9.56	2.51	2.82	1.78	3.04	7.09	42.83
1840..	3.15	2.03	3.18	3.98	1.91	4.60	3.34	6.82	5.20	5.04	4.61	3.15	47.01
1841..	5.80	1.50	2.85	4.52	3.47	1.65	2.55	3.18	3.50	3.73	2.80	6.08	41.63
1842..	1.02	3.78	2.39	2.92	2.40	3.18	1.95	7.42	3.23	2.84	3.73	3.19	38.05
1843..	1.99	3.49	5.73	4.82	2.09	5.18	2.53	9.38	1.57	9.45	3.07	2.28	51.58
1844..	3.44	2.18	4.12	0.57	5.59	3.00	3.81	4.93	1.84	6.49	2.12	2.49	40.58
1845.	4.97	3.37	3.56	1.70	2.42	2.57	3.31	2.79	2.58	4.66	3.90	3.91	39.74
1846..	2.74	2.55	4.35	1.54	4.33	3.10	3.25	2.44	0.47	2.09	4.96	3.10	34.92
1847..	4.86	4.88	3.57	1.41	1.91	4.44	4.48	4.06	3.63	3.99	4.17	6.41	47.81
1848..	2.92	2.60	3.03	1.55	6.18	2.58	4.72	1.53	2.49	3.15	3.09	5.54	39.38
1849..	0.99	0.99	4.21	2.24	3.61	1.53	2.25	7.86	1.40	6.36	3.05	3.36	38.45
1850..	4.75	3.56	1.86	3.93	8.72	2.88	6.81	6.50	4.93	3.65	2.63	5.37	55.59
1851..	1.66	5.07	1.28	4.43	4.07	3.69	4.31	3.03	2.05	5.43	5.30	3.17	43.50
1852..	2.42	3.35	3.26	4.71	2.30	2.54	3.38	5.19	2.48	1.76	6.43	4.88	42.70
1853..	2.11	6.69	2.39	3.79	5.40	2.64	3.59	7.13	5.66	3.75	6.24	1.84	51.23
1854..	2.01	4.53	3.11	8.33	3.19	1.75	3.53	0.99	5.46	2.31	7.48	2.39	45.08
1855..	5.06	2.70	1.08	3.85	1.49	5.19	6.10	2.55	0.55	10.08	4.12	5.41	48.18
1856..	2.48	0.79	1.12	2.51	5.31	1.92	1.96	12.13	3.47	1.40	2.85	4.19	40.13
1857..	3.55	2.41	2.12	7.68	6.82	2.66	4.98	3.14	3.04	3.88	2.07	5.31	47.66
1858..	3.52	1.60	0.80	3.20	2.98	4.62	6.73	4.82	4.14	3.86	2.16	3.16	41.59
1859..	4.89	3.54	6.27	2.96	4.08	6.16	2.61	6.65	4.47	1.85	2.96	4.85	51.29
1860..	1.21	2.93	1.58	1.28	4.57	3.57	6.13	2.68	6.12	2.18	3.52	3.84	39.61
1861..	4.34	3.28	3.76	5.65	4.45	2.69	5.23	4.10	2.75	4.53	3.93	2.17	46.88
1862..	5.25	2.84	4.20	2.28	2.33	11.69	5.12	2.98	2.12	3.28	4.76	1.91	48.86
1863..	5.05	4.43	5.60	2.33	3.59	4.09	8.64	6.11	2.16	4.04	5.28	4.87	56.19
1864..	2.20	1.12	2.58	2.57	2.54	1.38	0.96	4.40	2.92	2.94	6.20	4.63	34.44
1865..	3.48	2.88	5.98	2.90	7.89	2.94	3.72	1.86	0.37	4.98	2.45	3.54	42.99
1866..	1.36	4.62	3.16	2.03	4.48	5.66	4.02	3.96	4.71	3.38	3.86	3.57	44.81
1867..	1.32	3.65	3.12	3.79	4.61	5.67	4.00	9.16	1.11	3.85	4.31	1.51	46.10
1868..	3.52	1.03	3.25	4.27	7.66	2.44	3.28	5.67	10.63	1.37	4.80	1.47	49.59
1869..	3.47	4.14	5.46	1.53	5.65	5.99	2.98	1.04	4.32	11.36	2.59	4.96	53.49
1870..	5.87	5.25	2.71	3.70	1.72	2.73	2.53	2.83	1.75	4.49	3.28	1.84	38.70
1871..	1.96	2.91	3.99	3.09	3.82	6.58	3.52	6.45	1.30	6.09	3.51	2.67	45.89
1872..	1.51	1.89	2.87	2.20	3.11	3.25	7.07	5.28	6.20	3.64	4.48	2.69	44.19
1873..	5.01	2.17	3.13	1.74	3.91	1.59	2.93	3.47	4.77	6.36	3.51	3.31	41.90
1874..	5.46	2.19	1.35	6.03	5.22	5.06	11.58	2.69	1.82	1.85	3.54	1.17	47.96
1875..	2.90	3.62	4.20	3.33	2.19	2.89	8.15	6.17	4.65	3.89	3.97	1.03	46.99
1876..	2.31	5.53	7.14	3.11	3.96	3.87	4.84	0.27	3.71	1.12	2.49	3.22	41.57
1877..	2.52	0.36	6.97	2.45	1.93	4.59	6.47	2.79	0.91	6.99	5.44	1.02	42.44
1878..	3.58	3.67	2.57	5.85	2.36	6.00	2.16	6.97	2.82	2.05	5.34	6.02	49.39
1879..	1.75	3.49	2.98	3.85	3.32	5.37	5.75	5.89	2.59	1.80	2.35	4.85	45.99
1880..	4.58	3.60	2.68	2.64	1.90	1.40	6.34	2.91	2.69	2.27	2.50	2.29	35.80
1881..	4.01	1.77	4.86	1.65	4.28	3.95	1.50	2.76	2.37	4.24	4.58	6.15	42.12
1882..	5.44	4.23	5.20	1.52	6.50	2.25	1.83	0.25	11.85	1.67	1.33	1.47	43.54
1883..	3.24	4.03	1.70	2.18	6.20	3.99	3.69	1.57	3.17	4.31	1.80	2.99	38.87
1884..	3.60	4.62	5.67	2.48	2.02	1.38	3.75	5.10	1.25	2.40	2.53	5.58	40.38
1885..	3.78	3.88	0.86	3.38	3.08	3.49	2.07	8.31	0.85	3.65	5.54	3.54	42.43
1886..	5.39	3.94	3.31	1.73	3.10	2.33	3.82	2.60	5.48	2.97	5.25	3.61	43.53
1887..	4.57	5.05	4.05	2.98	1.13	5.09	8.93	7.75	1.22	2.10	3.35	4.11	50.33
1888..	3.87	3.94	5.96	3.08	4.29	5.40	3.63	4.29	10.70	5.19	3.91	3.78	58.04
Mean.	3.34	3.18	3.44	3.18	3.88	3.76	4.45	4.39	3.43	3.88	3.83	3.59	44.36

Record of the Mean Temperature.

From 1837 to 1888, inclusive.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1837..	20.3	26.7	33.7	47.4	57.9	68.2	70.6	68.6	61.4	50.0	40.2	27.6	47.7
1838..	32.0	19.6	36.4	40.7	54.3	68.6	71.9	68.2	62.7	46.5	34.1	23.5	46.5
1839..	24.6	29.8	37.5	52.2	60.7	65.4	74.4	70.7	63.5	53.3	36.6	28.9	49.8
1840..	14.4	28.5	35.0	49.0	57.1	65.5	70.6	70.3	57.2	47.4	37.0	23.6	46.3
1841..	25.6	20.2	31.9	41.6	54.4	68.4	69.5	69.8	61.2	42.8	35.3	29.5	45.8
1842..	25.6	30.5	37.7	46.5	52.7	64.1	71.5	69.0	57.4	47.4	35.1	24.2	46.8
1843..	29.7	16.5	24.5	44.6	56.0	65.3	68.8	69.8	61.7	45.0	34.0	28.0	45.3
1844..	13.9	22.1	35.5	52.0	57.8	65.6	68.2	68.0	59.6	47.6	35.7	27.3	46.0
1845..	24.5	24.9	36.9	45.6	56.2	66.7	72.1	71.5	58.3	49.6	41.5	21.5	47.4
1846..	24.8	20.1	36.3	50.1	58.3	65.0	70.7	69.6	65.5	47.6	43.0	25.3	48.0
1847..	25.5	24.7	29.2	43.3	57.5	64.7	72.4	69.3	59.3	46.0	43.2	34.2	47.4
1848..	29.0	23.7	32.6	43.3	59.5	67.6	69.4	70.6	57.4	47.3	33.5	30.6	47.0
1849..	20.0	18.5	35.6	43.5	53.4	66.9	72.1	68.8	60.0	47.0	44.1	28.4	46.5
1850..	25.9	28.4	32.4	42.9	53.4	67.3	72.1	67.1	59.4	48.2	40.0	23.4	46.7
1851..	23.8	27.9	35.5	46.2	55.6	69.6	69.2	66.2	60.9	51.0	34.5	20.2	46.2
1852..	19.6	25.2	30.9	39.4	56.0	65.4	70.0	65.2	58.4	49.3	36.4	32.8	45.7
1853..	24.3	26.7	33.8	44.0	56.7	67.0	68.7	67.8	59.5	46.8	39.1	26.3	46.7
1854..	22.8	22.0	31.6	43.5	59.5	66.7	74.1	68.8	61.5	51.5	40.3	22.3	47.0
1855..	27.3	19.8	31.5	43.8	56.6	65.0	70.9	65.5	60.8	49.7	38.8	28.2	46.5
1856..	15.2	19.0	25.9	46.4	53.6	68.6	72.9	66.2	60.8	48.7	37.5	23.2	44.8
1857..	13.5	31.4	31.1	41.0	55.2	63.6	70.9	67.2	59.9	48.9	39.5	31.5	46.1
1858..	28.8	20.6	31.3	44.4	54.1	66.1	69.8	67.9	50.9	51.4	33.9	25.7	45.4
1859..	22.9	25.6	36.7	43.4	59.2	62.8	67.7	66.4	57.1	45.7	41.1	23.0	46.0
1860..	26.5	24.8	37.2	44.0	57.3	65.2	66.4	68.0	56.8	48.8	42.7	23.9	46.8
1861..	20.4	29.2	32.5	45.5	53.4	65.5	69.5	65.7	59.9	51.5	37.8	29.0	46.7
1862..	22.3	22.1	32.2	43.6	58.1	63.4	68.0	68.1	61.1	51.0	39.6	27.6	46.4
1863..	29.1	26.3	26.1	45.5	55.4	59.0	70.9	70.1	57.4	49.9	41.1	25.3	46.3
1864..	24.4	28.5	34.4	43.5	60.4	65.7	71.5	70.8	57.8	46.4	38.0	38.2	48.3
1865..	18.7	25.0	37.1	49.0	57.1	69.3	69.1	68.6	65.6	46.0	39.9	28.9	47.8
1866..	21.9	26.2	31.6	48.6	54.6	65.8	72.9	63.5	60.0	49.5	40.1	26.3	46.7
1867..	18.3	31.2	30.8	45.5	54.0	67.1	68.1	68.6	60.0	49.9	37.9	22.6	46.2
1868..	20.2	18.2	33.8	42.0	55.1	66.2	74.0	69.0	59.5	45.3	36.5	22.8	45.2
1869..	28.0	28.0	27.3	46.4	55.9	64.7	69.1	66.9	62.1	46.7	35.9	27.5	46.5
1870..	30.8	25.3	30.9	48.3	58.3	70.4	73.6	71.1	62.3	52.0	39.1	28.0	49.2
1871..	23.3	26.0	40.5	48.0	57.8	65.4	69.2	68.9	52.8	51.0	34.0	24.6	46.8
1872..	25.1	24.2	25.3	45.0	59.1	68.1	72.6	71.6	61.7	48.2	36.4	19.5	46.4
1873..	20.6	24.0	30.6	43.2	54.6	67.5	71.3	67.0	60.4	49.9	29.7	29.2	45.7
1874..	28.2	24.5	32.9	38.3	56.5	66.2	67.2	65.6	62.0	47.6	36.2	29.2	46.2
1875..	16.7	17.5	27.8	40.8	57.1	65.8	69.3	68.9	57.3	47.9	33.1	28.3	44.2
1876..	29.8	26.4	31.6	43.6	57.5	70.6	74.2	70.5	59.1	45.5	40.5	19.7	47.4
1877..	20.0	30.8	33.3	47.8	58.5	67.8	71.1	71.4	63.3	50.5	41.9	33.1	49.1
1878..	25.3	27.1	39.2	52.2	57.4	64.7	73.3	68.6	63.2	54.4	39.1	29.0	49.5
1879..	21.6	22.4	33.0	43.2	60.6	66.3	71.0	67.2	59.0	56.0	37.4	30.8	47.4
1880..	31.6	29.1	33.5	47.5	64.2	68.5	71.8	67.5	63.2	47.3	34.9	22.8	48.5
1881..	17.9	24.9	36.2	43.6	61.7	62.8	70.6	70.5	67.4	52.5	40.3	36.0	48.7
1882..	23.6	28.2	35.1	44.3	52.9	66.8	71.9	70.9	63.2	52.7	36.4	26.6	47.7
1883..	21.0	25.0	27.3	44.3	58.6	69.7	70.4	66.4	59.4	46.8	40.4	27.0	46.4
1884..	21.6	30.9	32.9	46.7	57.4	69.0	68.6	69.2	64.4	50.3	38.4	30.0	48.3
1885..	22.7	15.2	23.3	45.3	54.8	63.8	70.4	66.0	58.3	49.1	39.8	29.6	44.9
1886..	21.8	35.1	33.5	50.4	57.3	63.2	68.8	66.3	59.5	48.9	38.3	23.0	46.2
1887..	19.4	24.2	26.4	41.6	60.9	65.7	73.7	64.9	55.9	47.0	36.5	26.6	45.2
1888..	13.8	22.0	26.8	40.4	54.7	65.8	67.2	67.4	57.1	43.1	38.9	30.4	44.0
Mean.	23.0	24.7	32.4	45.1	56.9	66.1	70.7	68.3	60.1	48.7	38.0	27.0	46.7

Record of the Maximum Temperature.

From 1838 to 1888, inclusive.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1838..	55.0	42.0	58.0	67.0	80.0	90.0	92.0	88.0	85.0	77.0	57.0	43.0	92.0
1839..	50.0	50.0	65.0	72.0	80.0	84.0	86.0	85.0	80.0	70.0	56.0	53.0	86.0
1840..	38.0	56.0	64.0	79.0	88.0	88.0	94.0	90.0	77.0	72.0	55.0	44.0	94.0
1841..	50.0	44.0	60.0	67.0	81.0	90.0	94.0	88.0	84.0	64.0	68.0	44.0	94.0
1842..	37.0	55.0	68.0	82.0	78.0	84.0	90.0	82.0	84.0	70.0	60.0	43.0	90.0
1843..	50.0	37.0	42.0	70.0	82.0	86.0	91.0	84.0	87.0	69.0	57.0	40.0	91.0
1844..	39.0	49.0	56.0	83.0	84 0	86.0	86.0	84.0	83.0	70.0	54.0	45.0	86.0
1845..	46.0	55.0	71.0	77.0	88.0	90.0	94.0	89.0	81.0	74.0	65.0	38.0	94.0
1846..	45.0	40.0	59.0	76.0	83.0	87.0	93.0	90.0	88.0	81.0	61.0	45.0	93.0
1847..	44.0	47.0	52.0	77.0	84.0	88.0	91.0	85.0	85.0	67.0	70.0	59.0	91.0
1848..	56.0	43.0	64.0	74.0	86.0	90.0	87.0	87.0	81.0	70.0	52.0	58.0	90.0
1849..	46.0	43.0	60.0	68.0	83.0	92.0	93.0	83.0	70.0	68.0	63.0	43.0	93.0
1850..	45.0	52.0	60.0	70.0	73.0	90.0	87.0	87.0	80.0	67.0	63.0	49.0	90.0
1851..	48.0	48.0	73.0	67.0	82.0	88.0	87.0	83.0	80.0	73.0	56.0	44.0	88.0
1852..	43.2	47.4	53.0	61.0	79.0	84.0	90.0	85.7	85.0	70.0	50.8	56.0	90.0
1853..	45.0	51.0	56.4	76.3	84.2	91.3	85.1	91.7	84.7	69.0	59.5	42.8	91.7
1854..	50.4	45.0	65.4	70.6	79.0	87.5	97.0	88.5	90.0	75.8	66.0	41.5	97.0
1855..	48.0	42.0	57.8	76.0	81.0	92.0	91.6	84.5	85.0	73.0	63.0	46.2	92.0
1856..	34.8	38.6	44.9	76.7	89.0	94.0	95.0	87.3	78.9	75.5	61.0	41.8	95.0
1857..	37.1	61.8	54.5	58.3	86.4	86.9	90.3	90.3	85.7	73.0	67.0	52.0	90.3
1858..	51.4	47.1	57.7	68.1	74.2	90.3	92.0	79.0	85.2	73.0	59.0	42.8	92.0
1859..	39.4	44.1	56.6	71.0	86.0	91.5	90.0	81.8	73.8	75.0	65.8	62.9	91.5
1860..	50.3	52.0	71.3	68.3	81.0	83.0	84.0	84.4	79.0	69.9	66.7	37.5	84.4
1861..	38.0	53.5	56.3	80.3	77.2	84.0	91.7	90.0	82.3	75.5	64.0	51.4	91.7
1862..	42.9	40.0	44.5	72.9	84.0	86.0	90.0	88.0	80.0	83.0	68.2	52.0	90.0
1863..	52.0	45.3	47.3	77.0	88.0	85.6	85.5	90.0	80.0	71.0	65.4	51.5	90.0
1864..	44.2	46.8	53.8	64.8	86.0	93.5	91.9	98.0	80.0	68.7	62.0	49.4	98.0
1865..	39.5	45.4	63.7	79.5	85.8	87.0	85.4	90.0	89.0	72.0	68.0	54.9	90.0
1866..	40.0	55.0	55.8	84.2	80.0	90.1	94.0	81.6	83.1	73.0	60.8	51.2	94.0
1867..	33.5	50.0	53.0	66.0	75.5	85.0	90.0	83.5	80.0	76.0	65.0	46.0	90.0
1868..	39.5	45.0	59.8	67.5	75.0	88.7	94.5	85.0	79.5	68.0	58.0	42.7	94.5
1869..	49.0	50.6	53.8	74.0	83.0	80.7	89.9	87.2	85.0	71.4	56.9	45.3	89.9
1870..	54.3	55.0	50.5	78.0	82.4	93.0	91.2	91.3	83.5	71.5	61.0	47.0	93.0
1871..	50.0	50.6	55.5	74.8	92.8	88.2	85.6	85.0	78.0	73.1	62.0	43.3	92.8
1872..	42.9	50.0	44.0	84.0	84.1	91.8	91.7	88.8	88.5	69.0	54.0	40.3	91.8
1873..	42.3	45.0	49.3	66.2	82.0	90.0	92.4	86.2	85.8	70.5	52.0	57.7	92.4
1874..	52.0	49.3	57.2	63.0	86.0	93.0	90.0	84.0	85.8	66.0	60.0	49.0	93.0
1875..	35.5	50.0	51.0	63.0	84.7	89.0	91.5	84.8	84.7	70.3	56.2	55.0	91.5
1876..	63.0	52.3	59.0	63.3	86.0	87.7	95.0	90.0	90.0	71.1	71.7	42.0	95.0
1877..	43.0	50.0	52.8	75.8	84.5	88.0	89.1	87.4	85.7	75.4	66.8	55.2	89.1
1878..	44.4	53.3	65.1	73.1	83.2	90.2	92.2	83.3	84.5	77.3	57.2	53.7	92.2
1879..	50.1	43.2	51.6	72.4	83.0	90.3	91.4	90.6	85.6	82.6	68.2	54.5	91.4
1880..	47.9	57.6	59.8	77.7	93,0	91.1	90.5	88.0	90.0	71.4	59.2	38.9	93.0
1881..	38.0	47.0	50.8	78.4	89.0	80.0	87.2	90.8	94.0	86.2	66.7	61.4	94.0
1882..	45.0	47.4	56.2	68.0	78.0	90.0	92.1	93.0	87.7	73.8	66.1	48.0	93.0
1883..	42.2	43.1	51.1	67.3	89.0	90.8	93.0	86.2	79.8	77.1	67.2	53.1	93.0
1884..	40.1	46.0	54.0	70.3	85.2	92.5	93.0	92.4	90.0	78.2	61.0	57.4	93.0
1885..	57.0	39.0	50.0	83.0	85.0	89.0	93.0	87.0	81.0	80.0	70.0	65.0	93.0
1886..	56.0	52.0	61.0	83.0	82.0	82.0	95.0	90.0	83.8	77.9	65.5	49.0	95.0
1887..	47.2	43.8	46.0	74.4	86.5	91.0	93.6	88.0	80.0	74.4	64.8	51.0	93.6
1888..	41.0	49.0	49.0	84.0	80.0	94.5	85.5	87.0	76.0	66.0	71.0	56.5	94.5
Mean.	45.5	47.9	56 3	73.0	83.2	88.6	90.7	87.2	83.2	72.9	62.1	48.9	91.9

Record of the Minimum Temperature.

From 1838 to 1888, inclusive.

Year.	Jan.	Feb.	Mar.	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1838..	6.0	-5.5	4.0	17.0	30.0	43.0	50.0	41.0	38.0	27.0	3.0	-7.0	-7.0
1839..	-13.0	0.0	4.0	22.0	27.0	40.0	49.0	44.0	34.0	22.0	11.0	-2.0	-13.0
1840..	-21.0	-14.0	7.0	19.0	34.0	44.0	50.0	50.0	36.0	23.0	18.0	-2.0	-21.0
1841..	-17.0	-6.0	8.0	21.0	29.0	43.0	42.0	42.0	46.0	20.0	13.0	5.0	-17.0
1842..	-10.0	5.0	13.0	17.0	30.0	34.0	49.0	45.0	30.0	26.0	13.0	-2.0	-10.0
1843..	-8.0	-15.0	7.0	15.0	35.0	34.0	47.0	53.0	30.0	28.0	17.0	2.0	-15.0
1844..	-22.0	-10.0	5.0	14.0	33.0	42.0	40.0	46.0	26 0	25.0	3.0	-5.0	-22.0
1845..	0 0	-3.0	8.0	24.0	30.0	41.0	46.0	42.0	32.0	17.0	12.0	-10.0	-10.0
1846..	-1.0	-6.0	2.0	22.0	32.0	41.0	44 0	47.0	37.0	25 0	20.0	1.0	-6.0
1847..	4.0	-8.0	9.0	5.0	34.0	42.0	46.0	48.0	35.0	15.0	5.0	3.0	-8.0
1848..	-12.0	-2.0	4.0	25.0	32.0	39.0	49.0	44.0	31.0	28.0	11.0	-3.0	-12.0
1849..	-8.0	-10.0	12.0	21.0	32.0	39 0	45.0	50.0	37.0	29.0	25.0	3.0	-10.0
1850..	-2.0	-11.0	8.0	19.0	31.0	44.0	48.0	44.0	32.0	23.0	16.0	-15.0	-15.0
1851..	-5.0	-8.0	12.0	24.0	30.0	41.0	49.0	39.0	29.0	31.0	13.0	-15.0	-15.0
1852..	-15.0	-3.4	0.3	23.3	38.5	43.9	55.0	48.9	33.0	24.3	15.0	6.1	-15.0
1853..	-2.5	0.5	7.6	27.4	31.8	39.0	54.0	45.9	37.0	24.9	13.8	7.2	-2.5
1854..	-9.6	-4.8	14.0	23.7	34.0	39.8	57.7	50.8	33.8	27.0	14.0	-9.0	-9.6
1855..	10.7	-16.0	7.8	17.0	41.5	48.0	57.2	44.7	33.0	30.2	15.0	7.0	-16.0
1856..	-7.5	-11.0	-9.0	16.5	38.2	48.0	55.9	48.2	41.8	25,0	18.0	-7.0	-11.0
1857..	-18.2	-2.7	7.0	14.3	39.8	49.0	55.5	53.6	32.0	25.0	13.0	2.2	-18.2
1858..	0.0	-5.0	-8.0	28.5	40.3	51.0	58.5	58.8	37.0	31.5	14.6	0.0	-8.0
1859..	-19.4	2.8	3.5	28.7	43.9	45.0	53.0	47.4	41.0	24.8	24.0	-8.5	-19.4
1860..	-8.0	-7.2	22.8	23.1	38.9	52.0	53.0	49.1	32.0	28.0	15.0	-7.0	-8.0
1861..	-17.0	-20.0	5.5	18.2	33.0	51.0	56.7	48.5	41.6	25.0	17.0	-6.5	-20.0
1862..	0.0	-2.0	13.8	24.3	44.0	49 5	51.9	48.0	39.0	26.0	18.0	-1.3	-2.0
1863..	5.0	-9.0	-6.0	25.0	38.3	51.0	55.3	48.7	32.0	21.0	18.0	3 2	-9.0
1864..	-1.5	-4.3	15.0	31.8	40.0	47.3	53.9	54.8	41.0	28.5	10.8	18.0	-4.3
1865..	-4.5	-1.0	13.0	33.0	42.8	55.9	54.8	47.5	35.0	24.2	18.5	6.8	-4.5
1866..	-14.5	-1.5	11.5	30.0	40.0	48.0	55.0	48.0	35.5	26.5	16.8	-3.8	-14.5
1867..	-5.0	8.0	8.0	29.0	36.0	54.0	55.3	48.3	39.0	27.0	17.5	-3.0	-5.0
1868..	0.0	-18.3	-7.3	23.0	36.0	51.8	61.0	51.0	36.2	19 2	23.8	-5.0	-18.3
1869..	3.0	-1.0	-9.0	26.7	35.2	47.4	53.5	50.0	36.3	26.8	16.9	-7.5	-9.0
1870..	5.0	6.2	6.5	35.0	42.8	53.5	54.5	47.0	40.0	26.0	24.7	1.0	1.0
1871..	-5.5	-9.5	24.8	27.0	41.0	51.8	54.0	50.0	32.0	24.3	7.0	-6.5	-9.5
1872..	2.5	-2.5	-4.8	29.0	43.7	48.7	59.1	52.9	39.5	29.9	10.0	-8.0	-8.0
1873..	-22.0	-2.5	1.8	33.5	39.0	50.6	56.1	49.1	36.2	27.0	6.5	7.0	-22.0
1874..	1.2	-5.0	9.7	18.7	39.0	51.3	38.0	46.3	39.0	28.5	16.0	0.0	-5.0
1875..	-8.2	-4.0	0.0	22.5	39.8	48.5	53.8	32.0	32.5	26.0	-1.0	-9.0	-9.0
1876..	2.8	-1.0	4.5	28.0	39 0	47.0	52.5	49.0	41.2	23.0	18.9	-1.0	-1.0
1877..	-3.5	8.5	10.0	32.5	40.0	54.7	58.1	54.8	39.0	25.3	19.4	13.0	-3.5
1878..	12.5	-3.2	13.2	37.0	40.5	46.4	55.2	49.9	37.0	27.0	19.8	11.7	-12.5
1879..	-4.5	1.0	7.0	32.7	40.0	49 0	56.7	53.2	30.4	20.8	7.7	-6.0	-6.0
1880..	2.0	-11.5	13.7	26.2	37.0	51.0	54.0	45.7	39.1	22.9	9.5	-5.0	-11.5
1881..	-12.4	-7.0	24.4	22.1	37.0	47.7	59.2	56.7	49.0	29 0	14.0	8.5	-12.4
1882..	-15.0	-6.0	17.4	23.7	39.1	52.2	56.3	49.7	43.7	32.2	12.0	0.0	-15.0
1883..	-2.5	-1.3	3.0	23.5	43.0	53.7	55.0	43.4	36.2	23.2	18.0	-12.8	-12 8
1884..	-8.0	5.1	0.0	31.2	37.6	50.0	57.1	48.8	39.0	26.5	19.8	-10.0	-10.0
1885..	-18.0	-15.0	-11.0	19.0	21.0	35.0	41.0	34.0	27.0	24.0	11.0	6.0	-18.0
1886..	-22.0	-11.0	-1.0	21.0	29.0	40.0	41.0	39.0	31.6	17.0	15.9	0.8	-22.0
1887..	-22.2	-3.8	-2.4	17.1	33.2	38.5	56.0	42.5	29.5	17.0	11.0	-6.0	-22.2
1888..	-21,5	-19.0	-3.0	15.0	26.0	38.0	46.0	42.0	25.0	26.0	5.7	3.5	-21.5
Mean.	-7.4	-5.3	6.0	23.6	36.1	45.9	52.1	47.3	35.6	25.1	14.2	-1.3	-11.7

BULLETIN No. 131. DECEMBER 1909.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

INSPECTION OF COMMERCIAL FERTILIZERS

BY

H. D. HASKINS, L. S. WALKER and P. V. GOLDSMITH.

This bulletin gives a general report of the fertilizer inspection work for the season of 1909. It discusses briefly valuations, retail cash prices, and the wisdom of buying only high grade fertilizers. General mention is made of fertilizer brands which show a serious commercial shortage, and summaries indicate the average quality of the fertilizers offered. Conversion factors relating to fertilizers are published and the tables of analyses show the detailed composition of the fertilizers sold in the state.

Approved and Authorized
WM. P. BROOKS, Director.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

CHARLES A. GOESSMANN, PH.D., LL.D.	*Honorary Director and Consulting Chemical Expert.*
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
JOSEPH B. LINDSEY, PH. D.,	*Vice Director and Chemist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. SC.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
EDWARD B. HOLLAND, M. SC.,	*Associate Chemist* (Research Sec.).
HENRI D. HASKINS, B. SC.,	*Chemist in Charge* (Fertilizer Sec.).
PHILIP H. SMITH, B. SC.,	*Chemist in Charge* (Feed and Dairy Sec.).
FRED C. SEARS, M. SC.,	*Pomologist.*
FRED W. MORSE, M. SC.,	*Research Chemist.*
HENRY J. FRANKLIN, PH. D.,	*Assistant Entomologist* (Cranberry Investigations.)
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist.*
GEORGE H. CHAPMAN, B. SC.,	*Assistant Botanist.*
LEWELL S. WALKER, B. SC.,	*Assistant Chemist.*
JAMES C. REED, B. SC.,	*Assistant Chemist.*
JOSEPH F. MERRILL, B. SC.,	*Assistant Chemist.*
CARL D. KENNEDY, B. SC.,	*Assistant Chemist.*
J. K. SHAW, M. SC.,	*Assistant Horticulturist.*
JOHN N. SUMMERS, B. SC.,	*Assistant Entomologist.*
JAMES T. HOWARD,	*Inspector.*
ROY F. GASKILL,	*Assistant in Animal Nutrition.*
C. M. DAMON,	*Observer.*

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. Lindsey, Chemist.

INSPECTION OF COMMERCIAL FERTILIZERS

FOR THE SEASON OF 1909.

By H. D. Haskins, Chemist in Charge.

ASSISTED BY

L. S. Walker and P. V. Goldsmith.*

(Approved and Authorized

Wm. P. Brooks, Director.)

In place of the full text of the Massachusetts fertilizer law, a few deductions therefrom are referred to at this time.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this state must be accompanied:

   First, with a distinct statement of the name of each brand offered for sale, the name of the manufacturer and place of factory.

   Second, with a statement of the percentages of phosphoric acid, soluble in distilled water, reverted as well as total, of nitrogen and of water soluble potassium oxide guaranteed in each distinct brand.

   Third, with the fee charged by the state for a certificate, which is five dollars for each of the following ingredients: nitrogen, phosphoric acid and potassium oxide guaranteed in each and every distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers but to all substances, single or compound, used for manurial purposes offered for sale in this state. Inferior substances like leather, hair, and wool waste, shall not be used unless so stated in the guarantee.

3. The certificate of compliance with the laws of the state must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint as many agents as they desire after having secured at this office the certificate of compliance with the laws of the state.

*Resigned November 15, 1909.

Note—The writer's thanks are due to Dr. J. B. Lindsey for suggestions and criticisms in the subject matter of this bulletin.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

Important to Agents. Agents who sell fertilizers for manufacturers whose plants and places of business are located outside of the state should satisfy themselves that the goods which they are to sell are of good quality, and are likely to meet the guarantee placed upon them; for in case the goods, upon analysis, show a serious deficiency and it becomes necessary to prosecute, then legal proceedings will have to be instituted *against the agent* selling the goods in question. The full text of the fertilizer law may be had upon application at this office.

The work of the collection and inspection of licensed fertilizers has increased gradually from year to year. A larger number of fertilizers has been licensed this year than during the previous season and the collection and analyses of licensed brands reaches the highest number ever attained during the history of the fertilizer inspection work in Massachusetts.

Manufacturers and Brands Licensed by Each. During the year 431 distinct brands of fertilizers and agricultural chemicals have been licensed in Massachusetts. Seventy-eight manufacturers, importers and dealers, including the various branches of the American Agricultural Chemical Co. have secured licenses for the sale of fertilizer in the state during the year. Two more licenses were issued and 22 more brands were licensed than for 1908. The licensed brands for the year may be classed as follows:

Complete fertilizers	306
Fertilizers furnishing only potash and phosphoric acid	9
Ground bone, tankage and dry ground fish .	51
Chemicals and organic compounds furnishing nitrogen	65
Total	431

List of Licensees and Brands.

The following is a list of the fertilizer manufacturers and importers who have secured a license for the sale of fertilizers in the state for the year 1909, together with the names of the brands licensed by each.

The American Agricultural Chemical Co., 92 State St., Boston, Mass.

North Western Empire Special,
Tobacco Starter and Grower,
High Grade Fertilizer with 10% Potash,
Grass and Lawn Top Dressing,
Special Grass and Garden Mixture,
Nitrate of Soda,
Muriate of Potash,
High Grade Sulphate of Potash,
Plain Superphosphate,
Kainit,
Fine Ground Tankage,
Fine Ground Bone,
Dissolved Bone Black,
Dry Ground Fish,
High Grade Tobacco Manure,
Basic Slag Phosphate,
Sulphate of Ammonia,
Church's Fish and Potash "D,"
Baker's A. A. Ammoniated Superphosphate,
Bradley's XL Superphosphate of Lime,
Bradley's Potato Manure,
Bradley's Corn Phosphate,
Bradley's Eclipse Phosphate for All Crops,
Bradley's Potato Fertilizer,
Bradley's Complete Manure for Potatoes and Vegetables,
Bradley's Complete Manure for Corn and Grain,
Bradley's Complete Manure with 10% Potash,
Bradley's Complete Manure for Top Dressing Grass and Grain,
Bradley's Seeding Down Manure,
Bradley's Niagara Phosphate,
Bradley's English Lawn Fertilizer,
Bradley's Columbia Fish and Potash,
Clark's Cove Bay State Fertilizer,
Clark's Cove Bay State Fertilizer G. G.,
Clark's Cove Potato Manure,
Clark's Cove Potato Fertilizer,
Clark's Cove Great Planet Manure,
Crocker's Ammoniated Corn Phosphate,
Crocker's Potato, Hop and Tobacco Phosphate,
Cumberland Potato Fertilizer,
Cumberland Superphosphate,
Darling's Farm Favorite,
Darling's Potato Manure,
Darling's Complete 10% Manure,
Darling's General Fertilizer,
Darling's Blood, Bone and Potash,
Darling's Potato and Root Crop Manure,
Great Eastern Northern Corn Special,
Great Eastern Vegetable, Vine and Tobacco,
Great Eastern Garden Special,
Great Eastern General,
Pacific Potato Special,
Pacific High Grade General,
Soluble Pacific Guano,
Packer's Union Animal Corn Fertilizer,
Packer's Union Potato Manure,
Packer's Union Gardeners' Complete Manure,
Packer's Union Universal Fertilizer,
Quinnipiac Onion Manure,
Quinnipiac Phosphate,
Quinnipiac Potato Manure,
Quinnipiac Market Garden Manure,
Quinnipiac Corn Manure,
Quinnipiac Potato Phosphate,
Read's Farmers' Friend Superphosphate,
Read's Practical Potato Special,
Read's Standard Superphosphate,
Read's Vegetable and Vine Fertilizer,
Read's Potato Manure,
Read's High Grade Farmers' Friend Superphosphate,
Standard Fertilizer,
Standard Guano for All Crops,
Standard Complete Manure,
Standard Special for Potatoes,
Tucker's Original Bay State Bone Superphosphate,
Tucker's Special Potato Fertilizer,
Wheeler's Corn Fertilizer,
Wheeler's Potato Manure,
Wheeler's Havana Tobacco Grower,
Wheeler's Bermuda Onion Grower,
A. A. C. Co's Grass and Oats,
Williams & Clark's Americus Ammoniated Bone Superphosphate,
Williams' & Clark's Potato Phosphate,

Williams' & Clark's Americus High Grade Special,
Williams' & Clark's Americus Potato Manure,
Williams' & Clark's Americus Corn Phosphate,
Williams' & Clark's Royal Bone Phosphate for All Crops,
Williams' & Clark's Prolific Crop Producer.

W. H. Abbott, Holyoke, Mass.

Abbott's Eagle Brand,
Abbott's Animal Fertilizer,
Abbott's Tobacco Fertilizer,
Abbott's Onion Fertilizer.

American Cotton Oil Co., 27 Beaver St., New York, N. Y.

Choice Cottonseed Meal.

American Linseed Co., 100 William St., New York City.

Cleveland Flax Meal (or Oil Meal).

Armour Fertilizer Works, 861 Calvert Building, Baltimore, Md.

Armour's Grain Grower,
Armour's All Soluble,
Armour's Market Garden,
Armour's Complete Potato,
Armour's Fish and Potash,
Armour's Ammoniated Bone with Potash,
Armour's High Grade Potato,
Armour's Bone, Blood and Potash,
Armour's Fruit and Root Crop Special,
Armour's Onion Special,
Armour's Bone Meal,
Armour's Special Value.

H. J. Baker & Bro., 100 William St., New York, N. Y.

Baker's Pure Castor Pomace.

Baltimore Pulverizing Co., Baltimore, Md.

Market Garden,
Perfect Potato.

Beach Soap Co., Lawrence, Mass.

Beach's "Advance" Fertilizer,
Beach's "Reliance" Fertilizer,
Beach's Market Garden Fertilizer,
Beach's Top Dressing,
Beach's Fertilizer Bone.

Berkshire Fertilizer Co., Bridgeport, Conn.

Berkshire Complete Fertilizer,
Berkshire Complete Tobacco,
Berkshire Potato and Vegetable Phosphate,
Berkshire Grass Special,
Berkshire Long Island Special,
Berkshire Ammoniated Bone Phosphate.

Bonora Chemical Co., 488 Broadway, New York, N. Y.

Nature's Plant Food "Bonora."

Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.

Stockbridge's Tobacco Manure,
Stockbridge's Special Complete Manure for Quick Growth and Forcing,
Stockbridge's Special Complete Manure for Potatoes, Vegetables, etc.,
Stockbridge's Special Complete Manure for Corn and All Grain Crops,
Stockbridge's Special Complete Manure for Seeding Down, Permanent Dressing and Legumes,
Bowker's Bone, Blood and Potash,
Bowker's Complete Alkaline Tobacco Grower,
Bowker's Early Potato Manure,
Bowker's Lawn and Garden Dressing,
Bowker's Market Garden Fertilizer,
Bowker's Potato and Vegetable Fertilizer,
Bowker's Soluble Animal Fertilizer,
Bowker's Seeding Down Fertilizer,
Bowker's High Grade Fertilizer,
Bowker's Cranberry Phosphate,
Bowker's Corn, Grain and Grass,
Bowker's Fish and Potash "D" Brand,
Bowker's Fish and Potash "Square" Brand,
Bowker's Tobacco Starter,
Bowker's Hill and Drill Phosphate,
Bowker's Potato and Vegetable Phosphate,
Bowker's Farm and Garden Phosphate,
Bowker's Corn Phosphate,
Bowker's Clover Brand, Bone and Wood Ash Fertilizer,

Bowker's Bristol Fish and Potash,
Bowker's Bone and Wood Ash Fertilizer,
Bowker's Bone and Potash, Square Brand,
Bowker's 10% Manure,
Bowker's Potash or Staple Phosphate,
Bowker's Sure Crop Phosphate,
Bowker's Potash Bone,
Bowker's Gloucester Fish and Potash,
Bowker's Tobacco Ash Elements,
Bowker's Fresh Ground Bone,
Bowker's Dissolved Bone,
Bowker's Acid Phosphate,
Bowker's Nitrate of Soda,
Bowker's Sulphate of Ammonia,
Bowker's Dried Blood,
Bowker's Fine Ground Bone Tankage,
Bowker's Muriate of Potash,
Bowker's Double Sulphate of Potash and Magnesia,
Bowker's High Grade Sulphate of Potash,
Bowker's Ammoniated Food for Flowers,
Bowker's Kainit,
Bowker's Canadian Hard Wood Ashes,
Bowker's Fisherman Brand Fish and Potash,
Bowker's Market Bone,
Bowker's Dry Ground Fish.

Joseph Breck & Sons, Corporation, 51-52 No. Market St., Boston, Mass.

Breck's Market Garden Manure,
Breck's Lawn and Garden Dressing,
Breck's Ram's Head Brand Sheep Manure.

F. W. Brodé & Co., 40 So. Front St., Memphis, Tenn.

Owl Brand Cottonseed Meal.

Buffalo Fertilizer Co., William St., Buffalo, N. Y.

Fish Guano,
Farmers' Choice,
New England Special,
Celery and Potato Special,
Vegetable and Potato,
High Grade Manure,
Tobacco Producer,
Top Dresser,
Bone Meal,
Muriate of Potash.

T. H. Bunch Co., Little Rock, Ark.

Old Gold Brand Cottonseed Meal.

Coe-Mortimer Co., 24-26 Stone St., New York, N. Y.

E. Frank Coe's Celebrated Special Potato Fertilizer,
E. Frank Coe's Corn and Potato Fertilizer,
E. Frank Coe's Excelsior Potato Fertilizer,
E. Frank Coe's Famous Prize Brand, Grain and Grass,
E. Frank Coe's High Grade Ammoniated Bone Superphosphate,
E. Frank Coe's New Englander Corn and Potato,
E. Frank Coe's Red Brand Excelsior Guano,
E. Frank Coe's XXV Ammoniated Bone Phosphate,
E. Frank Coe's Gold Brand Excelsior Guano,
Genuine Peruvian Guano, Lobos Grade,
Peruvian Vegetable Grower,
Thomas Phosphate Powder (Basic Slag Phosphate),
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash.

John C. Dow Co., 13-14 Chatham St., Boston, Mass.

Dow's Pure Ground Bone.

Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.

IMP Plant Food.

Essex Fertilizer Co., 39 North Market St., Boston, Mass.

Essex XXX Fish and Potash,
Essex Complete for Potatoes, Roots and Vegetables,
Essex Market Garden and Potato Manure,
Essex Special Tobacco Manure,
Essex Complete for Corn, Grain and Grass,
Essex Special Potato Phosphate,
Essex A1 Superphosphate,
Essex Lawn Dressing,
Essex Potato Grower,
Essex Grain and Grass Fertilizer,
Essex Grass and Top Dressing,
Essex Nitrate of Soda,
Essex Ground Bone.

Farmers' Ground Rock Phosphate Co., Memphis, Tenn.

M. A. Evans, West Wrentham, Mass. New England representative.
Tennessee Rock Phosphate (Ground).

R. & J. Farquhar & Co., 6-7 So. Market St., Boston, Mass.

Farquhar's Lawn and Garden Dressing.
Farquhar's Vegetable and Potato Fertilizer.
Farquhar's Pure Ground Bone.
Clay's London Fertilizer.
Thomson's Grape Vine, Plant and Vegetable Manure.
Thomson's Special Chrysanthemum Manure.

Finch, Pruyn & Co., Glens Falls, New York.

Lime Ashes.

W. R. Grace & Co., Hanover St., New York, N. Y.

Nitrate of Soda.

Chas. W. Hastings, 76 Center St., Dorchester, Mass.

Ferti-Flora.

Thos. Hersom & Co., New Bedford, Mass.

Pure Bone Meal.
Meat and Bone.

Home Soap Co., 103 Webster St., Worcester, Mass.

Pure Ground Bone.

The Hubbard Fert. Co., Baltimore, Md.

Hubbard's Blood, Bone and Potash.
Hubbard's Royal Ensign.
Hubbard's Farmer's IXL.

Humphreys Godwin & Co., Memphis, Tenn.

Dixie Brand Cotton-seed Meal.

Hunter Bros. Milling Co., 1009 Pierce Building, St. Louis, Mo.

Prime Cotton-seed Meal.

Jordan Marsh Co., Boston, Mass.
Electroplasm.

John Joynt, Lucknow, Ontario, Canada.

Canada Hard Wood Ashes.

F. R. Lalor, Dunnville, Ontario, Canada.

Maple Brand Hard Wood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.

Lister's Special 10% Potato Fertilizer.
Lister's High Grade Special.
Lister's Success Fertilizer.
Lister's Special Corn Fertilizer.
Lister's Special Potato Fertilizer.
Lister's Special Tobacco Fertilizer.
Lister's Grain and Grass.
Lister's Potato Manure.
Lister's High Grade Sulphate of Potash.
Lister's Nitrate of Soda.

James E. McGovern, Andover, Mass.
Andover Animal Fertilizer.

Mapes' Formula and Peruvian Guano Co., 143 Liberty St., New York, N. Y.
Mapes' Potato Manure.
Mapes' Tobacco Starter Improved.
Mapes' Fruit and Vine Manure.
Mapes' Economical Potato Manure.
Mapes' Vegetable or Complete Manure for Light Soils.
Mapes' Average Soil Complete Manure.
Mapes' Cauliflower and Cabbage Manure.
Mapes' Corn Manure.
Mapes' Grass and Grain Spring Top Dressing.
Mapes' Lawn Top Dressing.
Mapes' Complete Manure "A" Brand.
Mapes' Cereal Brand.
Mapes' Complete Manure 10% Potash.
Mapes' Top Dresser Imp.—Half Strength.
Mapes' Tobacco Ash Constituents.
Mapes' Tobacco Manure, Wrapper Brand.
Mapes' Complete Manure for General Use.

The George E. Marsh Co., Lynn, Mass.
Ground Tankage.
Pure Bone Meal.

D. M. Moulton, Monson, Mass.
Ground Bone.

George L. Munroe & Sons, Oswego, N. Y.

Pure Unleached Wood Ashes.

National Fertilizer Co., 92 State St., Boston, Mass.

Chittenden's Complete Corn and Grain Fertilizer.
Chittenden's Fine Ground Bone.
Chittenden's Fish and Potash.
Chittenden's Fish and Potash XXX.
Chittenden's Market Garden Fertilizer.
Chittenden's Ammoniated Bone Phosphate.
Chittenden's High Grade Special Tobacco.
Chittenden's Potato Phosphate.
Chittenden's Complete Root Fertilizer.
Chittenden's Complete Tobacco Fertilizer.
Chittenden's Connecticut Valley Tobacco Grower.
Chittenden's Connecticut Valley Tobacco Starter.
Chittenden's Tobacco Special with Carbonate.
Chittenden's Dry Ground Fish.
Chittenden's Complete Grass Fertilizer.
Chittenden's Eureka Potato Fertilizer.
Double Manure Salt.
High Grade Sulphate of Potash.
Muriate of Potash.
Dissolved Bone Black.
Nitrate of Soda.
Carbonate of Potash.

Natural Guano Co., Aurora, Ill.

Pulverized Sheep Manure.

New England Fertilizer Co., 40A North Market St., Boston, Mass.

New England Corn Phosphate.
New England Potato Fertilizer.
New England High Grade Potato Fertilizer.
New England Corn and Grain Fertilizer.
New England Potato Grower.
New England Superphosphate.

Nitrate Agencies Co., 64 Stone St., New York, N. Y.

Nitrate of Soda.

Olds & Whipple, Hartford, Conn.

Olds & Whipple Home Mixture for Onions.
Olds & Whipple Dry Ground Fish.
Olds & Whipple Complete Tobacco Fertilizer.
Olds & Whipple Top Dressing for Grass.
Olds & Whipple High Grade Potato Fertilizer.
Olds & Whipple Vegetable Potash.
Olds & Whipple Fish and Potash.
Olds & Whipple Grey Pomace.
Olds & Whipple Corn and Potato Fertilizer.
Pulverized Bone and Meat.
High Grade Phosphate.
Sulphate of Potash.
Muriate of Potash.
Cottonseed Meal.
Nitrate of Soda.

Parmenter & Polsey Fertilizer Co., 40 N. Market St., Boston, Mass.

P. & P. Plymouth Rock.
P. & P. Special Potato Fertilizer.
P. & P. Potato Phosphate.
P. & P. A. A. Brand.
P. & P. Ground Bone.
P. & P. Potato Fertilizer.
P. & P. Potato Grower.
Star Brand Superphosphate.

Patrons' Co-operative Association, 704 Chamber of Commerce, Boston, Mass.

Nitrate of Soda.
Muriate of Potash.
Sulphate of Potash.
Basic Slag.
Fine Ground Fish.
Ground Bone.

R. T. Prentiss, Granby, Mass.

R. T. Prentiss' Top Dressing.
R. T. Prentiss' Potato.
R. T. Prentiss' Corn.

The Pulverized Manure Co., 28 Exchange Ave., Chicago, Ill.

Wizard Brand Manure.

W. W. Rawson & Co., Boston, Mass.

Rawson's Fine Ground Bone.
Rawson's Wizard Brand Cattle Manure.
Rawson's Wizard Brand Pulverized Sheep Manure.
Canada Hard Wood Ashes.

The Rogers Manufacturing Co., Rockfall, Conn.

All Round Fertilizer,
Complete Potato and Vegetable,
Complete Corn and Onion,
Fish and Potash,
Oats and Top Dressing,
Grass and Grain,
Tobacco and Potato,
Soluble Tobacco,
Tobacco Grower,
Knuckle Bone Flour,
Pure Fine Ground Bone,
Dry Ground Fish.

The Rogers & Hubbard Co., Middletown, Conn.

Hubbard's Complete Phosphate,
Hubbard's Potato Phosphate,
Hubbard's New Market Garden Phosphate,
Hubbard's Soluble Corn and General Crops,
Hubbard's Soluble Potato Manure,
Hubbard's Soluble Tobacco Manure,
Hubbard's Grass and Grain Fertilizer,
Hubbard's Oats and Top Dressing,
Hubbard's Pure Raw Knuckle Bone Flour,
Hubbard's Strictly Pure Fine Bone.

Ross Bros. Co., 88-92 Front St., Worcester, Mass.

Potato and Vegetable Fertilizer,
Corn, Grass and Grain Fertilizer,
Odorless Corn Fertilizer.

N. Roy & Son, So. Attleboro, Mass.

Roy's Animal Fertilizer.

Sanderson Fertilizer & Chemical Co., New Haven, Conn.

Sanderson's Formula "A,"
Sanderson's Formula "B,"
Sanderson's Top Dressing for Grass and Grain,
Sanderson's Potato Manure,
Sanderson's Special with 10% Potash,
Sanderson's Corn Superphosphate,
Sanderson's Fine Ground Fish,
Sanderson's Fine Ground Blood, Bone and Meat,
Sanderson's Fine Ground Bone.
Atlantic Coast Bone, Fish and Potash,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Plain Superphosphate.

M. L. Shoemaker & Co., Limited, Philadelphia, Pa.

Swift-Sure Superphosphate,
Swift-Sure Guano for Truck, Corn and Onions,
Swift-Sure Bone Meal.

Springfield Rendering Co., Springfield, Mass.

Tankage (Ground),
Steam Bone (Ground),
Raw Bone (Ground).

Thos. L. Stetson, Randolph, Mass.

Ground Bone.

Swift's Lowell Fertilizer Co., 40 N. Market St., Boston, Mass.

Swift's Lowell Bone Fertilizer,
Swift's Lowell Potato Phosphate,
Swift's Lowell Animal Brand,
Swift's Lowell Market Garden
Swift's Lowell Potato Manure,
Swift's Lowell Ground Bone,
Swift's Lowell Lawn Dressing,
Swift's Lowell Special Grass Fertilizer,
Swift's Lowell Potato Grower,
Swift's Lowell Tobacco Manure,
Swift's Lowell Dissolved Bone and Potash,
Swift's Lowell Empress Brand,
Swift's Lowell Sterling Phosphate,
Swift's Lowell Perfect Tobacco Grower,
Swift's Lowell Tobacco Starter,
Swift's Lowell Seeding Down Fertilizer,
Swift's Lowell Special Potato Fertilizer,
Swift's Lowell Dried Blood,
Swift's Lowell High Grade Sulphate of Potash,
Swift's Lowell Dissolved Bone,
Swift's Lowell Dissolved Bone Black,
Swift's Lowell Kainit,
Swift's Lowell Sulphate of Ammonia,
Swift's Superior Fertilizer,
Swift's Special Corn and Vegetable Manure,
Acid Phosphate,
Nitrate of Soda,
Muriate of Potash,
Ground Tankage.

A. L. Warren, Northboro, Mass.

Warren's Pure Ground Bone.

Whitman & Pratt Rendering Co., Lowell, Mass.

Corn Success,
All Crop,
Potato Manure,
Potato Plowman,
Vegetable Grower,
Potato Special,
Pure Ground Bone.

Wilcox Fertilizer Works, Mystic, Conn.

Wilcox Potato, Onion and Vegetable Manure,
Wilcox Grass Fertilizer,
Wilcox High Grade Tobacco Special,
Wilcox Complete Bone Superphosphate,
Wilcox Potato Fertilizer,
Wilcox Fish and Potash,
Wilcox Nitrate of Soda,
Wilcox Dry Ground Fish,
Wilcox Muriate of Potash,
Dry Ground Acidulated Fish.

Sanford Winter, Brockton, Mass.

Pure Ground Bone.

A. H. Wood & Co., Framingham, Mass.

B. B. General Fertilizer,
S. P. Fertilizer,
7-7-7 Fertilizer.

J. M. Woodard, Greenfield, Mass.

Woodard's Unground Tankage.

Worcester Rendering Co., Auburn, Mass.

Ground Tankage.

Fertilizers Collected. Our collecting season for some brands of fertilizer sold in Massachusetts is relatively short. As a general rule fertilizers cannot be found plentifully in the open markets until April 1st. Some of the fertilizer is used for early crops by the 15th or 20th of April, and by May 1st to 15th depending upon the season, considerable of the fertilizer has been used. In order to make a more complete canvass of the state in the short time allotted, and to cover a larger territory than heretofore; and in order to procure so far as possible samples of every brand of goods sold, an extra man was detailed for the collection during that portion of the season when fertilizers were found most plentiful. The samples which appear in the following tables of analyses were in all cases (except those marked manufacturers' samples) taken by an authorized agent of the experiment station. Mr. Jas. T. Howard, the regular assistant, aided by Mr. C. W. Gaskill covered the eastern part of the state while Mr. E. C. Hall looked after the collection in the Connecticut valley and central portion of the state. 110 towns were visited and samples were taken from 280 different agents. The total number taken was 1042, representing 458 distinct brands. Four hundred and eighteen more samples were collected and analyzed than during the preceding year. The collection has been made with the usual care and the inspectors have been instructed to sample at least 10 per-cent of the whole lot of each brand inspected, and never to sample less than 5 bags without making a special note of the fact on the guarantee slip which is sent to the laboratory with each sample taken.

Fertilizers Analyzed. The following analyses have been made in connection with the inspection of licensed fertilizers:

	Analyses.
Complete fertilizers	384
Ground bones, tankages and fish	61
Fertilizers furnishing potash and phosphoric acid, such as ashes, etc.	16
Nitrogen compounds such as sulphate of ammonia, nitrate of soda, blood, castor pomace, linseed and cottonseed meals	68
Potash compounds	34
Phosphoric acid compounds	17

These analyses have been grouped in the tables which follow in the order above given, and arranged alphabetically according to manufacturers' names. In addition to the above, 33 fertilizers have been collected and analyzed that were not licensed but which were manufactured for private use. The analyses of these brands appear in a table by themselves immediately following the tables of mixed licensed fertilizers, and just previous to the tables giving analyses of ground bones.

A total of 613 separate analyses were made in connection with the inspection of 1909. Whenever possible an analysis has been made of a composite composed of equal weights of distinct samples of the same brand, collected in various parts of the state. In instances where the results of analysis of a composite have shown a brand to be seriously deficient in one or more plant food elements, a new sample has been drawn for analysis from each original sample taken and a separate analysis made. This was done to ascertain if the shortage was general or confined to one or more lots of the same brand. Thirty-five such complete analyses were made from thirteen composites. One hundred and seventy-two more analyses have been made than during the previous year.

Trade Values of Fertilizer Ingredients. The following schedule of trade values of fertilizer ingredients was adopted at a meeting of station directors and chemists of the New England and New Jersey experiment stations, which was held in March 1909. These values represent the average cash pound cost, at retail, of nitrogen, phosphoric acid and potash in their various forms furnished by chemicals and unmixed raw materials on sale in the large markets in New England and New York during the six months preceding March 1st, 1909. As may be seen from the table which gives in comparison the trade values for 1908, the values for nitrogen and phosphoric acid are somewhat lower than for the previous year, while the various forms of potash remain unchanged.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1909 AND 1908.

	Cents per pound.	
Nitrogen.	1909	1908
In ammonia salts	17	17½
In nitrates	16½	18½
Organic nitrogen in dry and fine ground fish, meat, blood and in high grade mixed fertilizers	19	20½
Organic nitrogen in fine* bone and tankage	19	20½
Organic nitrogen in coarse* bone and tankage	14	15
Phosphoric Acid.		
Soluble in water	4	5
Soluble in neutral ammonium citrate solution (reverted phosphoric acid)	3½	4½
In fine* ground bone and tankage	3½	4
In coarse* bone and tankage	3	3
In cottonseed meal, linseed meal, castor pomace and ashes	3	4
Insoluble (in neutral ammonium citrate solution) in mixed fertilizers	2	2
Potash.		
As sulphate, free from chlorides	5	5
As muriate (chloride)	4¼	4¼
As carbonate	8	8

*Fine and medium bone and tankage are separated by a sieve having circular openings 1/50 of an inch in diameter. Valuations of these materials are based upon degree of fineness as well as upon composition.

Concerning Valuations. The "comparative valuations" per ton which appear in the tables of analyses represent the *cash cost at centers of distribution* in New England of an amount of nitrogen, potash and phosphoric acid in unmixed chemicals and standard raw materials of good quality, corresponding with the same amount and quality found in one ton of the fertilizer analyzed. It is assumed that the various elements of plant food in the mixed fertilizers are derived from high grade products. This may not always be the case hence it places the manufacturer who uses inferior and low grade materials on the same plane with those using high grade materials. The comparative valuations are no indication of the agricultural value of a fertilizer, which can only be ascertained by the increased yield due to its use.

It will be readily understood from the above that the valuations published in the tables do not represent the proper retail price of the fertilizer at the place where the sample was procured. To arrive at a fair retail price there should be added to the valuations the cost of grinding, mixing, bagging, storing, hauling and freighting the goods, as well as commissions to agents, long credits, depreciation of factory plants, interest, and profits. Commercial valuations are useful in comparing the relative values of similar brands of goods sold by different manufacturers.

Concerning Retail Cash Prices. The retail cash prices which are published in the following tables of analyses are, in almost every instance, verified in writing over the agent's signature. The prices are obtained first by the collector at the time the samples are drawn, later a communication is sent to every agent asking him to verify and if necessary correct these prices. Frequently two or three appeals have to be made before the desired verification can be secured. Great care and pains are taken, however, to obtain reliable and representative figures. In cases of wide variations in prices on the same brand, further correspondence is had with the several agents in order, if possible, to ascertain the cause of such variations.

Concerning Percentage of Difference. The term "percentage of difference" is simply another way of expressing the difference existing between the average valuation and the average selling price of the individual fertilizer, or otherwise expressed it is the percentage excess of the average retail cash price per ton over the calculated or commercial value of the nitrogen, potash and phosphoric acid actually contained in a ton of the goods in question.

To illustrate: If the comparative commercial value of the nitrogen, potash and phosphoric acid in a ton of fertilizer is $24.00 and the dealer's cash price per ton is $36.00, the difference is $12.00 or expressed in form of percentage it is 50.

The percentage of difference *does not* represent the profit which the manufacturer makes on the fertilizer as some have assumed; it must *include* the manufacturer's profit or a part of the same* but it also includes the cost of grinding, mixing, bagging, transportation, agents commissions, etc.

The following table shows the average comparative commercial values, the average cash prices and the average percentages of difference of the licensed complete fertilizers analyzed during the seasons of 1908 and 1909 in Massachusetts.

Year	Comparative Commercial Values	Retail Cash Prices	Money Difference	Percentage of Difference
1908	$25.81	$36.20	$10.39	40.25
1909	$22.19	$34.60	$12.41	56.01

A comparison of the above figures shows that the average cost of a ton of average complete commercial fertilizer was $1.60 less than for the season of 1908; on the other hand the average comparative commercial value was $3.62 less per ton. The above figures would indicate that the consumer of mixed fertilizers has not received as high a value for his money during this season as for the previous year.

It must be remembered that the above figures represent averages only, and include all grades of goods; for details those interested are referred to the tables themselves. It was not possible to determine the influence of tonnage in calculating the averages; had it been possible the figures would, in all probability, have been somewhat modified although not radically.

*Mr. W. H. Bowker, in a pamphlet entitled "The Utilization of Home Resources of Fertility," stated that the profit comes in "the difference between the retail price and wholesale cost of materials."

High and Low Grades of Fertilizer.

The 323 analyses of complete fertilizers which appear in the tables may be divided for convenience of study into three grades. Those having a commercial value of $18 or less per ton may be classed as low grade; 83 such brands occur in the analyses. Those having a commercial value between $18 and $24 may be classed as medium grade; 122 such brands occur. Those having a commercial value of over $24 per ton may be classed as high grade; 118 such brands occur.

GRADES OF FERTILIZER.

	Number of Brands	Per Cent. of Whole Number	Per Cent. of Nitrogen	Per Cent. of Available Phosphoric Acid	Per Cent. of Potash	Lbs. of Available Plant Food in 100 lbs. of Fertilizer	Average Valuation Per Ton	Average Cost Per Ton	Excess of Selling Price over Valuation Per Ton	Percentage Difference
High Grade,	118	36.53	3.94	7.62	8.00	19.56	27.63	39.05	11.42	41.33
Medium Grade,	122	37.77	2.61	8.10	5.34	16.05	20.69	33.85	13.16	63.61
Low Grade,	83	25.70	1.80	7.35	3.06	12.21	15.32	29.51	14.19	92.62

What the above table shows:—

1. That the percent of nitrogen and potash is much higher in the high grade goods than in the medium or low grade.

2. That with a 32 per cent advance in price over the low grade fertilizer, the high grade furnishes more than 60 per cent increase in available plant food.

3. With about a 32 per cent. advance in price over the low grade fertilizer, the high grade furnishes over 80 per cent. increase in commercial value.

4. A ton of the average high grade fertilizer furnishes about 43 lbs. more of nitrogen, 5½ more of available phosphoric acid and 99 more of actual potash than does a ton of the low grade goods.

5. The average high grade fertilizer with a 15½ per cent advance in price over the medium grade goods, furnishes about 22 per cent more plant food and about 35½ per cent increase in commercial value.

6. The medium grade goods cost about 15 per cent more than the low grade goods and furnish over 35 per cent greater commercial value.

7. That the percentage difference in the low grade fertilizer is more than double what it is in the high grade goods.

Table showing the Comparative Pound Cost of Nitrogen, Potash and Phosphoric Acid in its Various Forms, in the Three Grades of Fertilizer.

ELEMENT	Low Grade Fertilizers	Medium Grade Fertilizers	High Grade Fertilizers
Nitrogen....................	36.60 cts.	31.08 cts.	26.85 cts.
Potash (as muriate)..........	9.63 "	8.18 "	7.07 "
Soluble phosphoric acid	7.71 "	6.54 "	5.65 "
Reverted " "	6.74 "	5.73 "	4.95 "
Insoluble " "	3.85 "	5.27 "	2.83 "

What this table shows:—

1. That nitrogen has cost 9.75 cents, available phosphoric acid about 2 cents, and potash 2.56 cents per pound *more* in the average low grade fertilizer than in the average high grade goods.

2. That nitrogen has cost 4.23 cents, the available phosphoric acid over ¾ cents and the potash 1.11 cents *more* per pound in the average medium grade goods than in the average high grade fertilizer.

3. That every conclusion which can be drawn from the above tables emphasizes the fact that the farmer cannot afford to purchase the low grade fertilizers.

One wonders why so many farmers buy the low grade fertilizers and pay the high prices for plant food which these brands demand. The same amount paid for high grade goods will purchase ⅓ to ½ more plant food, and moreover the plant food in the high grade goods is likely to be more highly available and in better form. The intelligent farmer buys commercial fertilizer in order to get available plant food, not a large bulk of material irrespective of the amount and quality of the plant food which it contains. A ton of low grade fertilizer may contain 200 lbs. of plant food while a ton of high grade fertilizer often contains 500 lbs. of plant food, or to put it in another way 10 percent of the total weight of a ton of low grade fertilizer may be available plant food while 25 percent of the total weight of a ton of high grade fertilizer is often actually present in this form.

It costs no more to grind, mix, bag, transport and sell a ton of fertilizer containing 500 lbs. of plant food than a ton of low grade fertilizer containing 200 lbs. of plant food; hence the manufacturer can sell the plant food in high grade fertilizers cheaper than in low grade goods. The higher the grade the cheaper the plant food can be bought as a general rule.

WHY BUY LOW GRADE FERTILIZERS?

The following table shows a general summary of the results of analyses of the complete fertilizers as compared with the manufacturers' guarantee.

MANUFACTURER	No. of Brands Analyzed	No. with all three elements equal to guarantee	No. equal to guarantee in Commercial Value	No. with one element below guarantee	No. with two elements below guarantee	No. with three elements below guarantee
W. H. Abbott..................	3	1	2	1	2	—
American Agr'l. Chem. Co......	69	37	65	23	9	—
Armour Fert. Works...........	10	4	6	4	2	—
Baltimore Pulverizing Co.......	2	—	2	2	—	—
Beach Soap Co................	4	3	4	1	—	—
Berkshire Fert. Co.	6	4	6	2	—	—
Bowker Fert. Co...............	34	19	32	15	—	—
Joseph Breck & Sons, Corp.....	3	1	3	2	—	—
Buffalo Fert. Co...............	9	4	7	4	1	—
Coe-Mortimer Co..............	9	3	6	4	2	—
Eastern Chemical Co...........	1	—	1	1	—	—
Essex Fert. Co................	11	8	10	3	—	—
R. & J. Farquhar & Co.........	5	2	5	3	—	—
Hubbard Fert. Co.............	3	2	3	1	—	—
Jordan Marsh Co..............	1	—	—	—	1	—
Lister's Agr'l. Chem. Works.....	7	7	7	—	—	—
James E. McGovern............	1	—	—	—	1	—
Mapes' Form. & Peru. Guano Co.	17	11	17	5	1	—
National Fert. Co..............	12	6	12	6	—	—
Natural Guano Co.............	1	—	1	—	1	—
New England Fert. Co.........	6	3	5	2	1	—
Olds & Whipple...............	6	5	6	1	—	—
Parmenter & Polsey...........	6	3	6	3	—	—
R. T. Prentiss.................	3	—	—	1	1	1
Pulverized Manure Co..........	3	—	—	—	2	1
W. W. Rawson & Co...........	2	1	1	—	1	—
Rogers Mfg. Co...	9	8	9	1	—	—
Rogers & Hubbard Co..........	8	5	8	3	—	—
Ross Bros. Co.................	3	1	2	1	1	—
N. Roy & Son.................	1	—	1	1	—	—
Sanderson Fert. & Chem. Co....	7	1	5	6	—	—
M. L. Shoemaker & Co. Ltd.....	2	1	2	1	—	—
Swift's Lowell Fert. Co.........	18	10	15	5	3	—
Whitman & Pratt Rend. Co.....	5	3	5	2	—	—
Wilcox Fert. Works............	6	6	6	—	—	—
A. H. Wood & Co.............	3	—	—	2	1	—

What the above table shows:

1. That 296 distinct brands of licensed complete fertilizers were collected and analyzed.

2. That 138 brands (46.6 per cent of the whole number analyzed) fell below the manufacturer's guarantee in one or more elements.

3. That 106 brands were deficient in one element.

4. That 30 brands were deficient in two elements.

5. That 2 brands were deficient in all three elements. In this connection it might be added that 80 brands were found deficient in nitrogen, 63 in potash and 28 in phosphoric acid.

6. That 45 out of the 296 brands analyzed (over 15 per cent of the total number) showed a commercial shortage. The term "commercial shortage" meaning that the brands in question did not show the amount and value of the plant food guaranteed, although the excess of any element of plant food was figured in full value to offset the deficiencies.

7. That certain manufacturers are either extremely careless in mixing or else they do not allow a sufficient margin for variation in the composition of crude stock; in other words they try to have their goods run too close to the minimum guarantee.

Concerning Commercial Shortages. The season of 1909 shows the largest number of deficiencies and commercial shortages which has probably ever occurred in this state. The largest number of commercial shortages is below $1.00 in value per ton and yet many of the deficiencies are very serious, in many cases running one percent or over below the minimum guarantee. The following table has been prepared to show the commercial shortages in the mixed fertilizers for the season of 1909, also to furnish a comparison with the previous year.

Commercial Shortages.	Number of Brands.	
	1909.	1908.
Over $4.00 per ton..............................	4	—
Between $3.00 and $4.00 per ton..................	2	3
" $2.00 " $3.00 " "	5	1
" $1.00 " $2.00 " "	14	7
Under $1.00 not less than 25 cents per ton....... ..	35	not given

It might be said, perhaps with some degree of truth, that the above method of figuring commercial shortages by allowing the value of an excess of some element of plant food to balance the value of a deficiency on some other element was hardly just to the purchaser or consumer; there can be no question but what it is eminently fair to the manufacturer. We should not lose sight of the fact, however, that serious deficiencies or excesses change the essential character of a fertilizer.

All manufacturers whose goods show serious deficiencies have been advised, and all others are hereby informed, that such conditions must not continue to exist or it will be necessary to bring legal action against them as the deficiencies are a direct violation of our fertilizer law.

Brands Showing Commercial Shortages.

As stated above, in the majority of cases in the complete fertilizers where a serious deficiency of plant food has occurred in one instance, the value of the deficiency has been made up by an excess of one or both of the other elements, so that a commercial shortage in the brand did not actually occur. There were, however, among all of the complete fertilizers analyzed 35 samples which did not furnish an amount of plant food equivalent in money value to the amount guaranteed. No mention is made of those brands which show a commercial shortage of less than 50 cents per ton. The brands showing a commercial shortage of *over* 50 cents per ton are as follows:

W. H. Abbott, Holyoke, Mass.—Abbott's Tobacco Fertilizer, No. 601. Nitrogen found 3.66%, guaranteed 4%; available phosphoric acid found 9.88%, guaranteed 8%; potash found 9.34%, guaranteed 10%.

Abbott's Tobacco Fertilizer, No. 613. Nitrogen found 3.43%, guaranteed 4%; available phosphoric acid found 9.09%, guaranteed 8%; potash found 8.71%, guaranteed 10%.

Abbott's Tobacco Fertilizer, No. 819. Nitrogen found 3.77%, guaranteed 4%; available phosphoric acid found 10.28%, guaranteed 8%; potash found 8.58%, guaranteed 10%.

American Agricultural Chemical Co., Boston, Mass.—Bradley's Complete Manure, 10% Potash, No. 881. Nitrogen found 2.78%, guaranteed 3.30%; available phosphoric acid found 6.16%, guaranteed 6%; potash found 10.16%, guaranteed 10%.

Great Eastern Northern Corn Special, No. 780. Nitrogen found 2.26%, guaranteed 2.50%; available phosphoric acid found 8.96%, guaranteed 9%; potash found 2.19%, guaranteed 2%.

Read's High Grade Farmers' Friend, No. 828. Nitrogen found 2.89%, guaranteed 3.29%; available phosphoric acid found 6.86%, guaranteed 6%; potash found 8.85%, guaranteed 10%.

Armour Fertilizer Works, Baltimore, Md.—Armour's All Soluble, No. 844-918. Nitrogen found 2.60%, guaranteed 2.88%; available phosphoric acid found 8.19%, guaranteed 8%; potash found 4.18%, guaranteed 4%.

Armour's Blood, Bone and Potash, No. 843. Nitrogen found 3.95%, guaranteed 4.11%; available phosphoric acid found 7.72%, guaranteed 8%; potash found 7.49%, guaranteed 7%.

American Farmers' Complete Potato, No. 943. Nitrogen found 1.20%, guaranteed 1.64%; available phosphoric acid found 6.27%, guaranteed 7%; potash found 6.08%, guaranteed 6%.

Armour's Fish and Potash Mixture, No. 106-621. Nitrogen found 1.81%, guaranteed 2.06%; available phosphoric acid found 6.06%, guaranteed 6%; potash found 2.14%, guaranteed 2%.

American Farmers' Market Garden Special, No. 199. Nitrogen found 1.47%, guaranteed 3.28%; available phosphoric acid found 8.28%, guaranteed 8%; potash found 5.58%, guaranteed 7%.

American Farmers' Market Garden Special, No. 941. Nitrogen found 1.97%, guaranteed 3.28%; available phosphoric acid found 9.88%, guaranteed 8%; potash found 7.04%, guaranteed 7%.

Armour's Onion Special, No. 983. Nitrogen found 1.91%, guaranteed 2.47%; available phosphoric acid found 12.38%, guaranteed 12%; potash found 9.57%, guaranteed 10%.

Bowker Fertilizer Co., Boston, Mass.—Stockbridge's Permanent Dressing, No. 94. Nitrogen found 2.60%, guaranteed 2.47%; available phosphoric acid found 5.66%, guaranteed 6%; potash found 9.49%, guaranteed 10%.

Buffalo Fertilizer Co., Buffalo, N. Y.—Buffalo Top Dresser, No. 433-953. Nitrogen found 3.46%, guaranteed 5.74%; available phosphoric acid found 8.57%, guaranteed 6%; potash found 5.82%, guaranteed 5%.

Buffalo High Grade Manure, No. 955. Nitrogen found 1.81%, guaranteed 3.20%; available phosphoric acid found 6.80%, guaranteed 7%; potash found 6.31%, guaranteed 10%.

Coe-Mortimer Co., New York City.—Coe's Red Brand Excelsior Guano, No. 661. Nitrogen found 2.88%, guaranteed 3.30%; available phosphoric acid found 7.34%, guaranteed 8%; potash found 8.15%, guaranteed 7%.

Essex Fertilizer Co., Boston, Mass.—Essex Lawn Dressing, No. 110-746. Nitrogen found 3.46%, guaranteed 4%; available phosphoric acid found 7.58%, guaranteed 7%; potash found 6.03%, guaranteed 6%.

Jordan Marsh Co., Boston, Mass.—Electroplasm, No. 1028. Nitrogen found 3.76%, guaranteed 3.25%; available phosphoric acid found 9.29%, guaranteed 20.25%; potash found 2.39%, guaranteed 2.60%.

James E. McGovern, Andover, Mass.—McGovern's Animal Fertilizer, No. 540. Nitrogen found 3.11%, guaranteed 3.50%; available phosphoric acid found 14.10%, guaranteed 10%; potash found 3.17%, guaranteed 5.50%.

National Fertilizer Co., Boston, Mass.—Chittenden's Market Garden Fertilizer, No. 863. Nitrogen found 2.08%, guaranteed 2.50%; available phosphoric acid found 8.42%, guaranteed 8%; potash found 6.32%, guaranteed 6%.

R. T. Prentiss, Holyoke, Mass.—Prentiss' Corn Fertilizer No. 647. Nitrogen found 2.66%, guaranteed 2.87%; available phosphoric acid found 7.76%, guaranteed 8%; potash found 7.49%, guaranteed 8%.

Prentiss' Corn Fertilizer, No. 160. Nitrogen found 2.63%, guaranteed 2.88%; available phosphoric acid found 8.12%, guaranteed 8%; potash found 7.93%, guaranteed 8%.

Prentiss' Complete Top Dressing, No. 653. Nitrogen found 5.16%, guaranteed 5.76%; available phosphoric acid found 6.12%, guaranteed 6%; potash found 7.74%, guaranteed 8%;

Prentiss' Complete Potatoes and Roots, No. 915. Nitrogen found 2.45%, guaranteed 2.88%; available phosphoric acid found 7.50%, guaranteed 8%; potash found 10.18%, guaranteed 10%.

Pulverized Manure Co., Chicago, Ill.—Pulverized Hog Manure, No. 99-101. Nitrogen found 1.91%, guaranteed 2.10%; available phosphoric acid found 1.30%, guaranteed 1.20%; potash found 1.14%, guaranteed 1.35%.

Shredded Cattle Manure, No. 89-111-220. Nitrogen found 1.96%, guaranteed 2.10%; available phosphoric acid found 1.36%, guaranteed 1.20%; potash found 1.16%, guaranteed 1.35%.

Ross Bros. Co., Worcester, Mass.—Ross' Corn, Grass and Grain Fertilizer No. 1022. Nitrogen found 2.78%, guaranteed 2.88%; available phosphoric acid found 8.88%, guaranteed 8%; potash found 6.60%, guaranteed 8%.

Sanderson Fertilizer & Chemical Co., New Haven, Conn.—Sanderson's Formula A, No. 922. Nitrogen found 2.42%, guaranteed 3.33%; available phosphoric acid found 8.67%, guaranteed 6%; potash found 5.26, guaranteed 6%.

Sanderson's Special with 10% Potash, No. 866-920. Nitrogen found 2.50%, guaranteed 2.47%; available phosphoric acid found 5.28%, guaranteed 5%; potash found 9.36%, guaranteed 10%.

Swift's Lowell Fertilizer Co., Boston, Mass.—Swift's Lowell Potato Grower, No. 548. Nitrogen found 3.07%, guaranteed 3.28%; available phosphoric acid found 6.50%, guaranteed 6%; potash found 9.94%, guaranteed 10%.

Swift's Lowell Special Corn and Vegetable Fertilizer, No. 125. Nitrogen found 2.98%, guaranteed 3.28%; available phosphoric acid found 8.47%, guaranteed 8%; potash found 7.07%, guaranteed 7%.

A. H. Wood & Co., Framingham, Mass.—Wood's B.B. Fertilizer, No. 681. Nitrogen found 1.99%, guaranteed 2.50%; available phosphoric acid found 9.03%, guaranteed 7%; potash found 5.68%, guaranteed 5%.

Wood's S. P. Fertilizer, No. 641. Nitrogen found 3.08%, guaranteed 4%; available phosphoric acid found 6.09%, guaranteed 6%; potash found 11.46%, guaranteed 12%.

Wood's 7-7-7 Brand, No. 683. Nitrogen found 6.51%, guaranteed 7%; available phosphoric acid found 8.07%, guaranteed 7%; potash found 7.12%, guaranteed 7%.

Unmixed Fertilizers.

Ground Bone.

Twenty-nine samples of ground bone have been analyzed during the inspection of 1909. Eleven of the brands have been found deficient in phosphoric acid, and eight in nitrogen. Eight brands had a commercial shortage ranging from a few cents to $2.95 per ton. The average retail cash price for ground bone has been $30.39 per ton, the average valuation $26.09 and the percentage of difference 16.57. The brands showing a commercial shortage of 50 cents or over per ton are as follows:

Armour Fertilizer Co.'s Bone Meal, Nos. 324-618-936. Nitrogen found 2.48%, guaranteed 2.47%; phosphoric acid found 22.24%, guaranteed 24%.

Bowker Fertilizer Co.'s Ground Bone, Nos. 60-173-229-903-947. Nitrogen found 2.71%, guaranteed 2.47%; phosphoric acid found 20.80%, guaranteed 22.80%.

R. & J. Farquhar & Co.'s Ground Bone, No. 142. Nitrogen found 2.19%, guaranteed 2.47%; phosphoric acid found 21.50%, guaranteed 22.80%.

Thomas Hersom & Co.'s Pure Bone Meal, No. 114. Nitrogen found 2.64%, guaranteed 2.29%; phosphoric acid found 25.08%, guaranteed 28.00%.

D. M. Moulton's Ground Bone, No. 792. Nitrogen found 4.26%, guaranteed 4.49%; phosphoric acid found 18.96%, 19.00%.

A. L. Warren's Ground Bone, No. 625. Nitrogen found 2.14%, guaranteed 3.70%; phosphoric acid found 26.60%, guaranteed 22.78%.

Ground Tankage.

Nine samples of tankage have been analyzed and show the usual variations in composition. Only one brand has shown a serious shortage in nitrogen and four have tested low in phosphoric acid. The average retail cash price per ton was $30.18, the average valuation per ton $29.86, and the percentage of difference 1.07. Nitrogen in fine tankage has cost on the average 19.22 cents, while nitrogen in coarse tankage has cost 14.22 cents per pound. Only one brand showed a commercial shortage of over 50 cents per ton, namely:

Geo. E. Marsh & Co.'s Ground Tankage, No. 316. Nitrogen found 5.30%, guaranteed 6.99%; phosphoric acid found 14.02%, guaranteed 11.45%.

Dissolved Bone. Three samples of dissolved bone have been analyzed, only one of which was found deficient in plant food. No commercial shortages were found. The average retail cash price per ton was $26.67, the average valuation $20.69, and the percentage difference 28.90.

Dry Ground Fish. Twenty samples of dry ground fish have been examined of which nine were found deficient in nitrogen and only one in phosphoric acid. Six brands showed a commercial shortage ranging from a few cents to $1.89 per ton. The average retail cash price per ton was $38.96, the average valuation $36.13, and the percentage difference 7.83.

Nitrogen from dry ground fish has cost on the average 23.88 cents per pound.

The following brands show a commercial shortage of over 50 cents per ton:

Olds & Whipple's Dry Ground Fish, No. 15. Nitrogen found 6.16%, guaranteed 6.50%; phosphoric acid found 13.30%, guaranteed 12.00%.

Patrons' Co-operative Association's Dry Ground Fish, No. 412. Nitrogen found 7.50%, guaranteed 8.24%; phosphoric acid found 13.90%, guaranteed 12.36%.

Wood Ashes. Thirteen samples of ashes have been analyzed of which three were found deficient in phosphoric acid and six in potash. Six of these samples show a commercial shortage ranging from 32 cents to $1.10 per ton. Those showing a commercial shortage of 50 cents or more per ton are as follows:

John Joynt, Lucknow, Ontario, Canada.—Joynt's Wood Ashes, No. 51. Phosphoric acid found 1.18%, guaranteed 1%; potash found 3.55%, guaranteed 4.00%.

Joynt's Wood Ashes, No. 256. Phosphoric acid found 1.15%, guaranteed 1%; potash found 4.49%, guaranteed 5.00%.

Joynt's Wood Ashes, No 416. Phosphoric acid found .82%, guaranteed 1%; potash found 5.70%, guaranteed 6%.

Joynt's Wood Ashes, No. 822. Phosphoric acid found .95%, guaranteed 1%; potash found 5.62%, guaranteed 6%.

F. R. Lalor, Dunnville, Ontario, Canada.—Lalor's Hard Wood

Ashes, No. 383. Phosphoric acid found 1.56%, guaranteed 1%; potash found 4.10%, guaranteed 5%.

Sulphate of Ammonia. Three samples of sulphate of ammonia have been analyzed and found well up to the guarantee. The average cost of nitrogen per pound in this form has been 17.53 cents.

Nitrate of Soda. Thirteen samples of nitrate of soda have been analyzed and only two were found deficient in nitrogen. The average cost of nitrogen per pound in this form has been 17.11 cents. Two samples were found to have a commercial shortage of over 50 cents per ton. They were as follows:

Lister's Agricultural Chemical Works Nitrate of Soda, No. 674. Nitrogen found 15.40%, guaranteed 15.66%.

National Fertilizer Co.'s Chittenden's Nitrate of Soda, No. 474. Nitrogen found 14.90%, guaranteed 15.50%.

Dried Blood. Two samples of this material were examined and both were found deficient in nitrogen. They both contained sufficient phosphoric acid, however, so that there was no commercial shortage. The average cost of nitrogen from blood has been 25.57 cents per pound.

Castor Pomace. Four samples of castor pomace have been analyzed. One sample only was found deficient in nitrogen.

The Olds & Whipple's Castor Pomace, No. 7. Nitrogen found 4.38%, guaranteed 5%.

The average cost of nitrogen in this form has been 23.67 cents per pound.

Linseed Meal. Three samples of flax meal have been tested and the nitrogen guarantee has been maintained in each instance. The nitrogen from this source has cost on the average 26.47 cents per pound.

Cottonseed Meal. Forty-three samples of cottonseed meal have been examined, the same being licensed by six companies doing business in Massachusetts during the past year. This material, like castor pomace and linseed meal, is bought largely as a nitrogen source for tobacco. Nitrogen from cottonseed meal has cost on the average 23.61 cents per pound. Seventeen out of the forty-three samples analyzed show a nitrogen shortage ranging in value from a few cents up to $2.39 cents per ton. The samples showing a deficiency amounting to 50 cents or more per ton are as follows:

American Cotton Oil Co.'s Cottonseed Meal, No. 835. Nitrogen found 6.16%, guaranteed 6.50%.

F. W. Brodé & Co.'s Cottonseed Meal, No. 709. Nitrogen found 6.34%, guaranteed 6.50%.

T. H. Bunch Co.'s Cottonseed Meal, No. 864. Nitrogen found 6.00%, guaranteed 6.50%.

Humphreys, Godwin & Co.'s Cottonseed Meal, No. 223. Nitrogen found 6.10%, guaranteed 6.50%.

Cottonseed Meal, No. 376. Nitrogen found 5.87%, guaranteed 6.50%.

Hunter Bros. Milling Co.'s Cottonseed Meal, No. 280. Nitrogen found 6.32%, guaranteed 6.50%.

Cottonseed Meal, No. 499. Nitrogen found 6.30%, guaranteed 6.50%.

Cottonseed Meal, No. 539. Nitrogen found 5.94%, guaranteed 6.17%.

Cottonseed Meal, No. 627. Nitrogen found 6.35%, guaranteed 6.50%.

Cottonseed Meal, No. 640. Nitrogen found 6.13%, guaranteed 6.50%.

Carbonate of Potash. Three samples of carbonate of potash were analyzed and all were found to be of good quality. Potash in this form has cost on the average 7.68 cents per pound.

High Grade Sulfate of Potash. Nine samples of high grade sulfate of potash have been examined and the potash guarantee was maintained in all but three of them. A pound of potash in this form has cost on the average 5.03 cents. The brands showing a commercial shortage of over 50 cents per ton are as follows:

Patrons' Co-operative Association's High Grade Sulfate of Potash, No. 397. Potash found 52.60%, guaranteed 53.81%.

High Grade Sulfate of Potash, No. 421. Potash found 52.92%, guaranteed 53.81%.

Sanderson Fertilizer & Chemical Co.'s High Grade Sulfate of Potash, No. 896. Potash found 40.70%, guaranteed 48.67%.

Potash-Magnesia Sulfate. Six samples of double sulfate of potash and magnesia have been tested and in every case the potash guarantee has been maintained. The pound of actual potash in this form has cost 5.41 cents.

Muriate of Potash. Thirteen samples of muriate of potash have been examined and only two samples have shown a potash shortage which amounted in value to but a few cents per ton. The pound of actual potash in form of muriate has cost on the average 4.18 cents.

Kainit. Three samples of kainit have been analyzed and all of them tested over the minimum guarantee in potash. The average pound cost of actual potash in this form has been 6.13 cents.

Dissolved Bone Black. Three samples of dissolved bone black have been examined and all were found of good quality. The pound of available phosphoric acid from this source has cost on the average 7.41 cents.

Acid Phosphate. Seven samples of acid phosphate have been analyzed and the available phosphoric acid guarantee has been maintained in all but one instance. There were no commercial shortages. The pound of available phosphoric acid from this source has cost on the average 5.69 cents.

Basic Slag Phosphate. Six samples have been examined and the available phosphoric acid in all but one sample has run somewhat under the amount guaranteed. There has been a commercial shortage in only one instance, however, and that was less than 50 cents per ton. An excess of insoluble phosphoric acid has made up the value of the deficiencies in available phosphoric acid. The pound of available phosphoric acid (by Wagner's method) from basic slag has cost on the average 5.79 cents.

Conversion Factors.

The writer has been asked by a number of large users of fertilizers to publish in the fertilizer bulletin a table of conversion factors by means of which the amount of plant food may be calculated from the various chemical compounds in which they are contained.

To change:—

Nitrogen to ammonia,	multiply by	1.216
Ammonia to nitrogen,	" "	.823
Nitrate of soda to nitrogen,	" "	.165
Nitrogen to nitrate of soda,	" "	6.071
Nitrate of potash to nitrogen,	" "	.139
Nitrogen to nitrate of potash,	" "	7.221
Sulfate of ammonia to ammonia,	" "	.258
Muriate of potash to actual potash,	" "	.632
Actual potash to muriate of potash,	" "	1.582
Sulfate of potash to actual potash,	" "	.541
Actual potash to sulfate of potash,	" "	1.850
Nitrate of potash to actual potash,	" "	.466
Actual potash to nitrate of potash,	" "	2.146
Carbonate of potash to actual potash,	" "	.682
Actual potash to carbonate of potash,	" "	1.467
Bone phosphate to phosphoric acid,	" "	.458
Phosphoric acid to bone phosphate,	" "	2.185

Explanation of Table of Analyses.

In the first column will be found the name and address of the fertilizer manufacturer and the names of the brands analyzed. The second column designates the town where each sample was drawn.

The column giving "dealer's cash price per ton" shows the cash price that was charged the consumer for one ton of fertilizer at the place where the brand was collected. There are in some instances very wide differences between the prices which were charged by various agents for the same brand. For instance, in the products of the Pulverized Manure Co. one price was given as $15.00 per ton and another as $30.00 per ton. These variations are beyond all reason; they have, however, been verified by the agents in writing and so are published for what they are worth.

The valuation column shows the retail cash cost in our large markets or centers of distribution of amounts of nitrogen, phosphoric acid and potash, equivalent to those found in one ton of the fertilizer.

The "percentage of difference" column shows the percentage excess of the retail cash price over the valuation, another manner of expressing the difference between the cash cost and the commercial valuation of the fertilizer. This is explained more fully on a previous page.

The "laboratory number" is simply a reference number used in the collection and analyses of the various brands.

In the nitrogen column the water soluble nitrogen includes nitrogen as nitrates and as ammoniates, with more or less amido compounds, in case of acidulated goods, which rank with the ammonia compounds in availability. The organic nitrogen, as expressed in the tables, is that part of the total nitrogen insoluble in water. The total nitrogen includes all forms of nitrogen present.

In the phosphoric acid column the insoluble phosphoric acid is that part of the total phosphoric acid insoluble in water or a neutral solution of citrate of ammonia. The reverted phosphoric acid is that portion dissolved by a neutral solution of citrate of ammonia (specific gravity 1.09) by treating two grams of the fertilizer, previously washed with water, with 100 c. c. of the citrate solution one-half hour at 65° C. It is supposed to represent that part of the phosphoric acid insoluble in water but soluble in soil and root acids—it represents the difference between the total and the sum of the soluble and insoluble phosphoric acids. The available phosphoric acid column represents the sum of the soluble and reverted phosphoric acid.

The potash column shows the per cent of potash soluble in water; results published without an asterisk (*) indicate that the potash is present as chloride or that sufficient chlorine is present in the fertilizer to unite with all of the potash. Foot-notes indicate the amount of potash present as sulfate and carbonate.

The guarantee columns show the minimum percentage of nitrogen, total and available phosphoric acid, and potash guaranteed by the manufacturer to be present.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
W. H. Abbott, Holyoke, Mass.				
Abbott's Eagle Brand Fertilizer	Deerfield	$38.00	$27.92	36.06
Abbott's Onion Fertilizer	Whately	39.00	27.18	43.48
Abbott's Tobacco Fertilizer	Whately	41.00	30.13	36.11
" " "	So. Deerfield	41.00	28.13	45.75
" " "	Deerfield	41.00	30.02	36.57
American Agric. Chem. Co., 92 State St., Boston.				
Grass and Lawn Top Dressing	Seekonk	*34.00	23.58	69.64
" " " " "	Boston	40.00		
" " " " "	Springfield	40.00		
" " " " "	Marlboro	40.00		
" " " " "	Newburyport	40.00		
Grass and Lawn Top Dressing	Franklin	40.00	24.10	58.92
" " " " "	Holyoke	37.00		
" " " " "	Worcester	37.50		
" " " " "	Milford	37.00		
" " " " "	Milford	40.00		
" " " " "	Dalton	—		
High Grade Fertilizer, with 10% Potash	Bradstreet	38.00	26.06	47.35
" " " " " "	Marlboro	40.00		
" " " " " "	Newburyport	38.00		
" " " " " "	So. Amherst	36.00		
" " " " " "	Billerica	40.00		
Tobacco Starter and Grower	So. Deerfield	38.50	24.93	55.11
" " " "	Worcester	37.50		
" " " "	Westfield	40.00		
High Grade Tobacco Manure	Bradstreet	49.00	35.48	38.11
" " " "	Bradstreet	49.00		
Special Grass and Grain Mixture	Medway	55.00	43.08	27.66
Northwestern Empire Special	Seekonk	34.00	24.75	42.4[illegible]
" " "	Fall River	36.50		
Baker's "A.A" Ammoniated Superphosphate	New Bedford	35.00	18.51	89.0[illegible]
Bradley's X L Superphosphate	Bradstreet	32.00	19.62	68.1[illegible]
" " "	Westport	33.00		
" " "	New Bedford	33.00		
" " "	Amherst	34.00		

*Not included in average in calculating percentage difference.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed	Found.	Guaranteed.
830	10.24	1.06	1.69	2.75	2.50	.77	10.82	3.74	15.33	13.00	11.59	11.00	8.44*	10.00
617	13.47	2.21	1.38	3.59	3.50	.51	8.49	2.00	11.00	10.00	9.00	8.00	7.46*	7.00
601	11.49	2.25	1.41	3.66	4.00	.77	9.11	2.36	12.24	11.00	9.88	8.00	9.34*	10.00
613	11.90	1.97	1.46	3.43	4.00	.70	8.38	2.28	11.36	11.00	9.08	8.00	8.71*	10.00
819	11.59	2.27	1.50	3.77	4.00	.55	9.73	2.30	12.58	11.00	10.28	8.00	8.58*	10.00
117, 180, 191, 326, 354	6.44	4.72	.06	4.78	3.91	1.38	4.56	1.66	7.60	6.00	5.94	5.00	2.76	2.00
557, 652, 689, 873, 885, 894	8.96	4.51	.26	4.77	3.91	1.19	4.46	2.56	8.21	6.00	5.65	5.00	3.16	2.00
4, 312, 380, 455, 504	12.31	2.11	1.09	3.20	2.40	4.54	2.44	2.10	9.08	7.00	6.98	6.00	10.08	10.00
607, 688, 909	10.68	1.94	1.39	3.33	3.30	6.37	2.27	1.77	10.41	10.00	8.64	8.00	5.72*	4.00
43, 47	9.62	2.49	3.12	5.61	5.70	1.79	4.25	2.30	3.34	7.00	6.04	5.00	10.02*	10.00
38	3.98	6.82	1.64	8.46	8.43	.29	4.54	3.79	3.62	7.25	4.83	—	9.96	8.25
28, 08	13.38	2.01	1.24	3.25	3.30	7.01	1.41	1.64	10.06	9.00	8.42	7.00	7.00	7.00
56	16.35	1.25	1.19	2.44	2.50	7.14	1.97	1.92	11.03	11.00	9.11	9.00	2.21	2.00
37, 66, 69, 03	14.09	1.45	1.23	2.68	2.50	6.59	2.62	2.56	11.77	11.00	9.21	9.00	2.24	2.00

*No. 830	Chlorine 1.17%,	equivalent to	1.54%	potash,	6.90%	potash as sulfate
" 617	" .88%	"	1.18%	"	6.28%	" "
" 601	" .79%	"	1.06%	"	8.28%	" "
" 613	" .85%	"	1.14%	"	7.57%	" "
" 819	" .73%	"	.98%	"	7.60%	" "
" 607-688-909	" .37%	"	.49%	"	5.23%	" "
" 43-47	" 1.00%	"	1.33%	"	8.69%	" "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chem. Co. (Continued.)				
Bradley's X L Superphosphate	Franklin	$34.00		
" " "	West Upton	34.00		
" " "	Munson	33 50	$19.23	78.37
" " "	Gardner	35.00		
" " "	Milford	35.00		
Bradley's Potato Fertilizer	Amherst	32.00		
" " "	Franklin	32.00		
" " "	Leominster	31.00	18.09	75.52
" " "	Munson	31.50		
" " "	Williamstown	31.00		
" " "	Milford	33.00		
Church's Fish and Potash, "D"	New Bedford	28.00		
" " " " "	Westport	29.00	21 24	39.50
" " " " "	So. Amherst	30.00		
" " " " "	So. Deerfield	31.50		
Bradley's Potato Manure	New Bedford	33 00		
" " "	Plymouth	32.00	19.80	63.32
" " "	Beverly	32.00		
Bradley's Potato Manure	Franklin	34.00		
" " "	Framingham	35 00	20.63	67.23
" " "	West Upton	34.00		
" " "	Gardner	35.00		
Bradley's Eclipse Phosphate	Concord	28 00		
" " "	Marlboro	29 00	13.82	107.45
" " "	Williamstown	29 00		
Bradley's Eclipse Phosphate	Southbridge	28 00	13.93	101.00
Bradley's Comp. Manure for Potatoes and Veg.	Bradstreet	38 00		
" " " " " " "	Concord	39.50	25.52	52.35
" " " " " " "	Franklin	40 00		
" " " " " " "	Holyoke	38 00		
Bradley's Comp. Manure for Potatoes and Veg.	West Upton	40.00	25 18	54.88
" " " " " " "	Williamstown	38 00		
Bradley's Comp. Man. for Top Dress. Grass and Grain	Lawrence	38 00		
" " " " " " " "	Holyoke	38.00	25.51	51.58
" " " " " " " "	Dalton	40 00		
Bradley's Comp. Manure, 10% Potash	Medway	42 00	25.62	63.93

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid Reverted.	Phosphoric Acid Insoluble.	Phosphoric Acid Total. Found.	Phosphoric Acid Total. Guaranteed.	Phosphoric Acid Available. Found.	Phosphoric Acid Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
537, 771, 791, 838, 892	15.49	1.32	1.20	2.52	2.50	7.20	2.09	2.51	11.80	11.00	9.29	9.00	2.30	2.00
293, 551, 743, 784, 840, 875	15.80	1.07	1.07	2.14	2.06	6.31	2.40	2.70	11.41	10.00	8.71	8.00	3.02	3.00
59, 73, 466, 611	12.95	2.20	1.16	3.36	2.07	3.49	3.73	3.63	10.85	7.50	7.22	6.00	2.94	2.00
79, 207, 356	11.82	1.82	.93	2.75	2.50	4.07	2.48	2.02	8.57	8.00	6.55	6.00	5.02	5.00
563, 645, 774, 799	13.16	2.11	.81	2.92	2.50	4.48	1.97	2.02	8.47	8.00	6.45	6.00	5.42	5.00
304, 332, 842	13.86	.68	.55	1.23	1.03	6.12	2.51	2.17	10.80	10.00	8.63	8.00	2.22	2.00
970	10.85	.77	.33	1.10	1.03	.77	7.11	5.45	13.33	10.00	7.88	8.00	2.63	2.00
42, 306, 554, 650	12.29	2.18	1.24	3.42	3.30	5.82	2.75	1.84	10.41	9.00	8.57	8.00	7.14	7.00
776, 841	11.61	2.23	1.12	3.35	3.30	5.69	2.58	1.94	10.21	9.00	8.27	8.00	7.02*	7.00
578, 654, 895	8.69	5.11	.17	5.28	4.95	1.51	4.66	1.94	8.11	6.00	6.17	5.00	2.64	2.50
544	11.63	1.98	1.38	3.36	3.30	4.28	1.90	1.30	7.48	7.00	6.18	6.00	9.86	10.00

*766–841 Chlorine 4.11%, equivalent to 5.49% potash, 1.51% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chem. Co. (Continued.)				
Bradley's Comp. Manure with 10% Potash	Lawrence	$39 00	$27.01	44.39
" " " " " "	Southwick	40.50	25.83	56.79
" " " " " "	Westfield	—	23.71	—
" " " " " "	East Brookfield	40.00	25.50	56.86
Bradley's Niagara Phosphate	Westfield	—	13.11	90.69
" " "	Brookfield	25.00		
Bradley's Comp. Manure for Corn and Grain	Fitchburg	40 50	25.41	58.08
" " " " " " "	West Upton	40.00		
" " " " " " "	Dalton	40.00		
Bradley's Columbia Fish and Potash	Westfield	28.00	16.06	74.34
Bradley's Corn Phosphate	Plymouth	30.00	18.52	67.38
" " "	Marlboro	33.00		
" " "	Beverly	30.00		
Bradley's Corn Phosphate	Lawrence	30.00	17.65	77.56
" " "	Milford	33.00		
" " "	Southbridge	31.00		
Bradley's English Lawn Fertilizer	Springfield	50.00	23.42	113.49
Bradley's Seeding Down Manure	Boston	34.00	18.85	80.37
Clark's Cove Great Planet	Spencer	39.00	24.59	58.60
Clark's Cove Bay State G. G.	Palmer	30.00	15.19	97.49
Clark's Cove Potato Manure	Spencer	30 00	19.01	57.81
Crocker's Ammoniated Corn Phosphate	Worcester	32.00	16.74	91.15
Crocker's Potato Hop and Tobacco Phosphate	Worcester	32 00	16.93	88.45
Cumberland Superphosphate	N. Leominster	32 00	17.67	79.23
" "	Munson	31 00		
" "	N. Wilbraham	32 00		
Cumberland Potato Fertilizer	N. Leominster	33 00	18 24	75.44
" " "	Munson	31 00		
Darling's Blood Bone and Potash	Worcester	41.00	28.05	49.73
" " " " "	Pepperell	43 00		
Darling's Complete 10% Manure	Barre Plains	38.50	25.69	49.86
Darling's Potato Manure	N. Amherst	32 00	19.70	62.44
" " "	So. Amherst	32.00		
Darling's Farm Favorite	Worcester	32.00	18.57	72.32
Darling's Potato and Root Crop Manure	Barre Plains	37.50	24.92	50.48

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
559	9.31	2.18	1 33	3.51	3.30	4.48	2.74	1.74	8.96	7.00	7.22	6.00	9.82	10.00
873	9.39	2.10	.96	**3.06**	3.30	3.45	4.01	2.00	9.46	7.00	7.46	6.00	10.20	10.00
881	14.81	1.73	1.00	**2.78**	3.30	3.62	2.54	1.34	7.50	7.00	6.16	6.00	10.16	10.00
940	10.01	1.77	1.37	3.14	3.30	2.87	3.49	2.14	8.50	7.00	6.36	6 00	10.20	10.00
926 948	12.20	.62	.73	1 35	.82	6.24	1.56	2.87	10.67	8 00	7.80	7.00	1.18	1.00
752 775 882	10.45	2.40	1.12	3.52	3.30	4.98	6.89	2.20	14.02	13.00	11.82	12.00	3 88*	3 00
860	13.14	1.18	1.01	2 19	1.65	3.97	2.30	3.38	9.65	6.00	6.27	5 00	2.44	2.00
178 311 365	12.39	1.23	1.43	2.66	2.06	6.31	2.11	1.79	10.21	10.00	8.42	8.00	1.95	1.50
550 891 971	13.91	1.14	1.04	2.18	2.06	5.80	3.20	3.43	12 43	10.00	9.00	8.00	1.85	1.50
.038	9.96	4.53	—	**4 53**	4.95	1.00	5.22	1.66	7.88	6.00	6.22	5.00	3.41	2.50
196	14 27	1.41	1.04	2.45	2.50	7.61	1.65	2.61	11.87	11.00	9.26	9.00	2.14	2.00
959	12.07	1.74	1.37	3.11	3.30	7.93	.44	2.20	10.57	9.00	8.37	8.00	6.98	7.00
949	11.96	.86	1.13	1.99	2.06	2.62	5.01	2.48	10 11	10.00	**7.63**	8.00	1.62	1.50
957	13.95	.67	1.30	1 97	2 06	7.01	2 84	2 84	12 69	10 00	9.85	8 00	3.59	3.00
712	16.30	.96	.96	1.92	2.06	6.05	3.88	1.89	11.82	10.00	9.93	8 00	1.78	1.50
728	15.92	.86	1.19	2.05	2.06	5.41	2.37	2 17	9.95	10.00	**7 78**	8.00	3.15	3.00
726 871 904	14.07	1.11	1.27	2.38	2.06	3 30	5.50	2.02	10.22	10.00	8 80	8.00	2.08	1 50
725 790	15.21	1.31	.84	2.15	2.06	6.69	2.11	2 38	11 18	10 00	8 80	8 00	3.32	3.00
686 698	12.61	1.68	2 50	4 18	4.10	6.65	1.87	1.25	9.77	8 00	8.52	7 00	**6 72**	7.00
025	13 23	2.34	.97	3.31	3.30	4.22	1 85	1.38	7.45	7.00	6.07	6.00	10.36	10.00
420 467	14.88	1.63	1.05	2.73	2.50	4.00	2.14	1.89	8.03	8.00	6.14	6.00	5.34	5.00
679	13 09	1.15	1.00	2.15	2.06	5.25	3.27	3 89	12.41	10.00	8 52	8 00	3.31	3.00
024	9 53	2 94	.34	3.23	3.30	5.82	2.29	2.61	10.72	9.00	8 11	8.00	7.45	7.00

*752-775-882 Chlorine 2.58%, equivalent to 3.54% potash, 34% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chem. Co. (Continued.)				
Darling's General Fertilizer	Pepperell	$32.00	$15.62	104.37
Great Eastern Garden Special	Pepperell	40.00	25 52	56.73
Great Eastern Vegetable Vine and Tobacco	Billerica	31.00	22.49	35.60
" " " " " "	Billerica	31.00		
" " " " " "	Pratt's Junction	31.00		
" " " " " "	N. Wilbraham	33.00		
Great Eastern Northern Corn Special	N. Wilbraham	33.00	17.92	84.15
Great Eastern General	Mendon	26.50	16.71	53.59
Pacific Potato Special	Newburyport	30.00	18.15	65.29
Pacific High Grade General Fertilizer	Montague	37.00	25.93	42.69
Soluble Pacific Guano	Newburyport	28 00	16 59	77.81
" " "	S. Amherst	31.00		
Packer's Union Animal Corn Fertilizer	Amherst	34.00	19.43	74 99
Packer's Union Potato Manure	Amherst	34.00	19 53	74.09
Packer's Union Market Garden Comp. Manure	Concord	38.00	26.54	45.06
" " " " " "	Amherst	39 00		
Packer's Union Universal Fertilizer	Concord	29 00	14 47	100.41
Quinnipiac Market Garden Manure	Seekonk	36 00	26.07	45.76
" " " "	Fall River	37 50		
" " " "	Springfield	40 00		
" " " "	N. Amherst	38.50		
Quinnipiac Market Garden Manure	Holyoke	39.00	25 28	54.27
Quinnipiac Potato Phosphate	N. Amherst	30 00	21.31	43.92
" " "	So. Amherst	32.00		
" " "	Holyoke	30.00		
Quinnipiac Potato Phosphate	Williamstown	31.00	17 64	74.73
Quinnipiac Corn Manure	N. Amherst	30 00	17 88	67.78
" " "	So. Amherst	30 00		
Quinnipiac Corn Manure	Williamstown	31 00	16 88	83.64
Quinnipiac Phosphate	Leominster	33.00	19 07	73.04
Quinnipiac Potato Manure	Seekonk	30.00	20 18	58.57
" " "	N. Amherst	33.00		
" " "	Leominster	33.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
705	12.22	.73	.81	1.54	1.25	5.54	1.72	2.33	9.59	7.00	7.26	6.00	4.12	3.00
700	11.33	1.08	2.19	3.27	3.30	7.10	1.68	1.48	10.26	9.00	8.78	8.00	6.63*	7.00
513, 514, 719, 869	13.78	1.50	1.05	2.55	2.06	6.91	1.79	2.23	10.93	10.00	8.70	8.00	6.74	6.00
780	14.35	1.30	.96	2.26	2.50	7.07	1.89	2.53	11.49	11.00	8.96	9.00	2.19	2.00
1002	7.39	.29	.71	1.00	.82	2.56	4.74	2.30	9.60	10.00	7.30	8.00	7.92	4.00
374	14.90	1.12	.88	2.00	2.06	6.14	3.78	1.82	11.74	10.00	9.92	8.00	3.19	3.00
1033	11.42	1.78	1.48	3.26	3.30	5.92	3.21	1.28	10.41	—	9.13	8.00	7.95	7.00
379, 469	15.52	1.07	1.20	2.27	2.06	6.05	1.86	1.89	9.80	10.00	7.91	8.00	1.75	1.50
935	13.72	1.86	.56	2.42	2.50	7.80	3.02	1.23	12.05	11.00	10.82	9.00	2.52	2.00
932	17.39	1.22	.82	2.04	2.06	6.65	2.00	1.61	10.26	10.00	8.65	8.00	5.76	6.00
318, 981	10.45	1.68	1.34	3.02	2.40	5.25	1.94	1.79	8.98	7.00	7.19	6.00	9.52*	10.00
314	12.98	.46	.59	1.05	.82	5.41	3.37	2.12	10.90	10.00	8.78	8.00	3.68	4.00
113, 150, 236, 239	10.99	2.19	1.38	3.57	3.30	6.24	2.18	1.92	10.34	9.00	8.42	8.00	7.16	7.00
655	14.35	1.64	1.50	3.14	3.30	7.52	1.57	1.07	10.16	9.00	9.09	8.00	7.59	7.00
252, 453, 656	13.95	1.79	1.15	2.94	2.06	6.75	2.12	2.69	11.56	10.00	8.87	8.00	3.40	3.00
832	15.61	1.07	1.04	2.11	2.06	6.78	1.74	2.10	10.62	10.00	8.52	8.00	3.02	3.00
255, 456	12.78	1.34	1.19	2.53	2.06	5.95	2.72	1.28	9.95	10.00	8.67	8.00	1.92	1.50
831	13.69	.94	1.28	2.22	2.06	6.24	2.30	1.92	10.46	10.00	8.54	8.00	1.70	1.50
716	14.88	1.31	1.16	2.47	2.50	7.33	2.39	2.20	11.92	11.00	9.72	9.00	2.12	2.00
116, 242, 745	13.32	1.44	1.22	2.66	2.50	3.52	2.96	2.17	8.65	8.00	6.48	6.00	5.74	5.00

*No. 700 Chlorine .45%, equivalent to .60% potash, 6.03% potash as sulfate.
" 318-981 " .28% " .37% " 9.15% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co. (Continued.)				
Read's Practical Potato Special " " " " " " " "	Newburyport Billerica N. Hadley	$31.50 32 00 30.00	$18.06	72.59
Read's Practical Potato Special " " " " " " " "	Clinton Greenfield Sheffield	29 00 28 00 29 00	17.16	67.07
Read's Farmers' Friend Superphosphate	So. Deerfield	32 00	19.25	66.23
Read's High Grade Farmers' Friend	N Hadley	40 00	26 08	53.37
Read's High Grade Farmers' Friend	Greenfield	38.00	23.52	61.56
Read's Farmers' Friend Superphosphate " " " "	Billerica Greenfield	32.00 29.00	19.50	56.41
Read's Vegetable and Vine " " " " " " " "	S. Deerfield N. Hadley Clinton	35 00 33.00 32 00	20.87	59.75
Read's Potato Manure	Marlboro	37.00	22.32	65.77
Standard Special Potato	Worcester	30.00	16.71	79.53
Standard Guano for All Crops " " " " " " " " " "	Newburyport Clinton Spencer	31.00 27.00 28.00	14.47	98.13
Tucker's Original Bay State Superphosphate	Concord	30.00	16.94	77.09
Tucker's Special Potato Fertilizer " " " "	Concord Newburyport	30.00 33.00	18.20	73.08
Wheeler's Corn Fertilizer	Pepperell	30.00	18.17	65.11
Wheeler's Potato Manure	Pepperell	30.00	18.44	62.69
Wheeler's Havana Tobacco Grower " " " "	Pratt's Junction N. Wilbraham	35 50 33 00	26.26	39.95
Wheeler's Bermuda Onion Grower	West Acton	31 50	15 66	101.14
Williams & Clark's Royal Bone Phosphate " " " " "	Brockton Newburyport	27.00 26.00	15.18	74.57
Williams & Clark's Americus Potato Manure " " " " "	Brockton Rockland	32 00 34.00	21.23	55.44
Williams & Clark's Prolific Crop Producer " " " " "	Brockton Worcester	25 00 28.00	11.96	121.57
Williams & Clark's Amer. Ammo. Bone Phos.	Rutland	32 00	18.75	70.67

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.	Guaranteed
				Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
359, 508, 665	10.63	.86	.69	1.55	.82	4.39	2.21	1.64	8.24	5.00	6.60	4.00	8.00	8.00
713, 807, 932	11.69	.45	.59	1.04	.82	4.64	3.29	2.07	10.00	5.00	7.93	4.00	7.70	8.00
604	13.78	1.30	.88	2.18	2.06	3.58	6.81	2.94	13.33	10.00	10.39	8.00	3.15	3.00
664	6.84	2.62	.79	3.41	3.29	4.50	1.82	.52	6.84	7.00	6.32	6.00	10.69	10.00
828	13.46	1.90	.99	2.89	3.29	4.22	2.64	1.38	8.24	7.00	6.86	6.00	8.85	10.00
503, 826	14.91	1.11	1.18	2.29	2.06	6.56	2.04	2.38	10.98	10.00	8.60	8.00	4.26	3.00
610, 672, 727	13.47	1.07	1.16	2.23	2.06	6.27	2.63	2.41	11.31	10.00	8.90	8.00	5.38	6.00
1007	9.65	1.06	.97	2.03	2.40	5.18	1.27	2.97	9.42	7.00	6.45	6.00	10.36	10.00
730	16.01	.77	1.19	1.96	2.06	5.37	2.51	2.33	10.21	10.00	7.88	8.00	3.01	3.00
353, 710, 956	13.70	.74	.77	1.51	1.03	5.28	2.78	2.81	10.87	10.00	8.06	8.00	2.04	2.00
321	13.33	.75	1.46	2.21	2.00	6.63	1.71	1.87	10.21	10.00	8.34	8.00	1.87	1.50
313, 373	14.44	1.13	.99	2.17	2.06	6.20	2.75	2.00	10.95	10.00	8.95	8.00	3.24	3.00
702	13.34	1.11	.90	2.01	1.65	5.25	5.06	3.33	13.64	10.00	10.31	8.00	2.25	2.00
703	12.67	1.31	.64	2.45	2.06	4.16	3.87	2.41	10.44	10.00	8.03	8.00	3.36	3.00
740, 906	8.89	1.54	1.28	2.82	2.40	5.18	2.78	1.66	9.62	7.00	7.96	6.00	9.54*	10.00
1009	12.66	.34	.75	1.09	.82	2.60	5.31	2.48	10.39	10.00	7.91	8.00	5.72	4.00
172, 371	13.13	.86	.71	1.57	1.03	6.33	2.42	2.10	10.85	10.00	8.75	8.00	2.32	2.00
174, 529	13.95	1.37	1.15	3.02	2.06	4.48	3.70	3.18	11.36	10.00	8.18	8.00	3.60	3.00
201, 729	12.31	.48	.67	1.15	.82	3.24	4.03	3.25	10.52	8.00	7.27	7.00	1.26	1.00
1000	3.62	2.28	.24	2.52	2.50	6.91	3.02	1.07	11.00	11.00	9.93	9.00	2.38	2.00

*740–906 Chlorine 66%, equivalent to 88% potash, 8.66% potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co. (Concluded.)				
Williams & Clark's Americus Corn Phosphate	Munson	$30.00	$17.80	65.73
" " " " "	Sheffield	29 00		
Williams & Clark's Am. H.G. Special Pot. Tob.etc	Rockland	42.00	24.70	53.85
" " " " " " " "	Sheffield	34.00		
Armour Fertilizer Works, Baltimore, Md.				
Armour's High Grade Potato	Seekonk	34 00	24.46	40.39
" " " "	Springfield	36 00		
" " " "	Amherst	33.00		
Armour's High Grade Potato	Salem	34.00	21.72	58.84
" " " "	Athol	36.00		
" " " "	Milford	32.00		
" " " "	Gt. Barrington	36.00		
Armour's All Soluble Fertilizer	Taunton	34.00	21.37	52.45
" " " "	Amherst	33 00		
" " " "	Salem	33 00		
Armour's All Soluble Fertilizer	Athol	36.00	19.47	72.06
" " " "	No. Adams	31.00		
Armour's Blood Bone and Potash	Billerica	40.00	27.32	40.19
" " " " "	Springfield	39.00		
" " " " "	Amherst	38.00		
" " " " "	Marlboro	39.00		
Armour's Blood Bone and Potash	Athol	44.00	26.28	67.42
American Farmers' Complete Potato Fert.	New Bedford	—	17.59	—
American Farmers' Complete Potato Fert.	S. Framingham	35.00	17.71	97.63
American Farmers' Complete Potato Fert.	Palmer	32.00	14.51	120.53
Armour's Fish and Potash Mixture	New Bedford	—	13 77	103.34
" " " " "	S. Deerfield	28.00		
Armour's Grain Grower	W. Springfield	23 00	17.46	43.18
" " "	S. Framingham	26.00		
" " "	Salem	26 00		
Armour's Grain Grower	Athol	29 00	14 15	93.21
" " "	No. Adams	25.00		
" " "	Gt. Barrington	28.00		
Armour's Ammoniated Bone and Potash	Bedford	28 00	17.35	65.71
" " " " "	Billerica	29 00		
" " " " "	S. Framingham	29.00		
" " " " "	Salem	29.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.	Guaranteed.
				Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
901, 917	14.43	1.24	1.26	2.50	2.06	6.46	1.93	2.28	10.67	10.00	8.39	8.00	1.60	1.50
523, 919	12.81	1.83	1.23	3.06	3.30	6.69	3.01	.74	10.44	9.00	9.70	8.00	7.12	7.00
112, 271, 297	7.77	1.95	.77	2.72	1.65	5.80	2.11	.69	8.60	—	7.91	8.00	10.00	10.00
382, 813, 883, 923	8.18	.90	.81	1.71	1.65	5.80	2.18	.82	8.80	8.50	7.98	8.00	10.68	10.00
135, 294, 378	8.76	2.01	1.24	3.25	2.38	6.95	1.40	.84	9.19	8.50	8.35	8.00	4.06	4.00
844, 918	10.41	1.63	.97	2.60	2.88	6.24	1.95	.82	9.01	8.50	8.19	8.00	4.18	4.00
211, 261, 299, 350	9.53	2.87	1.42	4.29	4.11	6.84	1.04	.54	8.42	8.50	7.88	8.00	7.84	7.00
843	10.48	2.84	1.11	3.95	4.11	5.99	1.73	.08	7.80	8.50	7.72	8.00	7.49	7.00
118	14.38	1.35	.70	2.05	1.65	5.40	2.00	.46	7.86	7.50	7.40	7.00	5.22	6.00
334	8.21	1.63	.30	1.93	1.65	5.92	1.08	.16	7.16	7.50	7.00	7.00	6.44	6.00
943	7.27	.41	.79	1.20	1.64	3.65	2.62	.51	6.78	8.00	6.27	7.00	6.08	6.00
106, 621	8.22	.65	1.16	1.81	2.06	4.48	1.58	1.59	7.65	—	6.06	6.00	2.14	2.00
145, 383, 355	7.07	1.58	.94	2.52	1.64	6.08	1.88	.97	8.93	10.00	7.96	8.00	2.29	2.00
810, 914, 924	8.98	.44	.94	1.38	1.65	6.75	2.11	.33	9.19	8.50	8.86	8.00	2.44	2.00
210, 213, 381, 377	5.27	1.63	1.20	2.83	2.47	4.09	2.41	1.18	7.68	6.50	6.50	6.00	2.14	2.00

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works. (Concluded.)				
Armour's Ammoniated Bone with Potash	Milford	$29.00	$17.06	64.12
" " " " "	N. Adams	27.00		
Armour's Fruit and Root Fertilizer	Taunton	26.00	17.35	63.27
" " " " "	Billerica	29.00		
" " " " "	Marlboro	30.00		
American Farmers' Market Garden Special	Seekonk	34.00	25.85	31.53
" " " " "	New Bedford	—		
American Farmers' Market Garden Special	Bedford	35 00	16.67	109.96
American Farmers' Market Garden Special	Palmer	38 00	20.75	83.13
Armour's Onion Special	N. Hadley	32.00	28.83	11.00
Armour's Onion Special	N. Hadley	32.00	28.55	12.08
Armour's Onion Special	Hadley	35.00	26.46	32.28
Baltimore Pulverizing Co., Baltimore, Md.				
Market Garden Fertilizer	Marblehead	28.00	20.72	35.14
" " "	Beverly	28.00		
" " "	Beverly	28.00		
Perfect Potato Fertilizer	Beverly	33.00	25.36	28.15
" " "	Marblehead	32 00		
Beach Soap Company, Lawrence Mass.				
Beach's Advance Brand	Lawrence	33.00	24.88	32.64
Beach's Market Garden Fertilizer	Lawrence	40.00	31.63	26.46
Beach's Reliance Fertilizer	Lawrence	28.00	18.93	47.91
Beach's Top Dressing	Lawrence	46.00	40.49	13.61
Berkshire Fertilizer Co., Bridgeport, Conn.				
Potato and Vegetable Phosphate	Sunderland	—	16.99	72.16
" " " "	Somerset	23 50		
" " " "	N. Amherst	30.00		
Potato and Vegetable Phosphate	Upton	34.00	17.03	99.65
Berkshire Complete Tobacco	N. Amherst	32.00	24.15	33.62
" " "	N. Hadley	32 00		
" " "	Sunderland	32 80		
" " "	N. Hadley	32.00		
Berkshire Ammoniated Bone Phosphate	N. Amherst	27.00	16.39	68.82
" " " "	Upton	28.00		
" " " "	S. Deerfield	28.00		
Berkshire Grass Special	Seekonk	36.00	24.69	45.81
Berkshire Complete Fertilizer	Somerset	31 50	21 98	44.45
" " "	Plainville	32.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
907 934	7.63	1.80	.90	2.70	2.47	4.13	2.24	1.36	7.73	—	6 37	6.00	2.48	2.00
93 224 327	7.80	1 11	.71	1.82	1.65	6 65	1.34	.84	8.83	8 50	7 99	8.00	5.04	5.00
76 91	8.07	2.59	1.05	3.64	3.28	7.20	.96	.59	8.75	8.50	8 16	8.00	7.50	7.00
199	9.23	.87	.60	1.47	3.28	6 02	2.26	.72	9.00	9.00	8.28	8.00	5.58	7.00
941	9.71	1.18	.79	1.97	3.28	7.25	2.63	.30	10.18	9.00	9.88	8.00	7.04	7.00
21	7.56	2.09	.54	2.63	2.47	8.87	3.42	2.05	14.34	14.00	12.29	12.00	10 43*	10.00
950	10.44	1.87	.58	2.45	2.47	9.98	3.12	1.56	14.66	—	13.10	12.00	10.84	10.00
983	8.66	1.22	.69	1.91	2.47	9.27	3.11	1.82	14.20	—	12.38	12.00	9.57*	10.00
341 369 362	7.67	2.15	.74	2.89	2.47	7.23	1.78	.84	9.85	—	9.01	3.00	3.80	4.00
361 345	8.64	2.33	1.42	3.75	3.29	7.80	1.49	.92	10.21	—	9.29	8.00	5.16	7.00
570	6.02	1.64	1.35	2.99	2.50	2.62	7.20	1.87	11.69	10.00	9.82	8.00	6.48*	6.00
543	6.69	3.71	1.03	4.74	4.74	1.89	5.74	.84	8.47	8.00	7.63	7.00	9.47*	9.75
571	7.69	1.09	1.05	2.14	1.65	2.05	8 01	1.89	11.95	10.00	10.06	8.00	3.79	3.00
576	4.01	5 05	.84	5.89	5.76	.10	7.32	1.10	8.52	7.00	7.42	4.00	16.20	15.00
35 96 244	8 52	1.06	1.01	2.07	1.70	4.61	2.17	.69	7.47	8.00	6.87	6 00	4.73	4.00
793	8.02	.31	1.73	2.04	1.70	5 41	1.62	.59	7.62	8.00	7.03	6.00	4.36	4.00
249 632 633 637	8 53	1.38	1.73	3.11	2.50	6.78	2.38	.61	9.77	9.00	9.16	3.00	5.80*	6.00
247 778 608	10.18	.34	1.35	1.69	.80	7.14	2.32	.90	10.36	9.00	9.46	8.00	2.84	2.00
131	12.30	2.08	2.46	4.54	5 00	2.28	4.19	.08	6.55	5.00	6.47	4.00	4.10	2.00
120 623	12.23	1.01	1.63	2.64	2.50	6.43	2.63	.61	9.72	9.00	9.11	8 00	6.00	6.00

* No. 21 Chlorine 5.32%, equivalent to 7.11% potash, 3.32% potash as sulfate.
983 " .69% " " .92% " 8.65% " " "
570 " .99% " " 1.32% " 5.16% " " "
543 " 1.16% " " 1.55% " 7.92% " " "
249–632–633–637 " 1.18% " " 1.57% " 4.23% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Berkshire Fertilizer Co. (Concluded.)				
Berkshire Long Island Special	Seekonk	$35.00	$26 38	32.68
" " " "	Seekonk	35.00		
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Square Brand Bone and Potash	Middleboro	23.00	16.31	62.48
" " " " "	Northampton	25 00		
Bowker's Square Brand Bone and Potash	Franklin	27 00	15.88	70.03
Bowker's Market Garden	Brockton	37 50	24.07	54.05
" " "	Northampton	34 00		
" " "	Townsend	37 00		
" " "	Upton	38 00		
" " "	Athol	38.50		
" " "	Milford	37.50		
Bowker's Tobacco Starter	S. Deerfield	35 00	20.60	65.05
" " "	Southwick	33.00		
Bowker's Potato and Vegetable Fertilizer	Brockton	33 00	21 19	52.62
" " " " "	Northampton	—		
" " " " "	Lawrence	32 00		
" " " " "	Holyoke	32.00		
Bowker's Potato and Vegetable Fertilizer	Leominster	33 00	20.15	65.46
" " " " "	Grafton Center	33.00		
" " " " "	Milford	34 00		
Bowker's Gloucester Fish and Potash	Taunton	26 00	12.57	106.84
Bowker's Fisherman's Fish and Potash	Southwick	26 00	16.40	58.54
Bowker's Early Potato Manure	Amherst	39 00	24.57	55.67
" " " "	S. Deerfield	37.00		
" " " "	Milford	37 00		
" " " "	N. Adams	40.00		
Bowker's All Soluble Animal Brand	Fall River	33.00	19.59	68.45
Bowker's Ammoniated Food for Flowers	Boston	*	15.42	—
Bowker's Potato and Vegetable Phosphate	Plymouth	34.00	19.34	63.75
" " " " "	S. Framingham	32 00		
" " " " "	Franklin	29 00		
Bowker's Potato and Vegetable Phosphate	N. Adams	30.00	15.55	92.92
Bowker's Lawn and Garden Dressing	Springfield	45 00	22 24	113.57
" " " " "	Newburyport	50 00		

*Sold only in small packages at 10c each.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid Reverted.	Phosphoric Acid Insoluble.	Phosphoric Acid Total. Found.	Phosphoric Acid Total. Guaranteed.	Phosphoric Acid Available. Found.	Phosphoric Acid Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) Guaranteed.
100, 129	11.31	1.56	2.14	3.70	3.30	4.00	2.90	.90	7.80	7.00	6.90	6.00	8.21*	7.00
202, 274	12.23	1.34	.97	2.31	1.65	4.32	2.51	2.25	9.08	7.00	6.83	6.00	2.28	2.00
573	13.06	.73	1.46	2.19	1.65	5.63	1.10	1.87	8.60	7.00	6.73	6.00	2.15	2.00
218, 277, 699, 783, 802, 874	12.21	1.42	1.19	2.61	2.47	3.24	3.52	2.07	8.83	7.00	6.76	6.00	10.40	10.00
616, 893	10.18	1.60	1.16	2.76	2.47	5.60	3.18	2.43	11.21	9.00	8.78	8.00	3.18*	3.00
217, 275, 575, 648	13.35	1.77	1.05	2.82	2.47	6.08	2.49	2.28	10.85	9.00	8.57	8.00	4.32	4.00
717, 762, 867	14.43	1.29	1.15	2.44	2.47	6.82	2.11	2.20	11.13	9.00	8.93	8.00	4.20	4.00
1003	12.43	.59	.39	.98	.82	6.14	2.99	.95	10.08	7.00	9.13	6.00	2.00	1.00
865	13.22	.87	1.50	2.37	2.47	1.15	3.28	2.48	6.91	5.00	4.43	4.00	4.15	4.00
233, 603, 886, 939	12.29	1.81	1.41	3.22	3.29	6.01	2.30	1.59	9.90	8.00	8.31	7.00	7.06	7.00
206	16.53	1.35	1.12	2.47	2.47	7.20	1.96	1.46	10.62	10.00	9.16	6.00	3.56	4.00
1030	6.55	2.03	.07	2.10	2.00	.10	6.40	1.43	7.93	6.00	6.50	4.00	3.55*	2.00
233, 335, 547	12.59	1.53	1.22	2.75	1.65	6.20	2.17	2.71	11.08	9.00	8.37	8.00	2.23	2.00
930	13.15	.63	1.09	1.72	1.65	4.70	3.95	2.66	11.31	—	8.65	8.00	1.98	2.00
205, 352	7.35	3.94	—	3.94	3.29	1.34	4.44	1.46	7.24	8.00	5.78	4.00	4.80	5.00

* No. 100–129 Chlorine 4.24%, equivalent to 5.66% potash, 2.55% as sulfate.
616–893 " .56% " " .75% " 2.43 " "
1030 " 2.16% " " 2.89% " .66% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Company. (Continued.)				
Bowker's Bone and Wood Ash Fertilizer	Mansfield	$28.00	$17.54	57.52
" " " " " "	Brockton	28 50		
" " " " " "	S. Framingham	28.00		
" " " " " "	Franklin	26.00		
Bowker's Hill and Drill Phosphate	Plymouth	34.00	20.57	61.64
" " " " "	Middleboro	35.00		
" " " " "	Northampton	29 00		
" " " " "	S. Framingham	35.00		
Bowker's Hill and Drill Phosphate	Palmer	33.00	19.10	72.77
Bowker's High Grade Fertilizer	Townsend	34.00	20.46	66.18
Bowker's High Grade Fertilizer	Woburn	32.00	19.73	62.19
Bowker's 10% Manure	Brookfield	31.00	19.67	57.60
Bowker's Corn Grain and Grass Fertilizer	Holyoke	34 00	20.67	64.49
Bowker's Corn Phosphate	S. Framingham	32.00	16.30	84.66
" " "	Franklin	29.00		
" " "	Lawrence	29 50		
" " "	Orange	30 00		
" " "	N. Adams	30 00		
Bowker's Blood, Bone and Potash	W. Peabody	42 00	26.75	57.01
Bowker's Farm and Garden Phosphate	Brockton	30 50	15.29	97.32
" " " " "	Orange	30 00		
" " " " "	N. Adams	30.00		
Bowker's Complete Alkaline Tobacco Grower	S. Deerfield	35.00	27.72	26.26
Bowker's Potash or Staple Phosphate	Orange	27.00	14.46	86.72
Bowker's Seeding Down Fertilizer	Littleton	32.00	24 33	31.52
Bowker's Potash and Bone	Plymouth	25 00	13 32	87.69
Bowker's Sure Crop Bone Phosphate	Lawrence	26 50	13.31	101.95
" " " " "	Leominster	27 00		
" " " " "	Franklin	26.00		
" " " " "	Palmer	28 00		
Bowker's Bristol Fish and Potash	Dighton	28 00	15 27	83.37
Bowker's Bone and Wood Ash Fertilizer	Adams	*	14.61	—
Bowker's Square Brand Fish and Potash	Northampton	27 00	17.05	58.36
Bowker's Cranberry Phosphate	Cataumet	35 00	19.33	80 60
Bowker's Fish and Potash D Brand	Dighton	31.00	18 22	70.14

* Sold only in Small Packages, 75c for 25 lb. bag

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.	Guaranteed.
				Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
166, 216, 323, 567	12.80	1.24	1.12	2.36	1.65	4.96	2.51	3.35	10.82	8.00	7.47	6.00	2 34	2.00
165, 183, 279, 310	13.69	1.73	1.20	2.93	2.47	7.07	2.04	2.56	11.67	10.00	9.11	9.00	2.38	2.00
942	14.63	1.28	1.19	2.47	2.47	6.69	3.19	2.02	11.90	10.00	9.88	9.00	2.16	2.00
706	14.63	1.33	1.08	2.46	2.47	4.67	4.61	2.02	11.30	10.00	9.28	7.00	4.58	4.00
506	14.39	1.49	.89	2.38	2.47	7.10	2.08	2.10	11.28	10.00	9.18	8.00	3.88	4.00
945	10.36	.45	1.03	1.48	.82	4.73	2.52	2.22	9.47	6.00	7.25	5.00	9.18	10.00
649	14.37	1.24	1.24	2.48	2.47	5.82	4.50	1.48	11.80	9.00	10.32	8.00	3.93	4.00
349, 536, 579, 820, 908	14.03	.85	1.00	1.85	1.65	6.69	1.91	2.61	11.21	9.00	8.60	8.00	2.21	2.00
999	12 11	1.60	2 35	3.95	4.11	5.12	2.08	2 04	9.24	9.00	7.20	7.00	7.06	7.00
137, 833, 937	13.39	.90	.82	1.72	1.65	4.84	3.40	2.56	10.80	9.00	8.24	8.00	2.16	2.00
609	11 13	.85	3.13	4 03	4.00	.55	7.51	4.12	12.18	5.00	8.06	4.00	5 05*	5.00
845	9.39	.48	.33	.81	.82	6.15	3.81	1.84	11.80	9.00	9.96	8.00	3.82	3 00
1010	9 15	.84	1.82	2.66	2.47	2.95	3.67	2.28	8.90	9.00	6.62	6.00	10 25	10.00
136	14.45	.45	.66	1.11	.82	5.95	2.57	2.12	10.64	9.00	8.52	6.00	2.20	2.00
553, 718, 546, 944	9 80	.64	.51	1.15	.82	3.26	5.16	2.94	11.36	9.00	8 42	8.00	2.10	2.00
63	9.75	.75	.93	1.68	1.65	4.67	3.38	3.36	11.41	8.00	3.05	5.00	2.03	2.00
916	13.43	.57	1 08	1.65	1.75	.15	7.37	3.36	10 88	9.00	7.52	7.00	2.29	2 25
267	12 24	.96	1.49	2 45	2.47	1.75	3 29	2.50	7 54	5.00	5 04	4.00	4 04	4 00
.026	15 84	1.44	1 18	2.62	2.47	6.33	3.33	2.22	11 88	12 00	9.66	9 00	2 02	2.00
92	13.02	1.17	1.68	2.85	2.47	3.90	2 72	2.30	8 92	8 00	6 62	3.00	2.26	2 00

No. 609 Chlorine 1.65%, equivalent to 2.21% potash, 1.73% potash present as sulfate, 1.11% potash present carbonate. Total potash soluble in dilute hydrochloric acid 5.73%.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Co. (Concluded.)				
Stockbridge's Spec. Comp. Man. Corn & all Grain " " " " " " " " " " " " " " " "	Dighton S. Framingham S. Deerfield	$37 00 40.00 39.00	$27.58	40.21
Stockbridge's Spec. Comp. Man. Corn & all Grain "	Townsend N. Grafton Munson Milford	39.00 40.00 39 00 39 00	26.07	50.56
Stockbridge's Man. Per. Dressing Fruits, Etc.	Dighton	37.00	22.70	63.00
Stockbridge's Man. Per. Dressing Seeding	Dighton	37.00	22.46	64.74
Stockbridge's Sp. Com. Man. Q'k Growth & Forc. "	Plymouth Amherst S. Framingham Townsend	42.00 40 00 40 00 39.00	27.01	49.01
Stockbridge's Sp. Com. Man. Q'k Gr. Tom. etc.	Dighton	40.00	26.39	51.57
Stockbridge's Sp. Com. Man. Q'k Gr. Grass Top D. "	Dighton Lexington Northampton S. Deerfield N. Grafton Milford	40 00 39 00 36.00 39.00 40 00 39.00	28.12	38.09
Stockbridge's Tobacco Manure	S. Deerfield	45.00	34 66	29.83
Stockbridge's Sp. Com. Man. Potatoes and Veg. "	Dighton Plymouth Springfield Northampton Amherst S. Framingham	37 00 42 00 40 00 36 00 40 00 40.00	26.28	49.05
Stockbridge's Sp. Com. Man. Potatoes and Veg. "	Franklin Townsend Orange Milford Munson	39 00 39 00 40 00 39 00 39 00	26.87	45.89
Joseph Breck & Sons Corp., Boston, Mass.				
Breck's Lawn and Garden Dressing	Taunton	50.00	25.72	94.40
Breck's Market Garden Manure	Boston	34 00	19 14	77.64
Ram's Head Pulverized Sheep Manure	Boston	35.00	12.88	171.74

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
71, 322, 615	9.35	2.28	1.53	3.81	3.29	2.62	3.10	2.23	12.95	11.00	10.72	10.00	6.30	7.00
697, 767, 788, 900	11.07	2.05	1.24	3.29	3.29	4.39	5.82	2.10	12.31	11.00	10.21	10.00	7.02	7.00
80	12.50	1.30	1.30	2.60	2.47	4.50	2.64	1.33	8.52	10.00	7.14	6.00	8.62	10.00
94	13.03	1.30	1.30	2.60	2.47	3.97	1.69	1.63	7.34	9.00	5.66	6.00	9.49	10.00
235, 281, 325, 695	10.36	2.92	1.71	4.63	4.93	3.68	1.84	2.33	7.35	6.00	5.52	4.00	6.38	6.00
73	13.88	2.33	2.07	4.40	4.93	4.80	1.74	1.04	7.58	6.00	6.54	4.00	6.02	6.00
83, 185, 264, 620, 760, 853	15.40	3.19	1.60	4.79	4.93	3.94	2.10	1.48	7.52	6.00	6.04	4.00	7.04	6.00
605	7.46	4.00	1.73	5.73	5.75	3.49	2.19	.79	6.47	6.00	5.68	4.00	10.00*	10.00
62, 192, 219, 263, 284, 329	11.33	1.82	1.46	3.28	3.29	4.58	2.20	1.74	8.52	7.00	6.78	6.00	10.16	10.00
569, 696, 847, 859, 782	11.00	1.40	1.91	3.31	3.29	4.96	2.56	1.00	8.52	7.00	7.52	6.00	10.22	10.00
182	8.37	4.90	—	4.90	4.13	1.25	4.18	1.30	6.73	7.00	5.43	5.00	5.42	5.00
1014	14.39	1.37	1.07	2.44	2.50	7.59	2.05	2.51	12.15	11.00	9.64	9.00	2.24	2.00
168	6.45	—	2.59	2.59	2.67	—	—	—	1.64	1.50	—	—	2.06	1.75

No. 605 Chlorine .77%, equivalent to 1.02% potash, 8.98 potash as sulfate.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation
Buffalo Fertilizer Co., Buffalo, N. Y.				
Farmer's Choice	Mansfield	$27.00	$17.67	52.80
" "	W. Boylston	27.00		
" "	Southbridge	27.00		
Buffalo Fish Guano	Man'f't'r's Sample	—	15.19	—
Celery and Potato Special	Mansfield	36.00	21.37	62.23
" " " "	Southbridge	34.00		
" " " "	Townsend	34.00		
Buffalo Vegetable and Potato	Somerset	32.00	21.44	52.75
" " " "	Mansfield	34.00		
" " " "	Sunderland	32.00		
" " " "	Townsend	33.00		
Buffalo Top Dresser	N. Amherst	37.00	31.10	18.97
Buffalo Top Dresser	Sunderland	39.00	23.75	66.32
" " "	Townsend	40.00		
Buffalo High Grade Manure	N. Amherst	34.00	26.29	29.33
Buffalo High Grade Manure	Amesbury	37.00	26.32	40.58
Buffalo High Grade Manure	Sunderland	36.00	25.84	39.32
Buffalo High Grade Manure	W. Boylston	33.00	26.33	41.63
Buffalo High Grade Manure	Townsend	36.50	18.07	101.99
Buffalo New England Special	Mansfield	30.00	18.87	52.78
" " " "	Amesbury	28.00		
" " " "	Sunderland	27.00		
" " " "	W. Boylston	30.00		
" " " "	Southbridge	29.00		
" " " "	Townsend	29.00		
Buffalo Ideal Wheat and Corn*	Sheffield	27.00	18.76	43.92
Buffalo Tobacco Producer	Sunderland	38.00	25.90	46.71
Coe-Mortimer Co., 24-26 Stone St., New York City.				
Red Brand Excelsior Guano Market Garden	Hadley	37.00	23.18	59.62
Peruvian Vegetable Grower	Grafton Center	40.00	28.12	42.24
High Grade Ammoniated Bone Superphosphate	Grafton Center	31.00	16.47	96.35
" " " " "	Baldwinsville	32.00		
" " " " "	Westfield	34.00		
Excelsior Potato Fertilizer	Dighton	38.00	21.41	77.48
Excelsior Potato Fertilizer	Grafton Center	38.00	22.34	70.09
Columbian Corn and Potato	Westfield	32.00	15.52	106.13

*Name changed to New England Special.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.			
				Found.	Guaranteed.				Found.	Guaranteed	Found.	Guaranteed.	Found.	Guaranteed.
157 741 974	12.50	1.27	.45	1.72	.82	4.26	4.54	1.77	10.57	9.00	8.80	8.00	5.10	5.00
1037	13.61	.74	.44	1.18	.82	6.12	3.43	1.02	10.57	—	9.55	9.00	3.72*	2.00
141 979 952	13.59	1.24	.56	1.80	1.64	4.80	4.16	1.56	10.52	9.00	8.96	8.00	**9.00**	10.00
72 171 431 964	11.83	2.18	.41	2.59	2.45	5.56	3.14	1.87	10.57	9.00	8.70	8.00	**5.84***	7.00
248	3.77	5.73	.25	5.98	5.74	4.52	2.44	1.48	8.44	7.00	6.96	6.00	5.70	5.00
433 953	10.22	2.98	.49	**3.47**	5.74	4.35	4.22	.95	9.52	7.00	8.57	6.00	5.32	5.00
250	9.58	3.05	.40	3.45	3.28	5.03	3.49	1.64	10.16	8.00	8.52	7.00	**8.56**	10.00
370	12.58	3.23	.18	3.41	3.20	4.32	3.34	1.20	8.86	8.00	7.66	7.00	9.86	10.00
428	10.75	3.02	.22	3.24	3.20	3.58	3.74	1.22	8.54	8.00	7.32	7.00	10.31	10.00
742	9.61	2.87	.37	3.24	3.20	4.83	3.85	.84	9.52	8.00	7.68	7.00	10.30	10.00
955	17.15	1.51	.30	**1.81**	3.20	3.25	3.55	3.38	10.18	8.00	**6.80**	7.00	**6.31**	10.00
170 375 424 714 973 954	13.59	1.36	.56	1.92	1.64	5.56	4.32	.69	10.57	10.00	9.88	9.00	5.14	5.00
931	12.80	1.13	.55	1.68	1.64	6.31	3.95	.61	10.87	10.00	10.26	9.00	5.61	5.00
426	6.53	1.38	2.54	**3.92**	4.51	.04	4.39	2.76	7.19	5.00	4.43	—	7.55*	5.50
661	6.84	1.87	1.01	**2.88**	3.30	5.37	1.97	.92	**8.26**	9.00	**7.34**	8.00	8.15	7.00
763	8.20	2.94	.44	3.38	3.30	5.67	3.21	.84	**9.72**	10.00	8.88	8.00	9.44*	9.00
764 323 399	10.27	.67	1.18	1.85	1.85	5.18	2.45	1.56	9.19	9.00	**7.63**	8.00	3.80	3.00
70	8.46	1.23	1.15	2.38	2.47	.80	6.32	1.66	8.78	8.00	7.12	7.00	8.40	8.00
765	8.14	1.96	.63	2.59	2.47	4.67	2.87	.44	7.98	8.00	7.54	7.00	7.94*	8.00
397	9.83	.64	.92	1.56	1.25	5.86	2.79	.87	9.52	9.50	8.65	8.50	3.35	2.50

*No. 1037 Chlorine 2.16%, equivalent to 2.88% potash, .83% potash as sulfate.
72–171–431–964 " 3.86% " " 5.16% " .68% " " "
426 " .93% " " 1.24% " 6.31% " " "
763 " .58% " " .78% " 8.66% " " "
765 " 2.92% " " 3.90% " 4.04% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Coe-Mortimer Co. (Concluded.)				
XXV Ammoniated Bone Phosphate	Springfield	$30.00	$10.80	177.77
Celebrated Potato Special	Grafton Center	32.00	17.43	83.78
" " "	Westfield	34.00		
Gold Brand Excelsior Guano	Dighton	36.00	20.66	71.82
" " " "	Baldwinsville	35.00		
New Englander Corn and Potato Fert.	Springfield	30.00	11.41	162.92
Eastern Chemical Co., Boston, Mass.				
I M P Plant Food	Boston	190.00†	90.95	108.91
Essex Fertilizer Co., 39 N. Market St., Boston.				
Essex Comp. Manure Potatoes, Roots and Veg.	Westport	41.00	28.76	42.56
" " " " " " "	Taunton	40.00		
" " " " " " "	Marlboro	42.00		
Essex Comp. Manure Potatoes, Roots and Veg.	Sterling	39.00	26.17	49.03
Essex Comp. Manure Potatoes, Roots and Veg.	Spencer	40.00	25.99	51.33
" " " " " " "	Leominster	40.00		
" " " " " " "	Gardner	38.00		
Essex Market Garden and Potato Manure	S. Framingham	35.00	19.35	80.87
Essex Market Garden and Potato Manure	Leominster	35.00	18.72	86.97
Essex Market Garden and Potato Manure	Spencer	34.00	18.99	79.04
Essex XXX Fish and Potash	Taunton	30.00	19.11	56.99
" " " " "	S. Framingham	30.00		
Essex XXX Fish and Potash General Crops	Sterling	28.00	18.57	50.78
Essex XXX Fish and Potash	Spencer	30.00	17.39	72.51
Essex Complete Manure Corn, Grain and Grass	Leominster	39.00	26.45	47.44
Essex Complete Manure Corn, Grain and Grass	S. Lowell	40.00	26.40	51.52
Essex Complete Manure Corn, Grain and Grass	Spencer	40.00	26.91	48.64
Essex A1 Superphosphate	S. Framingham	28.00	14.01	98.64
" " "	Leominster	27.50		
" " "	Sterling	28.00		
Essex Lawn Dressing	Taunton	45.00	23.61	90.60
" " "	Leominster	45.00		
Essex Potato Grower	Spencer	40.00	22.97	74.14
Essex Grain and Grass Fertilizer	Sterling	39.00	14.19	174.84
Essex Special Tobacco Manure	S. Lowell	42.00	29.91	40.42
Essex Grass and Top Dressing	S. Lowell	42.00	28.30	48.41
R. & J. Farquhar & Co., Boston, Mass.				
Farquhar's Vegetable and Potato Fertilizer	Boston	42.75	24.18	76.80
Farquhar's Lawn and Garden Dressing	Boston	47.50	25.31	87.67

† Sold for $12.00 per 100 lbs., also put up in tablet form called "Biscuit."

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
988	7.20	.72	.26	.98	.82	4.00	3.55	.82	**8.37**	9.50	**7.55**	3.50	1.55*	1.50
761 911	10.32	1.17	.81	1.98	1.65	6.27	1.72	1.25	9.24	9.00	7.99	8.00	4.01*	4.00
61 795	9.35	1.68	.96	2.64	2.47	2.53	4.68	1.59	**8.80**	9.00	**7.21**	8.00	6.30	6.00
989	10.69	.68	.30	.98	.30	8.75	3.31	.59	**7.65**	3.50	**7.06**	7.50	**2.80***	3.00
1029	.47	12.99	—	12.99	13.00	25.75	.48	—	26.23	25.3	26.23	25.3	25.34†	24.60
107 122 351	3.16	2.14	1.88	4.02	3.25	5.25	1.56	.84	7.65	7.00	6.81	6.00	10.25	10.00
715	5.88	1.40	2.12	3.52	3.25	2.75	3.24	1.48	7.47	7.00	5.99	6.00	**9.75**	10.00
962 723 849	7.63	1.30	2.01	3.31	3.25	2.75	3.31	2.20	8.26	7.00	6.06	6.00	10.04	10.00
347	9.05	1.10	1.19	2.29	2.00	6.30	1.33	.90	9.03	9.00	3.18	8.00	5.14	5.00
722	10.21	.79	1.24	2.03	2.00	6.55	1.65	.94	9.14	9.00	8.20	8.00	5.34	5.00
960	8.76	.95	1.22	2.17	2.00	6.40	1.64	1.00	9.04	9.00	8.04	8.00	5.24	5.00
109 328	8.63	1.23	1.37	2.60	2.00	6.01	2.21	1.61	9.83	9.00	8.22	8.00	3.20	3.00
747	8.71	.55	1.57	2.12	2.10	.32	9.43	4.25	14.00	12.00	9.75	9.00	2.55	2.25
961	8.95	.89	1.24	2.13	2.00	5.54	2.49	2.05	10.08	9.00	8.03	8.00	3.13	3.00
721	9.28	1.17	2.14	3.31	3.28	2.55	4.03	1.36	7.94	7.00	6.58	6.00	10.52	10.00
523	8.23	1.27	2.05	3.32	3.28	4.58	2.04	.40	7.02	7.00	6.62	6.00	10.64	10.00
963	10.43	1.11	2.58	3.69	3.28	5.40	1.00	.84	7.24	7.00	6.40	6.00	**9.39**	10.00
292 724 744	7.65	1.09	.64	1.73	1.20	4.36	2.34	.84	8.04	8.00	7.20	7.00	2.35	2.00
110 746	6.62	3.47	.17	**3.64**	4.00	5.43	2.15	.38	7.96	8.00	7.58	7.00	6.03	6.00
958	9.57	.58	1.90	2.48	2.46	5.05	1.63	.46	7.14	7.00	6.68	6.00	9.90	10.00
720	8.89	.63	.47	1.10	.82	4.85	3.34	1.59	9.78	9.00	8.19	8.00	4.00	4.00
522	6.27	1.32	2.71	4.03	4.00	2.92	3.89	1.25	8.06	7.00	6.81	6.00	**9.76***	10.00
562	11.86	1.99	2.13	4.12	4.00	4.95	2.93	1.08	8.96	8.00	7.88	7.00	8.24	8.00
140	7.63	2.01	1.43	3.44	3.00	6.05	.45	1.10	7.60	7.00	6.50	—	7.43	7.00
143	7.22	2.98	.45	3.43	3.30	1.19	7.13	3.99	12.31	14.00	8.32	4.00	6.98	7.00

* No. 988 Chlorine 1.02%, equivalent to 1.37%, potash. .18% potash as sulfate.
761–911 " 1.57% " " 2.10% " 1.91% " " "
989 " 2.02% " " 2.70% " .10% " " "
† 1029 Potash as nitrate, valued at 5 cts. per pound. No chlorides present.
522 Chlorine 1.01%, equivalent to 1.35% potash. 8.41 potash as sulfate

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
R. & J. Farquhar & Co. (Concluded.)				
Thomson's Improved Vine Plant and Veg. Man	Boston	$ *	$27.73	—
Thomson's Special Crysanthemum Manure	Boston	**	30.70	—
Clay's London Fertilizer	Boston	90 00	25.44	253.77
Hubbard Fertilizer Co., Baltimore, Md.				
Hubbard's Blood, Bone and Potash	Billerica	38 00	24 39	55 80
Hubbard's Royal Ensign	Boston	33 00	19.45	69 67
Hubbard's I. X. L.	Boston	23 00	14.33	83.31
Jordan Marsh Co., Boston, Mass.				
Electroplasm	Boston	***	20 77	--
Lister's Agricultural Chemical Works, Newark, N. J.				
Lister's Special Potato Fertilizer	N. Hanover	31 00	18 58	62 16
" " " "	Pepperell	30 00		
" " " "	Greenfield	27 50		
" " " "	Williamstown	32 00		
Lister's Special Tobacco	Hadley	31 00	19 31	60 54
Lister's Success Fertilizer	N. Hanover	30 00	18 34	60 19
" " "	Hadley	30 00		
" " "	Pepperell	30 00		
" " "	Greenfield	26 50		
Lister's 10% Potato Grower	Hadley	40 00	27 62	44.82
" " " "	Pepperell	40 00		
Lister's High Grade Special for Spring Crops	Pepperell	36 00	22 70	58.59
Lister's Potato Manure	Seekonk	37 00	24 85	54.93
" " "	Hadley	40 00		
Lister's Special Corn Fertilizer	N. Hanover	31 00	17 27	83 38
" " " "	Williamstown	32 00		
" " " "	Milford	32 00		
Jas. E. McGovern, Andover, Mass.				
McGovern's Animal Fertilizer	S. Lawrence	35 00	23 37	49 74
Mapes Formula and Peruvian Guano Co., N. Y. City				
Mapes' Lawn Top Dressing	Taunton	34 00	15 79	115 33
Mapes' Complete Potato Manure	Taunton	42 00	27.48	52 84
" " " "	Manomet	46 00†		
" " " "	Northampton	40 00		
" " " "	Lawrence	40 00		
" " " "	Fitchburg	42 00		
Mapes' Grass and Grain Top Dressing	Taunton	44 00	28 52	51.66
" " " " " "	Northampton	42 00		
" " " " " "	Lawrence	43.00		
" " " " " "	Fitchburg	44 00		

* No. 1005 Sold only in small quantities $6.50 per 112 lbs.
** " 138 " " " " " 13.30 " " "
*** " 1028 " " " " " cans at 15c. each.
† " 179 $42.00 Cash. Boston, Mass.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen Organic.	Nitrogen Total Found.	Nitrogen Total Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash Guaranteed.
1005	7.87	1.75	1.97	3.72	3.50	6.63	3.65	1.59	11.87	12.00	10.28	8.00	6.61*	7.00
138	2.97	1.92	3.23	5.15	4.00	3.81	4.63	4.35	12.79	12.00	8.44	6.50	4.44*	4.50
139	8.17	2.34	3.06	5.40	4.50	.10	5.94	3.38	9.42	8.00	6.04	.75	.30	.25
511	9.68	2.22	1.16	3.38	3.32	5.35	2.89	.69	8.93	8.00	8.24	7.00	6.88	7.00
1015	8.03	1.82	.84	2.66	2.46	3.39	5.00	1.00	9.39	—	8.39	8.00	4.07	4.00
1018	10.88	1.01	.66	1.67	1.64	5.95	2.26	1.18	9.39	—	8.21	8.00	2.45	2.00
1028	11.03	3.29	.47	3.76	3.25	.19	6.57	2.53	9.29	20.25	6.76	20.25	2.39	2.60
564 701 812 851	15.36	1.30	1.03	2.33	1.65	5.99	2.48	2.46	10.93	9.00	8.47	8.00	3.22	3.00
676	10.62	1.31	1.22	2.53	2.06	4.96	3.59	1.94	10.49	8.00	8.55	—	3.08*	3.00
531 677 707 824	14.73	1.48	.84	2.32	1.24	5.86	3.32	2.87	12.05	11.00	9.18	9.00	2.31	2.00
675 704	12.91	3.05	.77	3.82	3.29	4.93	1.80	.95	7.68	9.00	6.73	6.00	10.28	10.00
708	11.09	.92	.88	1.80	1.64	4.58	3.91	2.97	11.46	—	8.49	8.00	10.17	10.00
88 659	12.18	2.19	1.11	3.30	3.30	7.07	1.48	1.33	9.88	9.00	8.55	8.00	7.00	7.00
532 848 902	15.64	1.03	1.04	2.07	1.65	5.95	2.37	2.12	10.44	—	8.32	8.00	3.00	3.00
540	7.87	1.58	1.53	3.11	3.50	.23	11.23	2.64	14.10	10.00	11.46	—	3.17*	5.50
87	8.89	2.71	.14	2.85	2.47	1.41	1.82	1.02	4.25	3.50	3.23	—	3.30	2.50
86 179 276 549 749	7.98	3.77	.33	4.10	3.71	1.85	6.28	1.18	9.31	8.00	8.13	8.00	7.20*	6.00
84 273 542 756	7.56	4.43	.56	4.99	4.94	1.02	5.61	1.51	8.14	6.00	6.63	5.00	7.04	7.00

No. 1005 Chlorine 3.61%, equivalent to 4.82% potash, 1.79% potash as sulfate.
138 " 2.83% " " 3.78% " .66% " " "
676 " .31% " " .42% " 2.60% " " "
540 " .40% " " .55% " 2.62% " " "
86-179-276-549-749 " .70% " " .94% " 6.26% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Mapes Formula & Peruvian Guano Co. (Concluded).				
Mapes' Complete Manure for General Use	Lawrence	$33.00	$23.03	64.64
Mapes' Economical Potato Manure	Fitchburg	39.00	23.26	36.23
" " " "	Baldwinsville	38.00		
Mapes' Economical Potato Manure	Southwick	41.00	26.27	56.07
Mapes' Fruit and Vine Manure	Taunton	43.00	24.91	72.62
" " " " "	Fitchburg	43.00		
Mapes' Corn Manure	Manomet	42.00†	22.12	72.92
" " "	Northampton	37.00		
" " "	Lawrence	36.00		
" " "	Fitchburg	38.00		
Mapes' Cereal Brand	Taunton	32.00	16.26	102.95
" " "	Fitchburg	32.00		
" " "	Baldwinsville	35.00		
Mapes' Veg. Man. or Comp. Manure Light Soils	Manomet	49.00*	28.88	69.67
Mapes' Average Soil Complete Manure	Fitchburg	39.00	25.71	51.69
Mapes' Tobacco Starter Improved	Southwick	33.00	23.03	64.64
Mapes' Cauliflower and Cabbage Manure	Fitchburg	41.00	24.33	63.52
Mapes' Wrapper Brand Tobacco Manure	Hadley	51.00	36.27	40.61
Mapes' Complete Manure A Brand	Fitchburg	38.00	20.63	34.18
Mapes' Tobacco Ash Constituents	Southwick	36.00	26.43	35.95
Mapes' Improved Top Dressing Half Strength	Southwick	35.00	22.83	53.31
Mapes' Complete Manure 10% Potash	Three Rivers	31.00	21.63	43.32
National Fertilizer Co., 92 State St., Boston, Mass.				
Chittenden's Market Garden Fertilizer	New Bedford	—	22.24	41.32
" " " "	Sunderland	30.30		
" " " "	Sunderland	32.00		
" " " "	Upton	32.00		
Chittenden's Market Garden Fertilizer	Milford	35.60	20.10	77.11
Chittenden's Connecticut Valley Tobacco Grower	Hatfield	46.00	32.00	45.31
" " " " "	Sunderland	47.00		
Chittenden's Connecticut Valley Tobacco Starter	Hatfield	46.00	36.32	27.56
" " " " "	Sunderland	47.00		
" " " " "	Sunderland	46.00		
Chittenden's Complete Fertilizer for Roots	Sunderland	35.00	25.93	40.11
" " " " "	Sunderland	36.00		
" " " " "	Leominster	33.00		

† Cash Price $38.00 Boston, Mass.
* " " 45.00 " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Guaranteed.
541	3.70	2.90	.47	3.37	3.29	.87	8.77	1.36	11.00	10.00	9.64	8.00	4.76	4.00
739 821	6.54	3.82	.64	4.46	3.29	.87	3.94	1.71	6.52	6.00	4.81	4.00	8.90*	8.00
898	4.97	3.07	.29	3.36	3.29	1.09	4.46	1.28	6.83	6.00	5.55	4.00	10.28*	8.00
65 738	13.69	1.87	.48	2.35	1.65	1.13	5.93	.79	7.85	7.00	7.06	5.00	11.54*	10.00
164 270 555 731	9.60	2.27	.48	2.75	2.47	.87	6.95	2.87	10.69	10.00	7.82	8.00	6.89	6.00
75 750 796	9.79	1.78	.62	2.40	1.65	.96	4.82	2.64	8.42	8.00	5.78	6.00	3.12	3.00
151	9.59	4.24	.56	4.80	4.94	.70	7.67	1.02	9.39	8.00	8.37	6.00	6.12*	6.00
733	9.56	4.00	.39	4.39	4.12	1.92	5.47	.64	8.03	8.00	7.39	7.00	5.10*	5.00
927	7.50	3.55	.89	4.44	4.12	.10	7.88	1.00	8.98	8.00	7.98	6.00	1.78*	1.00
743	9.06	3.44	.51	3.95	4.12	1.06	5.79	1.13	7.98	6.00	6.85	6.00	6.28	6.00
984	9.91	4.90	1.20	6.10	6.18	.23	4.64	.61	5.48	4.50	4.87	—	11.71*	10.50
751	12.82	2.18	.54	2.72	2.47	1.00	9.77	1.97	12.74	12.00	10.77	10.00	3.22	2.50
877	11.51	.51	.21	.72	.50	.13	4.58	1.97	6.68	5.70	4.71	—	15.28*	15.00
879	6.53	4.81	.17	4.98	4.94	.64	2.97	.79	4.40	4.00	3.61	—	3.02	2.00
1016	4.22	1.79	.52	2.31	2.06	.36	5.17	.92	6.45	5.00	5.53	3.00	10.92	10.00
104 423 430 773	15.94	1.50	1.01	2.51	2.50	6.59	1.80	1.69	10.08	10.00	8.39	8.00	7.17	6.00
863	13.37	1.15	.93	2.08	2.50	5.44	2.98	2.12	10.54	10.00	8.42	8.00	6.32	6.00
12 400	10.20	1.60	3.63	5.23	4.50	.51	2.18	1.84	4.53	4.00	2.69	—	6.58*	3.00
40 391 408	7.00	6.09	2.77	8.86	8.25	.55	2.08	.90	3.53	3.00	2.63	—	3.00	2.50
36 148 753	14.27	2.51	1.24	3.75	3.30	6.84	1.86	1.79	10.49	10.00	8.70	8.00	6.12	6.00

*No. 739–821 Chlorine .99%, equivalent to 1.32% potash. 7.58% potash as sulfate.
898 " .27% " " .36% " 9.92% " " "
65–738 " .88% " " 1.18% " 10.36% " " "
151 " .64% " " .85% " 5.27% " " "
733 " .52% " " .70% " 4.40% " " "
927 " .74% " " .99% " .79% " " "
984 " 1.64% " " 2.19% " 9.52% " " "
877 " 1.68% " " 2.24% " 4.85% " " "
8.19% potash as carbonate. Acid Soluble Potash 15.74.
879 " .48%, equivalent to .64% potash. 2.38% potash as sulfate.
12–400 " None. Potash present as carbonate. Acid soluble potash 7.12%.
40–391–408 " .90%, equivalent to 1.20% potash. 1.80% potash as sulfate.
Acid soluble potash 3.02%.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
National Fertilizer Co., (Concluded.)				
Chittenden's Fish and Potash	N. Hadley	$30.00		
" " " "	N. Hadley	30 00	$21 21	39 39
" " " "	Sunderland	29 00		
Chittenden's Fish and Potash	W. Springfield	32 00	22 03	45 26
Chittenden's Fish and Potash	Hopedale	24 00	22 48	42 34
" " " "	Milford	30 00		
Chittenden's Fish and Potash XXX	N. Bedford	—	22 41	24 94
" " " " "	Upton	28 00		
Chittenden's Complete Tobacco Fertilizer	Hatfield	36 00		
" " " "	N. Hadley	35 00		
" " " "	Hatfield	36 00		
" " " "	W. Springfield	36 00	24 28	47 78
" " " "	Sunderland	35 00		
" " " "	Sunderland	35 00		
" " " "	Bradstreet	36 00		
" " " "	Whately	38 00		
Chittenden's Complete Tobacco Fertilizer	Bradstreet	36 00	24 67	45 93
Chittenden's Ammoniated Bone Phosphate	Leominster	31 00	17 90	73 18
Chittenden's Potato Phosphate	Man'f'trs Sample	—	21.48	—
Chittenden's Tobacco Special with Carbonate	Hadley	35 00	28 40	23 24
Chittenden's High Grade Tobacco Special	Sunderland	35 00	25 99	36.59
" " " " "	Whately	36 00		
Chittenden's Eureka Potato Fertilizer	N. Bedford	—		
" " " "	Milford	37 00	23.65	62.79
" " " "	Hopedale	40 00		
Chittenden's Complete Corn and Grain Fert.	Man'f'trs Sample	—	25 85	—
Natural Guano Co., Aurora, Ill.				
Pulverized Sheep Manure	Worcester	25 00	12 04	107 64
New England Fertilizer Co., Boston, Mass.				
New England High Grade Potato Fertilizer	Billerica	35 00	20.71	66.53
" " " " "	So. Lowell	34 00		
New England Superphosphate	So. Lowell	32 00	19 67	62 68
New England Superphosphate	Southbridge	35 00	19 11	33 15
New England Corn Phosphate	Billerica	30 00		
" " " "	S. Lowell	30 00	15 39	93.01
" " " "	Southbridge	32 00		
New England Potato Grower	So. Lowell	37 00	22 43	64 95

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.		Total.		Phosphoric Acid in 100 lbs.			Total.		Available.		Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
13 49 437	12 59	2 23	1 08	3 31	3 00	4 86	1 49	1 84	8 19	6 00	6 35	—	4 54	4 00
144	12 93	1 49	2 02	3 51	2 88	4 00	2.73	1 77	8 50	7 00	6 73	6 00	4 07	4 00
356 905	11 78	1.41	1 57	2.98	2 85	4 16	2 34	2 12	8 62	7.00	6 50	6 00	6 94	4 00
58 777	10 87	1 72	1 95	3 67	2 50	4 58	1 79	3 81	10 18	6.00	6 37	5 00	3 20	3 00
11 26 31 162 389 440 448 580	11 37	1 94	1 35	3 29	3 30	6.65	2 00	1 71	10 36	10 00	8.65	8.00	5 31*	5 00
459	12 04	2 14	1 18	3 32	3 30	7.71	1 29	1 54	10 54	10.00	9 00	8 00	5.39*	5.00
754	13 35	75	1 28	2 03	1 65	7 59	1.72	2 51	11.82	10.00	9 31	8 00	2.61	2 00
1036	10 71	1 34	1 16	2 50	2.06	2 41	5.55	2 20	10 16	10.00	7 96	8 00	6 83	6 00
992	9 24	2 04	2 44	4 48	4 50	trace	5 81	1 66	7 47	4 00	5 81	3.00	5.50*	5 50
395 588	9 39	1 33	3 25	4 58	4 50	.55	3 88	2 58	7 01	4 00	4 43	3 00	5.16*	5 50
130 854 975	12 28	1 57	1 43	3 00	2 40	4 45	2 28	1 74	8 47	7.00	6.73	6 00	8 26	10 00
1034	8 78	61	2 67	3 28	3.30	7.46	1 42	2 05	10.93	10.00	8 88	8 00	6 88	6 00
694	8 58	—	2 29	2 29	2 50	—	—	—	1 56	1 75	—	—	2 40	1 50
509 510	8 03	1 30	1 12	2 42	2 46	6 31	1 70	1 20	9 21	9 00	8 01	8 00	6 25	6.00
530	9 32	1 15	1 38	2 53	2 46	5 72	2 52	1 10	9.34	10 00	8.24	8 00	4 40	4 00
968	8 39	1 51	90	2 41	2.46	4 58	3 20	2 38	10.16	10 00	7 78	8.00	4 37	4 00
500 574 967	8 78	.92	.84	1 76	1 64	6 50	1 53	1.36	9.39	9 00	8 03	8 00	3 25	3 00
526	7.12	.99	1 43	2 42	2 46	4 22	2 56	.34	7.12	7 00	6.78	6 00	9 79	10 00

No. 11 26 etc. Chlorine .79%, equivalent to 1.06% potash, 4.25% potash as sulfate.
459 " .83% " " 1.11% " 4.28% " " "
992 " .70% " " .94% " 1.06% " " "
3.50% potash as carbonate. Acid soluble potash 6.05%.
395–588 " 1.16%, equivalent to 1.55% potash, 3.61% potash as sulfate

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
New England Fertilizer Co. (Concluded.)				
New England Corn and Grain Fertilizer	S. Lowell	$27.00	$12.42	129.50
" " " " " "	Southbridge	30.00		
New England Potato Fertilizer	Southbridge	33.00	19 13	72.49
Olds & Whipple, Hartford, Conn.				
Complete Tobacco Fertilizer	N. Hadley	36 00	26.25	37.13
Complete Tobacco Fertilizer	Sunderland	36.00	26.14	37.72
" " "	Sunderland	36.00		
" " "	Sunderland	36.00		
Complete Tobacco Fertilizer	Whately	36.00	25.03	46.50
" " "	Whately	37.00		
" " "	Whately	37.00		
Complete Tobacco Fertilizer	S. Deerfield	36.00	26.03	38.30
" " "	N. Hadley	36.00		
" " "	Sunderland	36.00		
High Grade Potato Manure	S. Deerfield	37.00	29.02	27.50
Home Mixture for Onions	Hatfield	34.00	24 31	34.34
" " " "	Sunderland	33 00		
" " " "	Sunderland	33.00		
Home Mixture for Onions	Bradstreet	34.00	25.10	35.46
Home Mixture for Corn and Potatoes	Whately	35 00	26.96	29.82
Fish and Potash	N. Hadley	30.00	19 49	53.93
Home Mixture for Grass	Hatfield	34.00	25.78	31.89
Parmenter & Polsey Fertilizer Co., Boston, Mass.				
A. A. Brand Fertilizer	Marblehead	39 00	27.99	39.34
P. and P. Potato Grower	S. Lowell	37.00	22.50	64.44
Plymouth Rock Brand	Beverly	32.00	19.53	69.63
" " "	S. Lowell	32.50		
" " "	Hopedale	34.00		
" " "	Adams	34.00		
P. and P. Special Potato Fertilizer	S. Lowell	39.50	20.47	83 19
" " " "	Hopedale	40.00		
" " " "	Adams	33.00		
P. and P. Star Superphosphate	S. Lowell	—	15.33	—
P. and P. Potato Phosphate	Adams	39 00	21 19	84.04
R. T. Prentiss, Holyoke, Mass.				
Prentiss' Corn Fertilizer	Holyoke	34 00	22.04	54.26
Prentiss' Corn Fertilizer	W. Springfield	33.00	22.67	45.56
Prentiss' Complete for Top Dressing	Holyoke	40 00	29.68	34.77

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
517 969	7.44	.54	.78	1.32	1.23	5.35	1.66	.97	7.98	8.00	7.01	7.00	2.11	2.00
966	13.18	1.60	1.07	2.67	1.64	3.26	4.00	2.46	9.72	8.00	7.26	7.00	3.80	4.00
20	5.42	2.60	2.51	5.11	4.53	none	3.12	.67	3.79	—	3.12	3.00	5.63*	5.50
33 45 433	7.24	2.59	2.43	5.02	4.53	.29	3.32	.38	3.99	—	3.61	3.00	5.70*	5.50
590 597 619	8.15	2.34	2.63	4.97	4.50	.23	2.76	.41	3.40	—	2.99	3.00	5.03*	5.50
623 638 639	7.77	2.19	2.82	5.01	4.52	.23	3.14	.49	3.86	—	3.37	3.00	5.52*	5.50
614	6.48	1.48	2.17	3.65	3.30	trace	6.83	1.74	8.57	—	6.83	6.00	11.70*	10.00
8 402 631	8.04	1.46	2.17	3.63	3.30	.23	6.34	2.41	8.98	—	6.57	6.00	7.08	6.50
460	6.61	1.46	2.25	3.71	3.30	.19	6.54	3.33	10.06	—	6.73	6.00	6.50	6.50
624	9.26	1.77	2.78	4.55	3.30	trace	6.16	.80	6.96	—	6.16	6.00	6.76	6.00
936	14.89	.94	1.90	2.84	2.50	1.02	5.14	1.36	7.52	—	6.16	5.00	4.25*	3.00
9	7.92	1.62	2.33	3.95	3.30	trace	7.19	2.23	9.42	—	7.19	6.00	6.47	6.00
337	9.08	1.93	2.03	4.01	4.11	5.03	2.83	.97	8.83	8.00	7.86	7.00	8.42	3.00
525	6.54	1.16	1.31	2.47	2.46	4.10	2.28	.64	7.02	7.00	6.38	6.00	9.93	10.00
360 558 852 913	3.58	1.30	1.27	2.57	2.46	5.69	2.42	1.61	9.72	9.00	8.11	8.00	4.00	4.00
560 861 929	9.30	1.03	1.32	2.35	1.64	5.99	1.89	1.20	9.08	7.00	7.88	6.00	6.31	6.00
518	6.86	1.01	.64	1.65	1.64	4.20	2.98	.94	8.12	8.00	7.13	7.00	4.28	4.00
935	8.80	1.46	.97	2.43	2.46	6.69	2.17	1.07	9.93	9.00	8.86	8.00	6.16	6.00
647	9.47	1.62	1.04	2.66	2.87	5.37	2.39	.61	8.37	10.00	7.76	8.00	7.49	8.00
160	8.43	1.68	1.05	2.63	2.88	6.73	1.39	.24	8.36	10.00	8.12	8.00	7.93	8.00
653	9.55	3.52	1.64	5.16	5.76	5.09	1.03	.28	6.40	9.00	6.12	6.00	7.74	8.00

No. 20 Chlorine 1.05%, equivalent to 1.40% potash 4.23%, potash as sulfate.
590–597–619 " 1.08% " " 1.44% " 3.59% " " "
33–45–43 " 1.50% " " 1.99% " 3.71% " " "
623–638–639 " 1.18% " " 1.59% " 3.93% " " "
614 " 7.21% " " 9.63% " 2.07% " " "
968 " .70% " " .94% " 3.31% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation
R. T. Prentiss. (Concluded.)				
Prentiss' Complete for Potatoes and Roots	W. Springfield	$35.00	$27.15	30.75
" " " " " "	Concord	36.00		
Prentiss' Complete for Potatoes and Roots	Holyoke	35.00	25.17	39.05
Prentiss' Complete for Potatoes and Roots	S. Williamstown	35.00	25.72	36.08
Prentiss' Complete for Potatoes and Roots	N. Adams	33.00	23.43	40.85
Pulverized Manure Co., Chicago, Ill.				
Pulverized Sheep Manure	Taunton	30.00	9.73	131.24
" " "	Seekonk	15.00		
Wizard Brand Pulverized Hog Manure	Taunton	30.00	9.13	161.44
" " " " "	Seekonk	13.00		
Wizard Brand Shredded Cattle Manure	Seekonk	13.00	9.43	158.01
" " " " "	Taunton	25.00		
" " " " "	Springfield	35.00		
W. W. Rawson & Co., Boston, Mass.				
Rawson's Wizard Brand Pulv. Sheep Manure	Boston	35.00	11.09	215.59
Rawson's Wizard Brand Cattle Manure	Boston	30.00	9.77	207.06
Roger's Manufacturing Co., Rockfall, Conn.				
Roger's Potato and Vegetable Fertilizer	N. Amherst	32.00	21.55	53.13
" " " " "	Sunderland	32.00		
" " " " "	Worcester	35.00		
High Grade Soluble Tobacco Manure	Sunderland	44.00	38.42	14.36
" " " " "	Sunderland	45.00		
" " " " "	N. Amherst	44.00		
" " " " "	Hadley	43.50		
High Grade Soluble Tobacco Manure	Deerfield	43.50	36.07	20.60
Fish and Potash	Sunderland	30.00	21.73	44.18
" " "	Sunderland	30.00		
" " "	Worcester	34.00		
High Grade Oats and Top Dressing	Sunderland	45.00	37.69	13.52
" " " " " "	Taunton	44.00		
" " " " " "	Sunderland	45.00		
High Grade Oats and Top Dressing	Fitchburg	46.00	33.24	36.83
" " " " " "	Deerfield	44.50		
" " " " " "	Deerfield	46.00		
Roger's All Round Fertilizer	Worcester	32.00	15.78	102.79
High Grade Complete for Corn and Onions	N. Amherst	36.00	25.83	37.17
" " " " " " "	Whately	35.00		
High Grade Complete for Corn and Onions	Fitchburg	41.00	25.91	58.24

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
149 305	7.58	2.09	1.11	3.20	2.88	7.01	1.46	.59	9.06	10.00	8.47	8.00	10.40*	10.00
657	10.12	1.75	1.23	2.98	2.88	5.65	1.05	1.36	8.06	10.00	6.70	8.00	10.31	10.00
829	9.79	1.86	.99	2.85	2.88	7.42	1.48	.26	9.16	10.00	8.90	8.00	10.07	10.00
915	8.69	1.38	1.07	2.45	2.88	6.50	1.00	.30	7.80	10.00	7.50	8.00	10.18	10.00
74 77	9.32	—	2.07	2.07	2.10	—	—	—	.97	1.20	—	—	1.23	1.35
99 101	7.19	—	1.91	1.91	2.10	—	—	—	1.30	1.20	—	—	1.14	1.35
89 111 220	10.51	—	1.96	1.96	2.10	—	—	—	1.36	1.20	—	—	1.16	1.35
169	10.42	—	2.29	2.29	2.10	—	—	—	1.25	1.20	—	—	1.64	1.35
193	8.97	—	2.06	2.06	2.10	—	—	—	1.20	1.20	—	—	1.22	1.35
240 394 634	10.40	1.45	1.03	2.48	2.25	6.08	3.01	1.20	10.29	10.00	9.09	8.00	6.19	5.00
1 241 254 660	7.88	3.31	2.51	5.82	5.00	2.02	6.01	2.43	10.46	8.00	8.03	6.00	11.00*	11.00
836	7.48	2.53	2.84	5.37	5.00	2.02	6.20	1.94	10.16	8.00	8.22	6.00	10.14*	11.00
403 636 691	8.29	1.69	1.68	3.37	3.26	3.49	2.25	1.48	7.22	6.00	5.74	4.00	5.46	3.76
32 85 396	7.39	5.55	1.39	6.94	6.30	4.61	3.17	1.74	9.52	9.00	7.73	7.00	8.15	7.50
755 794 817	9.34	4.57	1.33	5.90	6.30	.74	7.24	1.23	9.21	8.00	7.98	7.00	7.65	7.50
692	10.59	1.20	.53	1.73	1.65	6.18	2.95	1.00	10.13	10.00	9.13	8.00	2.46	2.00
243 622	8.73	2.22	1.50	3.72	3.50	4.35	3.43	1.23	9.01	8.00	7.73	6.00	7.37	7.00
737	7.53	2.43	1.39	3.82	3.60	4.32	3.69	1.20	9.21	8.00	8.01	6.00	6.88	7.00

No. 149–305 Chlorine 7.27%, equivalent to 9.70% potash, .70% potash as sulfate.
1–241–254–660 " .85% " " 1.14% " 9.86% " " "
836 " .98% " " 1.31% " 8.83% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Roger's Manufacturing Co. (Concluded.)				
Potato and Tobacco Manure	Fitchburg	$40.00	$30.05	33.11
" " " "	Deerfield	40.00		
Grass and Grain Fertilizer	Man'f't'r's sample	—	31.51	—
Tobacco Grower	Man'f't'r's sample	—	30.14	—
Rogers & Hubbard Co., Middletown, Conn.				
Hubbard's Oats and Top Dressing	Plymouth	59.00	41.56	40.76
" " " " "	N. Hanover	58.00		
Hubbard's Soluble Tobacco Manure	Whately	46.00	37.49	22.70
Hubbard's Potato Manure	Plymouth	46.00	32.50	35.38
" " "	Whately	42.00		
Hubbard's Potato Phosphate	Plymouth	36.00	23.27	47.51
" " "	N. Hanover	34.00		
" " "	Whately	33.00		
Hubbard's Potato Phosphate	Greenville	34.00	20.73	64.01
Hubbard's Soluble Corn and General Crops	Plymouth	40.00	23.24	67.80
" " " " " "	Williamstown	38.00		
Hubbard's Complete Phosphate	Plymouth	31.00	18.25	64.38
" " "	N. Hanover	29.00		
Hubbard's Complete Phosphate	Greenville	29.00	17.45	66.19
Hubbard's Fruit or Grass and Grain Fert.	Amherst	45.00	30.94	45.44
Hubbard's New Market Garden Phosphate	Plymouth	38.00	23.86	52.97
" " " " "	Whately	35.00		
Hubbard's New Market Garden Phosphate	N. Hanover	37.00	20.89	74.70
" " " " "	Greenville	36.00		
Ross Brothers Co., Worcester, Mass.				
Lawn and Garden Dressing	Worcester	38.00	18.20	108.79
Potato and Vegetable Fertilizer	Worcester	35.00	16.91	106.98
Potato and Vegetable Fertilizer	Worcester	35.00	18.96	84.59
Corn Grass and Grain Fertilizer	Worcester	38.00	22.91	65.86
N. Roy & Son, South Attleboro, Mass.				
Roy's Animal Fertilizer	So. Attleboro	30.00	29.87	.44
Sanderson Fertilizer & Chemical Co., New Haven, C.				
Formula "B" Tobacco Fertilizer	Sunderland	32.30	26.36	24.70
" " " "	Sunderland	34.00		
" " " "	N. Amherst	32.30		
Formula "B" Tobacco Fertilizer	Sunderland	32.30	25.27	27.82
Formula "B" Tobacco Fertilizer	Southwick	33.00	24.52	34.58
Top Dressing for Grass and Grain	Man'f't'r's sample	—	28.65	—

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
735-801	6.50	1.43	2.36	3.79	3.50	3.17	5.35	2 71	11.23	9.00	8.52	7.00	8.98*	8.75
997	6.99	.18	2.84	3.02	3.00	trace	9.50	6.98	16.48	16.00	9.50	—	12.55	12.5
998	7.06	1.85	3.19	5.04	5.00	1.47	4.59	1.23	7.29	5.00	6.06	4.00	6.97*	6.00
203-581	5.03	7.10	.97	8.07	8.50	.23	5.14	2.97	8.34	8.00	5 37	4.50	10.30	8.00
594	9.85	4.45	.44	4.89	5.00	.70	8.82	2.54	12.06	10.00	9.52	7.00	13.14*	10 00
214-592	11.16	4.11	1.40	5.51	5.00	.73	8.18	3.68	12.59	10.00	8.91	6.60	5.62*	5.00
175-535-591	10.02	2.30	.63	2.93	2.00	6.40	3.15	.74	10.29	10 00	9.55	9.00	6 39	5.00
834	9.70	1.59	.58	2.17	2.00	6.31	3.93	.33	10.57	10.00	10.24	9.00	6.11	5.00
234-808	7.41	1.55	.85	2.40	2.50	3.39	4.69	1.59	9.67	8.00	8 08	5.50	9.54	8.00
176-545	5.82	1.36	.56	1.92	1.50	4.26	3.62	.33	8.21	8.00	7.88	7.00	6.39	5.00
304	8.25	1.06	.60	1.66	1.50	4.90	3.65	.23	8.78	8.00	8.55	7.00	5 88	5.00
285	6.85	.96	1.97	2.93	2.20	.13	11.33	3.56	15.02	16.00	11.46	6.50	12.64	12.00
193-583	6.98	2.12	.60	2.72	2.00	3.67	2.80	.59	7.06	7.00	6.47	6.00	10.86	10.00
527-816	6.94	1.47	.49	1.96	2.00	3.71	3.04	.13	6.88	7.00	6.75	6.00	10 45	10.00
685	10.68	1.90	.69	2.59	2.50	trace	5.58	2.43	8.01	6.00	5 58	—	4 65*	5.50
687	10 69	.94	.73	1.67	1.64	6.20	2.20	1.02	9.42	—	8.40	8.00	4.74	5.00
1011	11.06	.61	1.01	1 62	1.64	7.70	1.16	1.10	9.96	—	8.86	8.00	6.39*	5.00
1022	9.78	1.43	1.35	2.78	2.88	6.72	2.16	1.05	9.93	—	8.88	8.00	6.60	8.00
1017	5.58	1.30	2.29	3.59	4.17	trace	16.39	3.84	20.23	16.60	16.39	11.65	4.40	4.16
29-427-439	8.91	1.63	1.57	3.20	3.33	5.60	3.00	2 66	11.26	10.00	8.60	6.00	7 28*	6.00
251	8.65	1.34	1.65	2.99	3.33	5.41	2.68	2.81	10.90	10.00	8.09	6 00	7 20*	6.00
868	8.31	1.41	1.80	3.21	3.33	5.50	1.76	1.36	8.62	10.00	7.26	6 00	6.92*	6.00
1006	10.41	3.34	1.39	4.73	4.00	4.07	3.32	1.18	8.57	—	7.39	7.00	6.32	7.00

No. 735-801	Chlorine	.67%,	equivalent	to	.90%	potash,	8.08%	potash	as sulfate.
998	"	.59%	"	"	.79%	"	6.18%	"	" "
594	"	.97%	"	"	1.30%	"	11.84%	"	" "
214-592	"	.94%	"	"	1.26%	"	4.25%	"	" "
685	"	2.04%	"	"	2.72%	"	1.93%	"	" "
1011	"	3.72%	"	"	4 97%	"	1.42%	"	" "
29-427-439	"	.35%	"	"	.47%	"	6.81%	"	" "
251	"	.43%	"	"	.57%	"	6.63%	"	" "
868	"	1.00%	"	"	1.32%	"	5.60%	"	" "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Sanderson Fertilizer & Chemical Co. (Concluded.)				
Sanderson's Formula "A"	Sunderland	$32.30		
" " "	Sunderland	—		
" " "	Dighton	32.50	$25.99	24.47
" " "	Sunderland	32.30		
" " "	N. Amherst	32.30		
" " "	Whately	34.00		
Sanderson's Formula "A"	Southwick	33.00	23.34	41.39
Sanderson's Formula "A"	Gt. Barrington	35.00	20.37	71.82
Sanderson's Special with 10% Potash	Southwick	33.00	21.45	58.50
" " " " "	Gt. Barrington	35.00		
Sanderson's Potato Manure	Man'f't'r's sample	—	19.13	—
Sanderson's Corn Superphosphate	Gt. Barrington	30.00	15.13	98.28
Atlantic Coast, Bone Fish and Potash	Gt. Barrington	26.00	13.04	99.38
M. L. Shoemaker & Co., Philadelphia, Pa.				
Swift Sure Superphosphate	Sunderland	33.00		
" " "	Hatfield	34.00	26.19	28.87
" " "	Sunderland	35.00		
" " "	Whately	33.00		
Swift Sure Superphosphate	Sunderland	—	24.91	—
Swift Sure Superphosphate	Deerfield	33.00	24.60	34.15
Swift Sure Guano for Truck, Corn and Onions	Man'f't'r's sample	—	19.71	—
Swift's Lowell Fertilizer Co., 40 N. Market St., Bos.				
Swift's Lowell Superior with 10% Potash	Seekonk	40.00		
" " " " " "	S. Lowell	41.50	28.09	47.13
" " " " " "	Turners Falls	42.50		
Swift's Lowell Animal Brand	Sunderland	29.00		
" " " "	Sunderland	—		
" " " "	Brockton	35.00		
" " " "	Lexington	33.00		
" " " "	Mansfield	35.00	21.34	49.40
" " " "	Middleboro	32.00		
" " " "	Sunderland	29.00		
" " " "	Woburn	32.00		
" " " "	Millis	35.00		
Swift's Lowell Animal Brand	Deerfield	30.00		
" " " "	Turners Falls	34.00	23.02	36.10
" " " "	Milford	30.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
23, 39, 93, 417, 429, 600	9.33	1.87	1.76	3.63	3.33	5.05	2.21	2.00	9.26	9.00	7.26	6.00	7.71	6.00
912	10.13	1.67	1.66	3.33	3.33	3.80	3.08	1.40	8.28	9.00	6.88	6.00	6.40	6.00
922	13.56	.71	1.71	2.42	3.33	6.08	2.59	.80	9.47	9.00	8.67	6.00	5.26	6.00
866, 920	7.67	1.07	1.43	2.50	2.47	3.84	1.44	.84	6.12	8.00	5.28	5.00	9.36	10.00
1013	10.90	1.73	.84	2.57	1.67	1.60	5.10	1.82	8.52	—	6.70	5.00	5.27	6.00
921	11.95	.59	1.08	1.67	1.67	5.56	2.21	1.13	8.90	9.00	7.77	7.00	3.02	2.00
933	14.35	.43	1.05	1.48	1.67	.81	3.41	.76	4.98	6.00	4.22	4.00	5.00	4.00
17, 25, 253, 587	9.31	2.36	1.08	3.44	2.88	8.51	2.44	1.66	12.61	12.00	10.95	9.00	4.96*	4.50
44	9.54	2.04	1.01	3.05	2.88	8.44	2.74	1.41	12.59	12.00	11.18	8.00	4.96*	4.50
809	9.04	1.94	1.12	3.06	2.88	8.23	2.26	1.79	12.28	12.00	10.49	9.00	4.97*	4.50
995	7.83	1.53	.67	2.20	1.65	5.05	4.67	1.79	11.51	10.00	9.72	8.00	4.62	5.00
124, 515, 818	8.37	1.86	1.73	3.59	3.69	5.31	2.29	1.36	8.96	8.00	7.60	7.00	10.37	10.00
23, 38, 152, 195, 215, 231, 435, 502, 534	9.15	1.65	1.40	3.05	2.46	6.42	2.33	1.36	10.11	10.00	8.75	8.00	4.25	4.00
805, 806, 976	7.37	.10	2.81	2.91	2.46	5.18	2.40	1.20	8.78	10.00	7.58	8.00	6.33*	4.00

No. 17–25–253–587 Chlorine .33%, equivalent to .44% potash, 4.52% potash as sulfate
44 " .29% " " .39% " 4.57% " " "
809 " .57% " " .76% " 4.21% " " "
805–806–976 " 3.40% " " 4.54% " 1.62% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Swift's Lowell Fertilizer Co. (Continued)				
Swift's Lowell Market Garden Fertilizer	Taunton	$37.00	$29.20	28.42
" " " " "	Woburn	38.00		
Swift's Lowell Potato Phosphate	Brockton	37.00	23.10	55.84
" " " "	Mansfield	37.00		
" " " "	Middleboro	34.00		
" " " "	Springfield	36.00		
Swift's Lowell Potato Phosphate	N. Grafton	35.00	20.46	71.06
" " " "	Turners Falls	36.00		
" " " "	East Cheshire	34.00		
Swift's Lowell Lawn Dressing	Brockton	45.00	26.78	68.03
" " " "	Concord	45.00		
Swift's Lowell Grass Special	Lexington	39.00	26.12	49.30
Swift's Lowell Potato Manure	Millis	32.00	15.08	102.91
" " " "	Holyoke	30.00		
" " " "	Turners Falls	32.00		
" " " "	Milford	28.00		
" " " "	East Cheshire	31.00		
Swift's Lowell Potato Grower	S. Lowell	40.00	24.58	62.73
Swift's Lowell Tobacco Manure	Deerfield	39.00	29.68	31.40
" " " "	Greenfield	39.00		
Swift's Lowell Dissolved Bone and Potash	Millis	30.00	16.32	73.10
" " " " " "	Milford	26.50		
Swift's Lowell Empress Brand	S. Framingham	—	12.83	107.87
" " " "	S. Lowell	27.00		
" " " "	Milford	24.00		
" " " "	Southwick	29.00		
Swift's Lowell Sterling Phosphate	So Lowell	27.00	13.88	87.31
" " " "	Greenfield	25.00		
Swift's Lowell Perfect Tobacco Producer	Sunderland	34.30	28.47	26.97
" " " " "	S. Lowell	38.00		
Swift's Lowell Bone Fert for Corn and Grain	Middleboro	30.00	18.85	64.45
" " " " " " " "	Lexington	30.00		
" " " " " " " "	Woburn	32.00		
" " " " " " " "	Millis	32 00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total.		Water Soluble.	Reverted.	Insoluble.	Total.		Available.			
				Found	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
132, 507	9.12	2.56	2.32	4.88	4.10	4.80	2.85	1.66	9.31	8.00	7.65	7.00	6.09	6.00
154, 212, 230, 260	8.62	1.93	1.11	3.04	2.46	7.33	1.22	1.02	9.57	9.00	8.55	8.00	6.12	6.00
769, 803, 938	7.74	1.28	1.07	2.35	2.46	6.05	1.91	1.30	9.26	9.00	7.96	8 00	6.23	6.00
155, 315	6 95	4 45	.13	4.58	4.10	6.33	1 09	.59	8.01	8.00	7.42	7.00	6.00	6.00
209	8 24	2.06	1.90	3.96	4.00	4.05	3.79	2.02	9.86	8.00	7.84	7.00	6.12	6.00
565, 651, 827, 853, 925	6.38	1.05	.64	1.69	1.64	4.54	2.31	1.00	7.85	8.00	6.85	7.00	4.03	4.00
543	8.83	1.37	1.68	3.05	3.28	4.42	2.08	.43	6.93	7.00	6.50	6.00	9.94	10.00
797, 815	7.22	2 45	1.72	4.17	4.00	3.75	3.13	1.46	8.34	7.00	6.88	6.00	9.25*	10 00
566, 977	8.40	.73	1.15	1.88	1.65	6.01	3.28	1.56	10.85	10.00	9.29	9.00	2.05	2.00
293, 563, 862, 833	7.00	.71	.70	1.41	1.23	5.86	1.35	.90	8.11	8.00	7.21	7.00	2.07	2.00
516, 793	7.37	.51	.51	1.02	.82	4.93	2.93	1.79	9.65	9 00	7.86	8.00	4.12	4.00
413, 521	7.11	2.76	2.28	5.04	4.00	.41	4 89	1.33	6.63	5.00	5.30	4.00	6.33*	6.00
187, 194, 520, 552	8.22	1.69	.86	2.55	1.64	6.12	2.37	1.10	9.59	9.00	8.49	8.00	3.33	3.00

No. 797–815 Chlorine 1.04%, equivalent to 1.39% potash, 7.86% potash as sulfate.
413–521 " .92% " " 1.23% " 5.10% " " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Swift's Lowell Fertilizer Co. (Concluded.)				
Swift's Lowell Bone Fert. for Corn, Grain, etc.	N. Grafton	$32.00	$15.67	100.25
" " " " " " " "	Turners Falls	32.00		
" " " " " " " "	Milford	27.50		
" " " " " " " "	E. Cheshire	34.00		
Swift's Lowell Tobacco Starter	Sunderland	—	19.68	—
Swift's Lowell Special Corn and Veg.	Seekonk	35.00	23.77	47.24
Swift's Lowell Seeding Down Fert.	Marlboro	27.00	20.46	30.84
Swift's Lowell Special Potato Fert.	Beverley	33.00	22.99	56.58
" " " " "	Greenfield	36.00		
" " " " "	Deerfield	35.00		
" " " " "	Milford	35.00		
Whitman & Pratt Rendering Co., Lowell, Mass.				
Corn Success	Billerica	30.00	17.57	70.74
Vegetable Grower	Beverly	36.00	26.04	38.25
Potash Special	Chelmsford	38.00	26.21	44.98
All Crops	N. Amherst	33.00	21.13	56.17
" "	Billerica	33.00		
Potato Manure	Billerica	33.00	21.64	52.49
Wilcox Fertilizer Works, Mystic, Conn.				
Wilcox Fish and Potash	New Bedford	30.00	20.04	42.21
" " " "	Amherst	23.00		
" " " "	Marblehead	28.00		
" " " "	Marblehead	28.00		
Potato, Onion and Vegetable Manure	New Bedford	36.00	27.62	76.21
" " " " "	Amherst	35.00		
" " " " "	Marblehead	35.00		
Potato, Onion and Vegetable Manure	Munson	34.00	25.93	31.12
High Grade Tobacco Special	Amherst	36.00	26.62	35.23
High Grade Tobacco Special	N. Hadley	36.00	25.64	40.40
Wilcox Potato Fertilizer	Amherst	30.00	13.78	51.75
" " "	Munson	27.00		
Wilcox Grass Fertilizer	Seekonk	37.00	26.60	39.09
" " "	Fall River	37.00		
Wilcox Complete Bone Superphosphate	Marblehead	29.00	18.36	60.67
" " " "	Munson	30.00		
A. H. Wood & Co., Framingham, Mass.				
Wood's B. B. Fertilizer	Framingham	30.00	19.53	53.21
Wood's S. P. Fertilizer	Framingham	40.00	27.33	46.35
Wood's 777 Brand Fertilizer	Framingham	45.00	34.69	32.60

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
766 850 855 923	7.85	.82	.95	1.77	1.64	5.25	2.91	1.13	9.29	9.00	8.16	8.00	3.03	3.00
34	9.29	1.29	1.30	2.59	2 46	5.57	2 53	1.08	9.13	—	8.10	8.00	4.34	2.00
125	10 52	1.48	1.50	2 98	3 23	6.37	2.10	1.15	9.62	9.00	8.47	8.00	7 07	7.00
330	9.25	1 39	1 03	2.42	2.47	6 43	2.05	.86	9.34	9.00	8.48	8.00	5 77	6.00
339 314 346 357	7.90	.79	1 60	2.39	2.46	5 37	1.61	.77	7.75	7.00	6.93	6.00	9.98	10.00
512	11.48	.86	.90	1 76	1.64	4.16	4.08	2.48	10.72	10.00	8.24	8.00	4.77	3.00
340	8.19	1.76	1.43	3.19	3.29	4.64	4.19	1.23	10.06	10.00	8.83	8.00	3.86	7.00
1021	6.83	1.86	1.54	3.40	2.38	3.04	4.07	1 28	8.39	8.00	7.11	6.00	9.71	10.00
436 501	11.42	1.49	1 30	2.79	2.46	5.25	3.96	1.87	11.08	11.00	9.21	9.00	4.00	4.00
505	10 45	1.26	1.33	2.59	2.45	4.22	3.10	2.10	9.42	9.00	7.32	7.00	6.97	5.00
67 295 342 348	20 30	1 11	1.98	3 09	2.46	2 11	3.67	2 10	7.88	6.00	5.78	5.00	4 29	3 00
103 287 344	12.12	2.25	1.65	3.90	3.30	6.50	2.00	1.07	9 57	8.00	8.50	7.00	7 38*	6.00
787	9.80	1.87	1.61	3.48	3 30	5.48	3 15	1 94	10.57	8.00	8.63	7 00	6 85*	6.00
302	7.43	1.47	1.83	3 30	3.30	trace	6.86	3.58	10.44	7.00	6.86	5.00	8 79*	7.00
951	6.91	1.67	2.13	3 80	3.30	.19	4.73	5 19	10.11	7.00	4.92	5 00	6.38*	7.00
290 789	14 89	.87	1 46	2 33	2.05	3.07	3.33	2 07	8 47	7.00	6.40	6 00	5 16*	4.50
127 229	9.70	2.86	1.37	4.23	4 11	4 64	2.40	1.66	8 70	7.00	7 04	6.00	6 29*	5 00
343 870	16 60	1 16	1 03	2 19	2.05	6.63	2.23	.56	9.42	9.00	8.86	8 00	4 04	3 00
681	8 09	1.24	.75	1 99	2.50	4.77	4.26	2 20	11.23	11 00	9 03	7 00	5 68	5 00
641	5 23	1 96	1 12	3 08	4.00	3.07	3.02	2.56	8 65	9 00	6.00	6 00	11 46*	12 00
683	6 71	6 41	.10	6 51	7.00	2 47	5.60	1 43	9 50	9 00	8 07	7.00	7 12	7.00

No. 103-287-344 Chlorine 3.55%, equivalent to 4.74% potash 2.64% potash as sulfate.
787 " 3.82% " " 5.11% " 1.74% " " "
302 " 1.74% " " 2.33% " 6.46% " " "
951 " .25% " " .35% " 6.03% " " "
290-789 " 2.56% " " 3.42% " 1.74% " " "
127-229 " 3.36% " " 4.49% " 1.80% " " "
641 " 3.20% " " 4.27% " 7.19% " " "

Fertilizers Furnishing Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
DISSOLVED PHOSPHATE AND POTASH.				
Lister's Agricultural Chemical Works, Newark, N.J.				
Lister's Grass and Grain Fertilizer	Hadley	$23.00	$10.34	122.44
WOOD ASHES.				
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Hard Wood Ashes	W. Newton	16.00	11.53	33.17
Finch, Pruin & Co., Glens Falls, N. Y.				
Lime Ashes	N. Hadley	6.50	5.58	16.49
John Joynt, Lucknow, Ontario, Can.				
Pure Hardwood Ashes	Sunderland	11.00	8.57	28.35
Pure Hardwood Ashes	N. Amherst	12.00	10.66	3.19
Pure Hardwood Ashes	Sunderland	12.00	10.91	10.00
Pure Hardwood Ashes	N. Amherst	12.00	9.98	20.24
Pure Hardwood Ashes	Sunderland	12.50	11.82	5.75
Pure Hardwood Ashes	Deerfield	12.00	11.96	.33
Pure Hardwood Ashes	Sunderland	12.25	9.71	26.16
Pure Hardwood Ashes	Sunderland	12.00	13.70	12.41*
F. R. Lalor, Dunnville, Ontario, Can.				
Hardwood Ashes	Salem	13.00	9.70	34.02
Geo. E. Munroe & Son, Oswego, N. Y.				
Canada Unleached Hardwood Ashes	Sunderland	10.25	9.90	3.53
W. W. Rawson & Co., Boston, Mass.				
Canada Hardwood Ashes	Boston	20.00	11.71	70.79
OTHER BRANDS.				
Bowker Fertilizer Co., Boston, Mass.				
Tobacco Ash Elements	N. Hadley	29.00	22.45	29.93
" " "	N. Hadley	29.00		
" " "	Northampton	29.50		
Tobacco Ash Elements	S. Deerfield	32.00	22.97	34.96
" " "	N. Hadley	29.00		
" " "	Southwick	32.00		

*Valuation in excess of selling price.

Fertilizers Furnishing Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.		Calcium Oxide (Cao) in 100 lbs.
					Total.		Available.				
		Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	
666	15 01	6.01	3.77	1.07	10.35	11 00	9.78	10.00	2.23	2.00	—
1001	7.17	—	—	—	1.77	1.00	—	—	5.41	4.00	27.32
10	1 21	—	—	—	.03	—	—	—	.76	—	63.39
51	15 94	—	—	—	1.13	1.00	—	—	3.55	4.00	32.03
52	13.11	—	—	—	1.24	1.00	—	—	4.71	5 00	34.95
245	13.91	—	—	—	1.23	1.00	—	—	5.12	5 00	23.65
256	25.61	—	—	—	1.15	1.00	—	—	4.49	5.00	31.04
416	21.39	—	—	—	.82	1.00	—	—	5.70	6.00	32.44
822	15.37	—	—	—	.95	1 00	—	—	5.62	6.00	35.32
53	15.93	—	—	—	1.15	1.00	—	—	4.29	4.00	31.33
55	19 36	—	—	—	1.37	1 00	—	—	6.98	4.00	25 19
333	13 65	—	—	—	1.56	1.00	—	—	4.10	5.00	32.41
54	12.23	—	—	—	.97	1.00	—	—	4.39	4.00	33.30
131	7 61	—	—	—	1.79	1.50	—	—	5 10	5 00	36.43
27 30 272	7.15	.45	6.37	4.20	11.02	—	6.83	6.00	16.10	15.00*	—
612 626 880	7.09	.47	6.69	3.63	10.34	—	7.17	6.00	16 56	15 00*	—

* No. 27–30–272 Potash as Sulfate. Acid Soluble Potash 17.43%.
612–626–880 " " " " " 17.95%.

NOTE.—The potash in the Ashes is largely present as Carbonate and has been valued at 8 cts. per pound. The lime in the ashes has been valued at the same price per pound as for agricultural lime namely, .0034 cts. per pound of actual calcium oxide

Fertilizers Manufactured for Private Use, Officially Collected (Not Licensed.)

Name of Manufacturer and Brand.	Where Sampled.	Manufacturer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works, Baltimore, Md.				
Buyer's Mixture	Hadley	$37.50	$31.11	20.54
Grass Grower	Springfield	28.00	13.39	109.11
Berkshire Fertilizer Co., Bridgeport, Conn.				
Hibbard's Special Onion Mixture	N. Hadley	33.00	28.71	14.94
Bowker Fertilizer Co., Boston, Mass.				
Special Potato Mixture	N. Wilbraham	41.00	30.07	36.35
Potato Mixture	N. Wilbraham	36.00	27.77	29.63
Corn Mixture	N. Wilbraham	35.00	24.30	44.03
Coe-Mortimer Co., New York City.				
Cowl's Special No. 1	N. Amherst	—	29.11	—
" " "	N. Amherst	—		
Cowl's Special No. 2	N. Amherst	—	26.79	—
" " "	N. Amherst	—		
" " "	N. Amherst	—		
Peruvian Market Garden Manure	Hadley	47.50	39.59	19.98
Peruvian Grass and Grain	Hadley	56.00	42.21	32.66
Peruvian Grass Top Dressing	Hadley	55.00	38.65	42.30
Standard Potato Fertilizer	Hadley	37.00	24.32	52.14
Peruvian Guano, Chincha Grade	Sunderland	45.00	33.41	33.09
" " " "	N. Hadley	43.25		
Peruvian Guano Lobos Grade	Westfield	38.00	23.48	61.83
Potato Manure Double Strength	Chicopee	37.00	28.27	30.88
Kidder's Special Mixture	Sunderland	33.00	26.48	24.62
Carter's Mixture	W. Springfield	—	26.48	—
Hobart's Special Mixture	N. Amherst	—	39.18	—
Ellis-Chalmers Co., Dedham, Mass.				
Plant Blood	Boston	**	27.54	—
Mitchell Fertilizer Co., Tremley, N. J.				
Mitchell's Vegetable Fertilizer	Seekonk	38.00	24.40	55.74
Mitchell's Special Fertilizer	Seekonk	38.00	27.46	38.38
Olds and Whipple, Hartford, Conn.				
High Grade Peruvian Guano	Whately	45.00	33.27	35.26
Sanderson Fertilizer & Chemical Co., New Haven				
Home Mixture for Grass	Bradstreet	34.00	30.51	11.44
Home Mixture for Onions	Bradstreet	31.50	30.17	4.41
M. L. Shoemaker & Co., Philadelphia, Pa.				
Warner Brother's Special Mixture	Sunderland	—	39.14	—
Whitman & Pratt Rendering Co., Lowell, Mass.				
Parson's Formula	Northampton	34.00	29.20	16.44
Hubbard's Special Mixture	N. Amherst	34.00	26.58	27.92
Buckeye Cotton Oil Co., Augusta, Ga.				
Cottonseed Meal	Bedford	33.00	21.96	50.27
Cottonseed Meal	Sunderland	32.00	27.09	18.12
Florida Cotton Oil Co., Jacksonville, Fla.				
Cottonseed Meal	Mansfield	32.00	22.15	44.47
Coe-Mortimer Co., New York City				
Nitrate of Potash	W. Springfield	—	31.32	—
Nitrate of Potash	Chicopee	33.00	31.77	7.62
Mitchell Fertilizer Co., Tremley, N. J.				
Nitrate of Soda	Seekonk	55.00	50.69	8.50
GROUND BONE.				
New England Fertilizer Co., Boston, Mass.				
Ground Bone	Southbridge	30.00	24.12	24.38
N. Roy & Son, So. Attleboro, Mass.				
Ground Bone	S. Attleboro	25.00	25.35	1.38*

* Valuation in excess of selling price.
** Sold only in small 10c. packages.

Fertilizers Manufactured for Private Use, Officially Collected (Not Licensed.)

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed	Potash (K_2O) in 100 lbs. Found.	Guaranteed.
673	8.32	2.51	1.00	3.51	4.00	9.02	2.22	1.02	12.26	—	11.24	11.00	9.86*	10.00
262	8.57	.30	1.01	1.31	1.65	6.18	2.24	.56	8.98	8.50	8.42	8.00	2.12	2.00
19	8.61	1.10	2.24	3.34	3.30	6.40	2.68	.67	9.75	—	9.08	8.00	9.46*	10.00
785	7.64	2.47	1.26	3.73	3.81	6.31	2.52	.46	9.29	8.00	8.83	6.00	10.05*	10.00
786	7.56	1.53	1.69	3.22	2.98	5.28	2.83	.31	8.42	8.00	8.11	6.00	10.21*	10.00
781	11.25	1.78	1.26	3.04	2.98	3.58	4.60	2.36	10.54	10.00	8.18	8.00	7.58	7.00
405, 407	7.28	3.15	.99	4.14	4.00	4.09	3.08	1.15	8.32	7.00	7.17	—	8.94*	8.00
404, 414, 415	6.58	3.26	.93	4.19	4.00	3.81	2.38	.92	7.11	6.00	6.19	6.00	7.14*	6.00
667	8.87	5.09	.97	6.06	5.74	5.12	3.43	1.28	9.83	9.00	8.55	8.00	11.90*	10.00
668	5.65	6.60	2.40	9.00	9.00	.45	3.77	2.02	6.24	6.00	4.22	4.50	7.22*	6.00
671	5.40	6.11	2.32	8.43	9.00	none	5.33	1.40	6.73	6.00	5.33	4.50	5.12*	6.00
662	5.56	2.02	1.03	3.05	3.30	3.62	2.62	.69	6.93	7.00	6.24	6.00	10.03	10.00
335, 629	8.87	6.18	.56	6.74	7.00	2.15	6.37	3.28	11.80	8.50	8.52	6.50	2.88*	2.00
910	10.95	1.71	.90	2.64	2.90	5.03	6.25	2.64	13.92	14.00	11.28	8.00	5.50	4.75
161	6.84	2.53	.85	3.38	3.70	4.77	2.39	.90	8.06	8.50	7.16	7.00	10.78*	10.00
390	9.40	3.06	.48	3.54	3.50	6.52	2.67	.97	10.16	—	9.19	8.00	6.84*	7.00
147	.06	2.27	—	2.27	—	none	6.96	5.88	12.84	—	6.96	—	11.65*	—
301	8.12	2.86	3.27	6.13	5.00	5.92	.63	.20	6.75	—	6.55	5.60	11.88*	11.00
1031	9.43	3.40	1.46	4.86	4.00	1.54	7.42	.10	9.06	6.50	8.96	6.00	3.98*	3.00
102	13.64	2.11	1.27	3.38	3.29	6.40	2.06	1.00	9.46	9.00	8.46	8.00	6.40	6.00
121	12.19	2.38	1.53	3.91	4.11	7.13	1.69	.86	9.68	9.00	8.82	8.00	7.46	8.00
602	7.98	6.43	.55	6.98	7.00	1.66	7.09	2.25	11.00	8.00	3.75	—	2.40*	2.00
461	9.48	2.95	.06	3.01	—	4.61	2.15	.43	7.19	—	6.76	—	17.50	—
465	9.52	2.06	2.21	4.27	—	3.65	4.30	1.82	9.77	—	7.95	—	8.89*	—
386	2.05	2.16	2.76	4.92	—	.51	8.14	5.22	13.87	—	8.65	—	13.24*	—
278	8.56	1.63	1.05	2.68	—	5.28	6.21	1.05	12.54	14.00	11.49	12.00	11.06*	10.00
434	6.04	1.53	1.09	2.62	2.47	6.43	3.68	1.71	11.82	11.00	10.11	9.00	9.00*	9.00
226	8.37	—	—	5.78	6.24	—	—	—	—	—	—	—	—	—
399	3.11	—	—	7.13	6.17	—	—	—	—	—	—	—	—	—
156	8.36	—	—	5.83	6.18	—	—	—	—	—	—	—	—	—
143	2.35	—	—	11.58	11.5	—	—	—	—	—	—	—	43.11	44.00
158	2.43	—	—	11.72	11.5	—	—	—	—	—	—	—	43.09	44.00
119	2.90	—	—	15.36	15.80	—	—	—	—	—	—	—		
													Mechanical Analysis Fine Bone	Coarse Bone
965	8.75	—	—	2.47	2.46	—	—	—	24.06	22.00	—	—	56.77	43.23
1019	6.23	—	—	4.67	—	—	—	—	18.66	—	—	—	16.34	83.66

* Nearly all of the potash present as sulfate.

Ground Bone.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co., Boston, Mass				
Fine Ground Bone	Westport	$30.00	$23.61	26.00
" " "	Amherst	30.00		
" " "	Leominster	27.00		
" " "	Milford	32.00		
Armonr Fertilizer Works, Baltimore, Md.				
Armour's Bone Meal	Marlboro	35.00	23.34	34.23
" " "	S. Deerfield	30.00		
" " "	N. Adams	31.00		
Beach Soap Co., Lawrence, Mass.				
Beach's Fertilizer Bone	Lawrence	26.00	26.50	1.89*
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Ground Bone	Dighton	30.00	23.13	27.97
" " "	Middleboro	30.00		
" " "	Plymouth	30.00		
" " "	Milford	29.00		
" " "	Brookfield	29.00		
Bowker's Market Bone	Milford	27.00	18.97	42.33
Buffalo Fertilizer Co., Buffalo, N. Y.				
Buffalo Bone Meal	Pepperell	30.00	25.53	17.51
John C. Dow Co., Boston, Mass.				
Dow's Pure Ground Bone	Boston	32.00	24.51	30.56
Essex Fertilizer Co., Boston, Mass.				
Essex Ground Bone	Taunton	30.00	24.88	20.58
R. & J. Farqnhar & Co., Boston, Mass.				
Farquhar's Ground Bone	Boston	28.50	21.36	33.43
Thomas Hersom & Co., New Bedford, Mass.				
Pure Bone Meal	New Bedford	28.00	25.34	10.50
Home Soap Co., Worcester, Mass.				
Pure Ground Bone	Worcester	28.00	25.32	10.58
" " "	N. Grafton	28.00		
The Geo. E. Marsh Co., Lynn, Mass.				
Marsh's Pure Ground Bone Meal	Concord	33.00	26.56	20.43
" " " " "	Salem	31.00		
D. M. Monlton, Munson, Mass.				
Ground Bone	Munson	30.00	24.21	23.92
National Fertilizer Co., Boston, Mass.				
Chittenden's Fine Ground Bone	Man'f't'r's Sample	—	24.56	—
W. W. Rawson & Co., Boston, Mass.				
Rawson's Fine Ground Bone	Boston	32 00	23.55	35.33
Rogers Manufacturing Co., Rockfall, Conn.				
Pure Knuckle Bone Flour	Whately	34.00	31.55	7.77
Pure Ground Bone	Man'f't'r's Sample	—	31.68	—
Rogers & Hubbard Co., Middletown, Conn.				
Hubbard's Raw Knuckle Bone Flour	E. Milton	39.00	29.67	31.45
Hubbard's Strictly Pure Fine Bone	W. Peabody	36.00	27.09	32.89
Sanderson Fert. & Chemical Co., New Haven, Conn.				
Sanderson's Fine Ground Bone	Southwick	30.00	24.42	22.85

* Valuation in excess of selling price.

Ground Bone.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Coarse Bone.
90 291 734 890	8.39	—	—	2.69	2.47	—	—	—	21.85	22.80	—	—	60.98	39.02
324 618 936	9.32	—	—	2.48	2.47	—	—	—	22.24	24.00	—	—	75.42	24.58
[5.56	7.32	—	—	3.45	3.00	—	—	—	23.59	20.00	—	—	46.30	53.70
60 173 225 903 947	8.50	—	—	2.71	2.47	—	—	—	20.80	22.80	—	—	64.03	35.97
834	6.49	—	—	2.29	1.65	—	—	—	16.52	20.00	—	—	67.10	32.90
1003	7.32	—	—	2.72	2.87	—	—	—	23.82	22.00	—	—	71.10	28.90
183	6.58	—	—	2.59	1.65	—	—	—	24.16	24.00	—	—	55.08	44.92
134	10.56	—	—	2.40	2.50	—	—	—	26.54	23.00	—	—	44.00	56.00
142	10.88	—	—	2.19	2.47	—	—	—	21.50	22.8	—	—	53.34	46.66
114	9.72	—	—	2.64	2.29	—	—	—	25.05	28.00	—	—	56.76	43.24
690 759	6.00	—	—	2.41	2.00	—	—	—	25.84	23.00	—	—	61.58	38.42
317 381	4.41	—	—	2.38	2.46	—	—	—	27.45	23.00	—	—	66.82	33.18
792	10.10	—	—	4.26	4.49	—	—	—	18.96	19.00	—	—	14.62	85.38
1035	8.96	—	—	2.90	2.47	—	—	—	21.70	22.80	—	—	67.66	32.34
184	6.82	—	—	2.65	2.47	—	—	—	22.08	22.80	—	—	59.39	40.61
598	10.57	—	—	3.94	3.94	—	—	—	25.48	25.00	—	—	80.70	19.30
996	8.78	—	—	3.60	3.00	—	—	—	26.48	22.00	—	—	94.37	5.63
1023	9.40	—	—	3.33	3.50	—	—	—	25.16	24.50	—	—	60.53	39.47
1027	8.36	—	—	4.19	3.25	—	—	—	20.60	22.00	—	—	48.08	51.92
867	7.71	—	—	2.93	2.47	—	—	—	21.22	20.00	—	—	68.90	31.10

Ground Bones, Dissolved Bones and Tankage.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
GROUND BONES.				
M. L. Shoemaker & Co., L't'd., Philadelphia, Pa.				
Swift Sure Bone Meal	Sunderland	$33.00	$33.60	1.79*
" " " "	Sunderland	33.00		
Springfield Rendering Co., Springfield, Mass.				
Steamed Bone Ground	Brightwood	27.50	28.63	3.95*
Raw Bone Meal	Brightwood	32.50	28.82	12.77
Thomas L. Stetson, Randolph, Mass.				
Pure Ground Bone	Brockton	33.00	26.07	30.42
" " "	Man't'rs sample	35.00		
Swift's Lowell Fert. Co., Boston, Mass.				
Swift's Lowell Ground Bone	Springfield	34.00	27.83	7.80
" " " "	Lexington	29.00		
" " " "	Beverly	23.00		
" " " "	Millis	—		
" " " "	Fitchburg	29.00		
Patron's Co-operative Association, Boston, Mass.				
Steamed Bone	Sunderland	25.00	26.43	5.41*
Steamed Bone	Sunderland	25.00	26.71	6.40*
A. L. Warren, Northboro, Mass. Warren's Ground Bone	Man'f't'r's sample	27.00	25.44	6.13
Sanford Winter, Brockton, Mass. Winter's Ground Bone	Man'f't'r's sample	—	26.60	—
DISSOLVED BONES.				
W. H. Abbott, Holyoke, Mass.				
Abbott's Animal Fertilizer	Sunderland	27.00	23.57	13.49
" " "	Bradstreet	27.00		
" " "	Whately	26.00		
" " "	Whately	27.00		
Bowker Fertilizer Co., Boston, Mass. Bowker's Dissolved Ground Bone	Bridgewater	29 00	20.35	42 51
Swift's Lowell Fertilizer Co., Boston, Mass. Swift's Lowell Dissolved Bone	Taunton	24 00	13 15	32.23
TANKAGE.				
Bowker Fertilizer Co., Boston, Mass. Bowker's "6 and 30" Tankage	Northampton	23.00	25.12	11.46
Thomas Hersom & Co., New Bedford, Mass. Meat and Bone	New Bedford	28.00	25.34	10.50
Geo. E. Marsh Co., Lynn, Mass. Ground Tankage	Concord	36.00	26.68	34.93
Olds & Whipple, Hartford, Conn. Pulverized Meat and Bone	N. Hadley	34 00	38 02	10.57*
Sanderson Fertilizer & Chemical Co., New Haven Blood, Bone and Meat	Bradstreet	33 50	30.93	3.31
Springfield Rendering Co., Springfield, Mass. Ground Tankage	Brightwood	32 50	33 83	4.07*

* Valuation in excess of selling price.

Ground Bones, Dissolved Bones and Tankage

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.: Water Soluble.	Nitrogen in 100 lbs.: Organic.	Nitrogen in 100 lbs.: Total. Found.	Nitrogen in 100 lbs.: Total. Guaranteed.	Phosphoric Acid in 100 lbs.: Water Soluble.	Phosphoric Acid in 100 lbs.: Reverted.	Phosphoric Acid in 100 lbs.: Insoluble.	Phosphoric Acid in 100 lbs.: Total. Found.	Phosphoric Acid in 100 lbs.: Total. Guaranteed.	Phosphoric Acid in 100 lbs.: Available. Found.	Phosphoric Acid in 100 lbs.: Available. Guaranteed.	Mechanical Analysis. Fine Bone.	Mechanical Analysis. Coarse Bone.
22 337	4.43	—	—	5.53	4.53	—	—	—	22.39	20.00	—	—	60.31	39.69
990	3.20	—	—	3.35	2.47	—	—	—	23.54	23.00	—	—	89.75	10.25
991	7.64	—	—	3.38	3.90	—	—	—	25.12	25.00	—	—	45.16	54.84
232 653	12.87	—	—	4.13	4.20	—	—	—	21.86	20.66	—	—	19.61	80.39
139 197 363 533 757	4.38	—	—	3.05	2.47	—	—	—	24.84	23.00	—	—	79.37	20.63
393	3.83	—	—	2.00	2.47	—	—	—	28.31	22.9	—	—	72.74	27.26
406	3.52	—	—	1.99	2.47	—	—	—	29.00	22.9	—	—	76.24	23.76
625	3.43	—	—	2.14	3.70	—	—	—	26.60	22.78	—	—	72.83	27.12
635	12.15	—	—	3.03	3.00	—	—	—	25.08	25.00	—	—	52.26	47.74
419 446 536 539	12.35	1.44	1.97	3.41	3.00	1.66	11.69	3.43	16.78	15.00	13.35	12.00	—	—
1020	7.00	.43	1.53	2.06	2.47	trace	13.42	3.32	21.74	22.8	13.42	5.00	—	—
64	10.93	1.25	.90	2.15	1.64	2.63	9.66	3.94	16.28	14.00	12.34	12.00	—	—
269	14.51	—	—	5.31	4.94	—	—	—	12.06	13.73	—	—	44.29	55.71
115	6.15	—	—	4.66	4.66	—	—	—	15.86	16.34	—	—	44.70	55.30
316	6.76	—	—	5.30	6.99	—	—	—	14.02	11.45	—	—	51.29	48.71
630	9.90	—	—	8.93	7.20	—	—	—	9.88	9.16	—	—	71.40	28.60
445	9.75	—	—	6.53	5.76	—	—	—	12.72	10.00	—	—	62.09	37.91
937	7.35	—	—	7.40	4.11	—	—	—	11.44	14.00	—	—	73.71	26.29

Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
TANKAGE.				
Swift's Lowell Fertilizer Co., Boston, Mass.				
Swift's Lowell Ground Tankage	Springfield	$30.00	$28.55	5.08
" " " "	Marblehead	31.00		
" " " "	S. Lowell	29.00		
J. M. Woodard, Greenfield, Mass.				
Unground Tankage	Greenfield	20.00	27.61	27.56*
Worcester Rendering Co., Worcester, Mass.				
Ground Tankage	Man'f't'r's sample	30.00	32.65	8.12*
DRY GROUND FISH.				
American Agricultural Chemical Co., Boston, Mass.				
Ground Fish	Bradstreet	40.00	35.81	11.71
" "	N. Hadley	40.00		
Bowker Fertilizer Co., Boston, Mass.				
Dry Ground Fish	Dighton	42.00	35.69	12.08
" " "	Springfield	40.00		
" " "	Northampton	38.00		
" " "	Amherst	40.00		
National Fertilizer Co., Boston, Mass.				
Chittenden's Dry Ground Fish	N. Hadley	38.00	34.96	8.70
Chittenden's Dry Ground Fish	Hatfield	38.00	36.72	3.49
Chittenden's Dry Ground Fish	Sunderland	39.00	34.82	12.00
Chittenden's Dry Ground Fish	Sunderland	38.00	36.49	4.13
Chittenden's Dry Ground Fish	Sunderland	39.00	35.52	9.80
Chittenden's Dry Ground Fish	Bradstreet	40.00	36.23	10.41
Chittenden's Dry Ground Fish	Bradstreet	40.00	35.97	11.20
Chittenden's Dry Ground Fish	Bradstreet	40.00	36.34	10.07
Olds & Whipple, Hartford, Conn.				
Dry Ground Fish	Sunderland	38.00	31.40	21.02
Dry Ground Fish	Whately	38.00	38.68	1.76*
Patron's Co-operative Association, Boston, Mass.				
Dry Ground Fish	Sunderland	35.50	37.92	6.38*
Dry Ground Fish	S. Deerfield	34.60	39.50	12.41*
Rogers Manufacturing Co., Rockfall, Conn.				
Dry Ground Fish	Deerfield	40.00	32.96	18.33
" " "	Deerfield	38.00		
Sanderson Fert. and Chem. Co., New Haven				
Fine Ground Fish	Sunderland	38.00	38.75	1.94*
Fine Ground Fish	Bradstreet	40.00	38.25	4.58
Wilcox Fertilizer Works, Mystic, Conn.				
Dry Fish Guano	N. Amherst	40.00	36.35	10.04
Dry Ground Fish Guano	Somerset	40.00	36.83	8.61
" " " "	Fall River	40.00		
" " " "	Amherst	40.00		
Acidulated Fish	Fall River	38.00	33.32	14.05

* Valuation in excess of selling price.

Tankage and Dry Ground Fish.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen: Organic.	Nitrogen Total: Found.	Nitrogen Total: Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid Total: Found.	Phosphoric Acid Total: Guaranteed.	Phosphoric Acid Available: Found.	Phosphoric Acid Available: Guaranteed.	Mechanical Analysis. Fine Bone.	Mechanical Analysis. Coarse Bone
258, 364, 519	8.55	—	—	5.63	5.00	—	—	—	15.36	14.00	—	—	47.61	52.39
839	7.04	—	—	5.60	4.00	—	—	—	16.74	20.00	—	—	25.84	74.16
904	5.73	—	—	6.06	5.00	—	—	—	16.35	15.00	—	—	76.37	23.63
40, 663	11.68	—	—	8.23	8.23	.15	5.37	1.64	7.16	7.00	5.52	—	—	—
32, 190, 263, 232	10.95	—	—	8.13	8.23	.45	5.19	1.54	7.18	7.00	5.64	—	—	—
13	9.05	—	—	8.17	8.24	trace	4.40	2.08	6.48	6.00	4.40	—	—	—
41	9.17	—	—	8.53	8.24	trace	4.98	2.04	7.02	6.00	4.98	—	—	—
338	9.26	—	—	8.17	8.24	.30	3.94	1.92	6.16	6.00	4.24	—	—	—
422	10.09	—	—	8.55	8.24	.10	4.70	1.58	6.38	6.00	4.80	—	—	—
425	11.74	—	—	8.25	8.24	.25	5.05	1.08	6.38	6.00	5.30	—	—	—
451	12.05	—	—	8.35	8.24	.20	5.62	1.02	6.84	6.00	5.82	—	—	—
464	10.04	—	—	8.38	8.24	.20	4.56	1.94	6.70	6.00	4.76	—	—	—
475	10.24	—	—	8.45	8.24	.26	4.80	1.64	6.70	6.00	5.06	—	—	—
15	10.29	—	—	6.16	6.50	trace	8.92	4.38	13.30	12.00	8.92	—	—	—
535	15.51	—	—	8.42	9.05	trace	8.96	1.02	9.98	6.00	8.96	—	—	—
412	9.77	—	—	7.50	8.24	.83	11.77	1.30	13.90	12.36	12.60	—	—	—
606	9.33	—	—	8.02	8.24	.93	10.89	1.66	13.43	12.36	11.82	—	—	—
825, 837	12.95	—	—	7.67	7.82	2.02	2.76	.66	5.44	5.00	4.78	—	—	—
246	15.50	—	—	8.62	8.23	.63	6.33	2.56	9.57	6.00	7.01	—	—	—
444	16.17	—	—	8.66	8.23	trace	6.53	1.82	8.40	6.00	6.58	—	—	—
14	9.82	—	—	8.62	8.50	.36	3.83	1.46	5.70	6.00	4.24	4.00	—	—
97, 228, 300	10.35	—	—	8.60	8.50	.32	4.76	1.40	6.48	6.00	5.08	4.00	—	—
221	12.94	—	—	7.69	7.81	2.05	3.31	.34	5.70	5.00	5.36	4.00	—	—

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble.	Nitrogen in 100 lbs. Found. Organic.	Nitrogen in 100 lbs. Guaranteed.
SULPHATE OF AMMONIA.									
Amer. Agric. Chem. Co., Boston									
Sulphate of Ammonia	Boston	$75.00	$70.58	6.26	167	.70	20.76	—	20.50
Bowker Fert. Co., Boston, Mass.									
Sulphate of Ammonia	Man'f's. Sample	—	70.13	—	1041	.75	20.64	—	19.00
Swift's Lowell Fert. Co., Boston, Mass.									
Sulphate of Ammonia	Marblehead	70.00	70.21	.30*	366	1.23	20.65	—	20.00
NITRATE OF SODA.									
Amer. Agric. Chem. Co., Boston									
Nitrate of Soda	New Bedford	55.00	50.49	3.98	68	2.34	15.30	—	15.00
" " "	Somerset	53.00			95				
" " "	S. Amherst	52.00			454				
" " "	Milford	50.00			372				
Bowker Fertilizer Co., Boston, Mass.									
Bowker's Nitrate of Soda	Dighton	51.00	50.26	.82	81	2.18	15.23	—	15.00
" " " "	Amherst	52.00			308				
" " " "	Palmer	50.00			946				
Coe-Mortimer Co., New York City									
Nitrate of Soda	N. Amherst	49.00	51.94	7.53*	286	1.90	15.74	—	15.00
" " "	Hadley	50.00			670				
" " "	Westboro	45.00			770				
Essex Fertilizer Co., Boston, Mass.									
Nitrate of Soda	Taunton	54.00	50.89	6.11	133	2.10	15.42	—	15.00
W. R. Grace & Co., New York City									
Nitrate of Soda	West Upton	52.00	49.70	7.65	768	2.33	15.06	—	15.00
" " "	Southbridge	55.00			978				
Nitrate of Soda	Man'f s. Sample	—	50.29	—	1042	1.48	15.24	—	15.00
Lister's Agric. Chem. Works, New., N.J.									
Nitrate of Soda	Hadley	50.00	50.82	1.61*	674	2.13	15.40	—	15.66
National Fertilizer Co., Boston, Mass.									
Nitrate of Soda	Bradstreet	52.00	49.17	5.76	474	2.69	14.90	—	15.50
Olds & Whipple, Hartford, Conn.									
Nitrate of Soda	Whately	60.00	50.62	18.53	582	1.94	15.34	—	14.81
Patrons Co-operative Association, Boston									
Nitrate of Soda	Sunderland	50.00	51.15	2.25*	334	1.92	15.50	—	15.00
Sanderson Fert. & Chem. Co., N. Haven									
Sanderson's Nitrate of Soda	Bradstreet	57.00	49.83	14.39	442	2.00	15.10	—	14.81
Swift's Lowell Fert. Co., Boston, Mass.									
Swift's Lowell Nitrate of Soda	Taunton	50.00	51.32	.62*	108	1.70	15.55		15.00
" " " " "	Marblehead	52.00			336				
Wilcox Fertilizer Works, Mystic, Ct.									
Wilcox Nitrate of Soda	Seekonk	60.00	49.63	20.39	126	2.00	15.04	—	15.00
DRIED BLOOD.									
Bowker Fertilizer Co., Boston, Mass.									
Dried Blood	Athol	50.00	37.67	32.73	** 800	19.63	—	9.22	9.50
Swift's Lowell Fert. Co., Boston, Mass.									
Dried Blood	Springfield	45.00	39.95	16.40	** 265	11.43	—	9.42	9.87
" "	Concord	48.00			319				

** No. 800 Phosphoric Acid 4.38%.
265–319 " " 6.92%.
* Valuation in excess of selling price.

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble.	Nitrogen in 100 lbs. Found. Organic.	Nitrogen in 100 lbs. Guaranteed.
CASTOR POMACE.									
Olds & Whipple, Hartford, Conn.									
O. & W. Castor Pomace	Hatfield	$24.00	$21.20	13.20	3	8.23	—	5.58	5.00
O. & W. Castor Pomace	Hatfield	24.00	16.64	44.23	7	8.88	—	4.38	5.00
O. & W. Castor Pomace	Hatfield	24.00	19 72	21.70	16	8.78	—	5.19	5.00
O. & W. Castor Pomace	Bradstreet	24 00	19 49	23.14	463	9.05	—	5.13	5.00
LINSEED MEAL.									
American Linseed Co., Chicago, Ill.									
Cleveland Flax Meal	Hatfield	32.00	23.41	36.70	5	10.88	—	6.16	5.76
Cleveland Flax Meal	Hatfield	34.00	23.98	41 78	6	11.66	—	6.31	5.76
Linseed Oil Meal	Salem	32 00	22.95	39.43	372	10.80	—	6.04	6.00
COTTONSEED MEAL.									
American Cotton Oil Co., Memphis, Tenn.									
Choice Cottonseed Meal	Bradstreet	32.00	24.74	29.34	457	10.19	—	6.51	6.50
Choice Cottonseed Meal	N. Hadley	30.00	24.47	22.60	491	6.87	—	6.44	6 50
Choice Cottonseed Meal	Whately	32.00	24.70	29.55	599	9.08	—	6 50	6.50
Choice Cottonseed Meal	Deerfield	29.50	23.41	26.01	835	10.71	—	6.16	6.50
F. W. Brode & Co., Memphis, Tenn.									
Owl Brand Pure Cottonseed Meal	W. Boylston	36.00	24.09	49.44	709	10.47	—	6.34	6.50
T. H. Bunch, Little Rock, Ark.									
Old Gold Cottonseed Meal	Southwick	32.00	22.80	40.35	864	9.33	—	6.00	6.50
Humphrey's, Godwin & Co., Memphis, Tenn.									
Dixie Brand Cottonseed Meal	Lowell	32.00	23.18	38.05	223	8.64	—	6.10	6.50
Dixie Brand Cottonseed Meal	Salem	33.00	22.31	47 92	376	11 65	—	5.87	6.50
Dixie Brand Cottonseed Meal	Sunderland	33 00	25.95	27.17	401	6.48	—	6.83	6.17
Dixie Brand Cottonseed Meal	Bradstreet	31.00	23.56	31.58	441	9.52	—	6 20	6.17
Dixie Brand Cottonseed Meal	Bradstreet	32.00	27.25	17.43	476	7.09	—	7.17	7.00
Dixie Brand Cottonseed Meal	N. Hadley	28.25	25.19	12 15	477	6 86	—	6.63	6.50
Dixie Brand Cottonseed Meal	N. Hadley	31 00	27.44	12.97	478	6.16	—	7.22	6.50
Dixie Brand Cottonseed Meal	Hatfield	29.75	25.76	15.49	479	7 10	—	6.78	6.50
Dixie Brand Cottonseed Meal	Hatfield	29.50	26.11	12.83	480	7 01	—	6.87	6.50
Dixie Brand Cottonseed Meal	Hatfield	29.50	25.04	17 81	481	7.08	—	6.59	6.50
Dixie Brand Cottonseed Meal	Hatfield	29 25	25 00	17.00	482	6.90	—	6.55	6 50
Dixie Brand Cottonseed Meal	Sunderland	30 00	24.51	22.40	490	8.07	—	6.45	6.50

NOTE.—Cottonseed Meal contains from 2 to 3 per cent of phosphoric acid and from 1.5 to 2.5 per cent of potash of which about 1.28 per cent is water soluble.

Linseed meal contains on the average 1.47 per cent. of phosphoric acid and 1.52 per cent potash.

Castor pomace contains on the average 2.12 percent of phosphoric acid and 1.20 per cent potash.

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble.	Organic.	Guaranteed.
Hunter Brothers Milling Co., St. Louis, Mo.									
Prime Cottonseed Meal	Sunderland	$31.50	$24.47	28.73	238	9.20	—	6.44	6.00
Prime Cottonseed Meal	Amherst	29.40	24.02	22.40	280	7 22	—	6.32	6.50
Prime Cottonseed Meal	S. Framingham	35.00	24.70	41.70	346	10.24	—	6.50	6.00
Prime Cottonseed Meal	Greenfield	—	25.76	—	483	7.13	—	6.78	6.00
Prime Cottonseed Meal	Greenfield	—	25.73	—	484	7.16	—	6 77	6.00
Prime Cottonseed Meal	Greenfield	—	25.76	—	485	7.32	—	6.78	6.00
Prime Cottonseed Meal	Amherst	29.40	24.85	18.31	486	7 80	—	6.54	6.00
Prime Cottonseed Meal	Sunderland	30.00	24.66	21.65	487	7.93	—	6.49	6.50
Prime Cottonseed Meal	N. Amherst	31.00	24.78	25.10	488	6.97	—	6.52	6.50
Prime Cottonseed Meal	N. Hadley	29.50	24.62	19.82	489	7.28	—	6.48	6.50
Prime Cottonseed Meal	N. Hadley	29.50	24.93	18.33	492	6.89	—	6.56	6.50
Prime Cottonseed Meal	Hadley	29.40	25.73	14.26	496	6.59	—	6.77	6.50
Prime Cottonseed Meal	Hadley	29.40	25.27	16.34	497	6.75	—	6.65	6.50
Prime Cottonseed Meal	N. Hadley	29.50	24.51	20.36	498	6.29	—	6.45	6.50
Prime Cottonseed Meal	N. Amherst	31.00	23.94	29.49	499	6.58	—	6.30	6.50
Prime Cottonseed Meal	S. Lawrence	36.00	22.57	59.50	539	11.96	—	5.94	6.17
Cottonseed Meal	Whately	30.00	25.00	20.00	577	10.29	—	6.58	6.50
Cottonseed Meal	N. Hadley	29.40	24.13	21.84	627	10.20	—	6.35	6.50
Cottonseed Meal	N. Hadley	29.40	24.55	19.76	634	10.74	—	6.46	6.50
Cottonseed Meal	N. Hadley	32.00	23.29	37.40	640	9.86	—	6.13	6.50
Cottonseed Meal	N. Grafton	32.00	24.78	29.14	753	9.57	—	6.52	6.50
Olds & Whipple, Hartford, Conn.									
Cottonseed Meal	Bradstreet	31.50	26.60	18.42	462	9.85	—	7.00	7.00
Choice Cottonseed Meal	Hatfield	31.50	26.56	18.60	493	7.06	—	6.99	7.00
Prime Cottonseed Meal	Hatfield	31.50	27.36	15.13	494	5.85	—	7.20	7.00
Prime Cottonseed Meal	Hatfield	31.50	27.78	13.39	495	6.06	—	7.31	7.00

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
HIGH GRADE SULPHATE OF POTASH.								
American Agricultural Chemical Co., Boston								
High Grade Sulphate of Potash	Bradstreet	$50.00	$50.08	1.84	48	.41	50.08	48.00
" " " " "	Amherst	50.00			288			
" " " " "	S. Amherst	52.00			452			
" " " " "	Framingham	52.00			646			
Bowker Fertilizer Co., Boston, Mass.								
High Grade Sulphate of Potash	Middleboro	52.00	49.18	1 67	200	1.40	49.18	48.00
" " " " "	Springfield	52.00			237			
" " " " "	Amherst	50.00			307			
" " " " "	Deerfield	46.50			811			
Coe-Mortimer Co., New York City								
High Grade Sulphate of Potash	N. Amherst	47.00	50.26	6.49*	24	.99	50 26	48.00
" " " " "	W. Springfield	—			159			
Lister's Agric. Chem. Works, Newark, N. J.								
High Grade Sulphate of Potash	Hadley	50 00	49 57	.87	669	.43	49.57	48.00
National Fertilizer Co., Bridgeport, Conn.								
High Grade Sulphate of Potash	Bradstreet	48.00	50.48	4.91*	471	.50	50.48	48.00
Patron's Co-operative Association, Boston								
Sulphate of Potash	Sunderland	52 00	52 60	1.14*	397	.88	52.60	53.81
Sulphate of Potash	Sunderland	46.20	52.92	12.70*	421	1.38	52.92	53.81
Sanderson Fert. & Chem. Co., New Haven								
High Grade Sulphate of Potash	Southwick	50 00	40.70	22 85	396	3.40	40.70	48.67
Swift's Lowell Fertilizer Co., Boston, Mass.								
High Grade Sulphate of Potash	Springfield	50.00	50 04	08*	257	1 25	50.04	48.00
" " " " "	S. Lowell	50.00			561			
SULPHATE OF POTASH-MAGNESIA.								
Bowker Fertilizer Co., Boston, Mass.								
Sulphate of Potash-Magnesia	Man'f'rs sample	—	28.34	—	1040	7.13	28.34	26.00
National Fertilizer Co., Boston, Mass.								
Low Grade Sulphate of Potash	N. Hadley	29.00	26.63	8.90	2	6 78	26.63	26.00
Low Grade Sulphate of Potash	Bradstreet	30.00	26.38	13.72	447	7.33	26.38	25.00
Olds & Whipple, Hartford, Conn.								
Low Grade Sulphate of Potash	Whately	30.00	27.80	7.91	595	7.78	27.80	25.96
Low Grade Sulphate of Potash	Whately	29.00	26.73	8.49	596	5.10	26.73	25 96
Sanderson Fertilizer & Chem. Co., New Haven.								
Low Grade Sulphate of Potash	Bradstreet	29.50	27.80	6.12	449	6.72	27.80	27.04
CARBONATE OF POTASH.								
National Fert. Co., Boston, Mass.								
High Grade Carbonate of Potash	Bradstreet	96.00	99.60	3.61*	443	7.83	62.25	60.00
High Grade Carbonate of Potash	Bradstreet	95.00	99.33	4.36*	473	none	62.08	60.00
Olds & Whipple, Hartford, Conn.								
Vegetable Potash	Man'f'r's Samp.	—	40.86	—	1032	5 22	25.48†	25.00

* Valuation in excess of selling price.

† Chlorine .98% equivalent to 1.30% potash, 1.27% potash as sulphate, 22.91% potash as carbonate. Total potash 26.34. This sample also contains 21.32% lime and .62% phosphoric acid which have been valued at 0034 cts. and 3 cts. per pound.

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
MURIATE OF POTASH.								
Amer. Agricultural Chemical Co., Boston								
Muriate of Potash	New Bedford	$46.00			57			
" " "	Amherst	45.00			296			
" " "	S. Amherst	46.00	$42 92	6 24	470	1.63	50.49	49.00
" " "	West Upton	45 00			772			
" " "	Milford	46.00			389			
Bowker Fertilizer Co., Boston, Mass.								
Muriate of Potash	Middleboro	50.00	42.30	18.20	222	2.53	49.77	49.00
Muriate of Potash	Amherst	44.00	47.12	6.62*	289	1.18	55.43	50.00
Buffalo Fertilizer Co., Buffalo, N. Y.								
Muriate of Potash	Southbridge	46.00	42.67	7.80	980	3.28	50.20	50 00
Coe-Mortimer Co., New York City								
Muriate of Potash	W. Springfield	42.00	43.69	3 87*	177	1.78	51.40	50.00
National Fertilizer Co., Boston, Mass.								
Muriate of Potash	Sunderland	43.00			409			
" " "	Sunderland	44 00	42 04	3.88	432	1.63	49.46	47.4
" " "	Leominster	44.00			736			
Olds & Whipple, Hartford, Conn.								
Muriate of Potash	Whately	46 00	48.78	5.70*	593	3.33	50.33	50.56
Patron's Co-operative Association, Boston								
Muriate of Potash	Sunderland	42.00	52.56	20.09*	392	.70	61.84	59.41
Muriate of Potash	Sunderland	37.00	43.20	14.36*	410	2.99	50.82	50.56
Muriate of Potash	Sunderland	44.40	51.60	13.95*	411	1.55	60.71	60.70
Muriate of Potash	Amherst	37.00	45.13	18.01*	644	1.05	53.09	50.56
Sanderson Fert. and Chem. Co., New Haven								
Muriate of Potash	Bradstreet	44.50	43.31	2.75	450	2.55	50.95	50.56
Swift's Lowell Fertilizer Co., Boston, Mass.								
Muriate of Potash	Taunton	42.00			123			
" " "	Marblehead	44.00	42 34	3.14	333	1.70	49.81	50.00
" " "	Beverly	45.00			358			
KAINIT.								
American Agric. Chemical Co., Boston								
Kainit	Framingham	17 00	10.73	58.41	632	2.30	12 62	12.00
Bowker Fertilizer Co., Boston, Mass.								
Bowker's Kainit	Man'fr's Sample	—	11.01	—	1039	3.58	12 95	12.00
Swift's Lowell Fertilizer Co,. Boston, Mass.								
Swift's Lowell Kainit	Concord	15.00	11.57	29.64	320	3.20	13.61	12.00

* Valuation in excess of selling price

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation. per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Phosphoric Acid in 100 lbs. Moisture	Water Soluble	Reverted	Insoluble	Total. Found.	Total. Guaranteed.	Available Found.	Available Guaranteed.
DISSOLVED BONE BLACK.													
American Agricultural Chemical Co., Boston													
Dissolved Bone Black	Lawrence	$30 00	$12.77	134.92	572	4 94	12.15	3 67	1 20	17 02	16.00	15 22	15 00
National Fertilizer Co., Boston, Mass.													
Dissolved Bone Black	Bradstreet	23 00	12.32	79.40	472	12 62	5.74	11 06	1 23	13 03	—	16.20	16 00
Swift's Lowell Fertilizer Co., Boston, Mass.													
Dissolved Bone Black	Springfield	22.00	14.84	48.25	266	10.01	15.20	2 72	1 32	19 30	—	17.93	15 00
ACID PHOSPHATE.													
American Agricultural Chemical Co., Boston													
Plain Superphosphate	Fall River	15.00	10.75	54.88	227	11.10	5.33	6 97	3.02	15.32	13.50	12 30	12 00
" "	Worcester	17.00			693								
" "	West Upton	18.00			779								
" "	W. Springfield	—			163								
Plain Superphosphate	Southbridge	20.00	12.17	64.34	972	7.40	6.75	8.47	2.10	17.32	15.00	15.22	14.00
Bowker Fertilizer Co., Boston, Mass.													
Bowker's Plain Superphosphate	Middleboro	17.00	9.63	76.55	186	10.18	3.90	2.76	1.44	13.10	13.00	11.66	12.00
Olds & Whipple, Hartford, Conn.													
High Grade Phosphate	Whately	20.00	16.58	20.63	584	16.32	.70	21.94	1.66	24.30	—	22.64	20.00
Sanderson Fertilizer & Chemical Co., New Haven													
Acid Phosphate	Bradstreet	16.00	11 80	35.59	458	11.90	11.23	3.35	1 18	15.76	—	14.58	14.00
Sanderson's Plain Superphosphate	M'fr's Sample	—	13.24	—	1012	14.50	14.52	2.22	.18	16.92	—	16.74	14.00
Swift's Lowell Fertilizer Co., Boston, Mass													
Acid Phosphate	Springfield	16 00	10.46	57.74	259	12.63	9.50	3.40	1 20	14.10	14.00	12.90	12.00
" "	Concord	17.00			309								
ROCK PHOSPHATE.													
Farmer's Ground Rock Phosphate Co., Mt. Pleas.													
Tennessee Ground Rock Phosphate	W. Wrentham	13.65	11.43	19.42	993	2.18	—	—	—	23.53	23.00	—	—
BASIC SLAG PHOSPHATE.													
American Agric. Chem. Co., Boston, Mass.													
Basic Slag Phosphate	Springfield	13.00	11 02†	63 34	204	.13	—	14.42	2 32	16.74	17.00	14.42	15 00*
Coe-Mortimer Co., New York City													
Basic Slag Phosphate Thomas Phosphate	N. Amherst	16 00	11.63†	37.57	50	.06	—	14.74	3.30	18.04	17.00	14.74	15 00*
Basic Slag Phosphate	W. Springfield	—	11 49†	—	146	.06	—	14.29	3.73	18.02	17 00	14 29	15.00*
Basic Slag Phosphate	S. Amherst	17 50	11 59†	50.99	468	.04	—	14.74	3.18	17.92	17.00	14.74	15.00*
Basic Slag Phosphate	Fitchburg	17.00	12.03†	41.31	732	.04	—	15.08	3.68	18.76	17.00	15.08	15.00*
Patron's Co-operative Association, Boston													
Basic Slag	Sunderland	16.00	10.57†	51.37	393	.06	—	13.14	3 42	16.56	17.00	13 14	—

* Guarantee based on Wagner's method of analysis.

† Valuation based upon availability of phosphoric acid as determined by Wagner's method of analysis which shows the phosphoric acid dissolved by a 2 per cent. citric acid solution. The available phosphoric acid is valued at 3½ cents and the insoluble at 2 cents per pound.

BULLETIN No. 132. JANUARY, 1910.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

INSPECTION OF

Commercial Feed Stuffs.

BY

P. H. SMITH and J. C. REED.

This bulletin contains the analyses of commercial feed stuffs found in the Massachusetts markets during the year 1909 together with such comments as are called for by the results of the inspection. Topics of especial importance are weed seeds in feed stuffs, weight of sacked feeds, and complete rations for dairy stock. In addition will be found a tabulated list of the wholesale cost of feeding stuffs for the year.

Requests for bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION:

STATION STAFF:

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

Department of Plant and Animal Chemistry

J. B. LINDSEY, Chemist.

Inspection of Commercial Feed Stuffs

By P. H. Smith* and J. C. Reed.

INTRODUCTION.

Extent of Work. During the past year 946 samples of the various feeding stuffs found offered for sale in the Massachusetts markets were collected by the official inspector. These have been carefully examined and the results are herewith published in bulletin form.

Observance of the Law. Practically no misrepresentation was detected although in a number of instances feedstuffs lacked the guarantee and other information required by statute. Wherever dealers appeared to be particularly careless in this respect, the matter was put into the hands of an attorney for settlement, but, thus far, in every case, a satisfactory agreement has been made without resorting to the courts. In the future it is the intention to prosecute where dealers cannot be brought by less drastic means to comply with the law. The requirements of the Massachusetts law are simple and explicit and afford protection to the reputable dealer as well as to the consumer; therefore, the continued evasion of the law by a few dealers is inexcusable and should not be tolerated. Even though the letter of the law may be

*The writer wishes to acknowledge the valuable suggestions made by Dr. Lindsey and the assistance of Mr. G. H. Chapman, Assistant Botanist, for the microscopical work performed.

closely observed, the consumer is often misled as to the true value of a feed by extravagant advertisements, circulars, etc. While there is no provision in the statute covering this matter, the consumer can easily avail himself of the privilege of obtaining the opinion of the experiment station as to the value of any feeding stuff.

Federal and State Law.

The extent to which the National Pure Food law aids in preventing adulteration and misrepresentation where feeds enter into interstate commerce, is perhaps not known and appreciated as it should be. When it is believed that a dealer is offering an adulterated article in good faith and is entirely ignorant of its true nature, cooperation between state and federal officials may lead to the prosecution of the party responsible for placing the article on the market. In this way the federal law can be of great assistance to those engaged in local control work, but this fact should not be taken to indicate that the responsibility of the retailer is any less, and he should use every means at hand to acquaint himself with the character of the goods he is handling.

Use of Low Grade Products.

On account of our increasing population and prevailing high prices, it is becoming more and more necessary to utilize all by-products having any substantial food value in the feeding of our domestic animals. While screenings, weed seeds, oat hulls, corn cobs, cottonseed hulls, and other low grade material may contain some nutriment, the foregoing statement should not be taken to indicate that a compounded feed containing one or more of these materials together with some high-grade concentrate is just as valuable as the high-grade concentrate itself. Where such a mixture is offered at its face value and no misrepresentation attempted, it is certainly a legitimate article of trade and should be so recognized. The writer firmly believes, however, that in order that the consumer may purchase intelligently, the ingredients going to make up a compounded feed should be stated on each package; but no legislation absolutely prohibiting the sale of low grade material should be enacted except in cases where it can be shown that certain kinds of material are poisonous or injurious to the animal.

Protein vs. Carbohydrates. Many manufacturers claim that the experiment stations place too much emphasis upon the value of protein and too little emphasis upon the value of carbohydrates. This station has never questioned the value and necessity of liberal amounts of carbohydrates in the ration. The question is rather an economic one, especially for the New England feeder who, under our climatic conditions, can easily produce a sufficient quantity of carbohydrates and must depend largely upon purchased protein to balance or round out the ration, particularly in the feeding of dairy animals.

Uniform Feed Law. It was the writer's pleasure to attend, during September, a conference between a committee of the American Feed Manufacturers' Association and state control officials, held at Washington in the interests of a uniform feed stuffs law. The decision of the conference was that such a law should be as simple as possible, and that a buyer of any feed stuff should be informed on the following points : —

1. The number of net pounds in the package.
2. Name, brand or trade-mark.
3. Name and principal address of the manufacturer or jobber responsible for placing the commodity on the market.
4. Its chemical analysis expressed in the following terms : —
    - *a.* Minimum percentage of crude protein.
    - *b.* Minimum percentage of crude fat.
    - *c.* Maximum percentage of crude fiber.
5. If a compounded or mixed feed, the specific name of each ingredient therein.

The Massachusetts law does not require a guarantee of fiber or a statement of ingredients in a compounded feed, and it is felt that in the near future the present law should be amended to include these statements.

STANDARDS FOR CATTLE AND POULTRY FOODS.

A standard for comparison is always necessary in passing judgment on the composition of concentrated feeds. The percentages of protein, fat and fiber **serve as an index** of their character in the majority of cases. To be of **standard quality,** the various concentrates should be free from foreign material, mould and rancidity, in good mechanical condition, and maintain the following percentages of protein, fat and fiber : — *

	Feed Stuff.	Protein.	Fat.	Fiber.
Protein Feeds.	*Blood Meal*	*85*	*0.2*	—
	Cottonseed meal (choice)	*41-46*	*8-10*	*7*
	Cottonseed meal (prime and good)	*36-41*	*7-9*	*8*
	Cottonseed meal (low grade)	*24*	*5-6*	*18*
	N. P. linseed meal	*38*	*2*	*9*
	O. P. linseed meal	*32*	*6*	*9*
	Gluten feed	*25*	*3*	*7.5*
	Distillers' dried grains (corn)	*32*	*10*	*12*
	Malt sprouts	*25*	*1*	*12.5*
	Brewers' dried grains	*22*	*5*	*12*
	Wheat middlings (flour)	*18-20*	*5*	*3.5*
	Wheat middlings (standard)	*17-19*	*5*	*7*
	Wheat mixed feed	*16-18*	*4.5*	*8.5*
	Wheat bran	*15-17*	*4.5*	*10*
	Oat middlings	*17*	*7*	*2.5*
	Rye feed	*15*	*3*	*4*
Starchy (Carbohydrate) Feeds.	*Ground oats*	*11*	*4*	*10*
	Ground wheat	*11*	*2*	*3*
	Barley meal	*11*	*1.5*	*6*
	Rye meal	*10*	*1.5*	*2*
	Corn meal	*9*	*3*	*2*
	Hominy meal	*10*	*7.5*	*4.5*
	Provender	*10*	*3.5*	*6*
	Corn and oat feed	*8-10*	*3.5*	—
	Fortified oat feed	*12-14*	*3.5*	—
	Oat feed	*5-8*	*2*	*20-26*
	Corn bran	*9*	*5*	*10*
	Dried beet-pulp	*8*	*0.3*	*18*
Poultry Feeds.	*Meat scraps*	*50*	*15*	—
	Meat and bone meal	*40*	*10*	—
	Bone meal	*25*	—	—
	Poultry mash and meal	*15*	*4.5*	—
	Chick and scratching grains	*10*	*3*	—
	Alfalfa meal, entire plant	*14*	*1.5*	*25*
	Clover meal, entire plant	*12*	*2*	*25*

* Fiber is the least valuable of the several constituents; the above standards for fiber represent the maximum percentage which the feed should contain to be of standard quality.

CHEMICAL ANALYSES OF FEED STUFFS.

1909 Collection.

I. Protein Feeds.

COTTONSEED MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Choice.		%	%	%	%	%
American Cotton Oil Co., New York.						
Choice,....... ...N. Hatfield Grain Co..	N. Hatfield....	41.99	41.00	8.00	9.00	6.42
Choice,..........P. W. Eaton & Co. ...	Williamstown .	43.75	41.00	8.34	9.00	—
H. E. Bridges & Co., Memphis.						
A. T. Butler	Adams	42.73	41.00	10.33	7.00	5.80
D. McCarthy	Turners Falls..	41.11	41.00	8.67	7.00	6.62
P. W. Eaton & Co. ...	Williamstown..	41.24	41.00	8.06	7.00	—
F. W. Brode & Co., Memphis.						
Owl, ...P. Foisy.............	New Bedford..	41.85	41-43	10.12	7-9	6.82
Buckeye Cotton Oil Co., Cincinnati, Ohio						
High Grade,......Pierce & Winn	Arlington......	41.47	41.00	9.50	8.00	6.81
Buckeye, ...R. W. Davis..........	Greenfield	41.24	39-41	7.20	6.5-7	—
Buckeye, ...Dennison Plummer Co.	New Bedford..	43.00	39-41	8.53	6.5-7	—
T. H. Bunch, Little Rock, Ark.						
Old Gold, ...Cutler Grain Co.......	S. Framingham	42 20	41.00	9.90	9.00	—
Chapin & Co., Boston.						
Green Diamond,..F. E. Smith	Amherst.......	43.13	41.00	9.60	9.00	5.31
Green Diamond...Evans & Bowker......	Baldwinsville .	43.48	41.00	8.23	9.00	—
Green Diamond...C. A. Pierce	Hinsdale	42.00	41.00	9.07	9.00	5.89
Florida Cotton Oil Co., Jacksonville, Fla.						
E. F. Wilbur & Son...	Mansfield	42.64	38.50	8.35	—	5.91
J. B. Garland & Son, Worcester.						
Golden Eagle, ...C. Bond.............	Charlton	44.40	41.00	9.30	9.00	—
Golden Eagle, ...G. P. Rogers	Worcester	43.09	41.00	8.23	9.00	—
Golden Eagle, ...J. B. Garland & Son ..	Worcester	43.96	41.00	9.33	9.00	4.86
Humphreys, Godwin & Co., Memphis.						
Dixie,...........W. J. Meek..........	Fall River	41.20	41.00	8.41	8.00	—
Dixie,...........J. A. Sullivan	Northampton .	41.38	41.00	9.05	8.00	6.59
Dixie,...........H. C. Puffer Co.	Springfield	41.59	38.5-43	8.07	7-9	—
Hunter Bros. Milling Co., St. Louis.						
Prime, ...Mackenzie & Winslow	Fall River	43.57	41.00	7.87	9.00	5.59
Prime, ...N. Paquin & Sons....	Fall River	43.43	41.00	8.23	7.50	5.38
Prime, ...J. Cushing Co.	Hudson	41.94	41.00	8.31	7.50	5.88
Prime, ...W. H. Smith	Northampton..	43.65	41.00	8.76	7.50	5 03
Prime, ...C. H. Symmes........	Winchester ...	41.85	38.50	8.16	8.00	7.25
Prime, ...J. B. Garland & Son ..	Worcester.....	43.13	41.00	8.82	7.50	—

COTTONSEED MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber
		%	%	%	%	%
Rome Oil & Fertilizer Co., Rome, Ga.						
Cherokee, ...W. H. Potter & Sons .	N. Adams	42.05	41-43	6.32	7-9	—
J. E. Soper Co., Boston.						
Choice Bolted,....J. N. Waite...........	Easthampton ..	41.24	40-42	8.80	7-9	—
Choice,...........J. Cushing & Co.	Hudson	44.71	41.00	8.33	8.00	—
Fancy,...........A. D. Potter..........	Orange........	43.70	43 00	9.09	9.00	—
E. A. Cole............	Housatonic ...	43.87	41.00	8.48	8.00	—
Southern Cotton Oil Co., Memphis.						
Prime, ...F. Diehl..............	Wellesley	43.22	41.00	7.67	7.00	—
Highest	....	44.71	—	10.33	—	7.25
Lowest..............	....	41.11	—	6.32	—	4.86
Average.............	....	42.62	—	8.60	—	6.01
Medium Grade. (Prime and Good).						
American Brokerage Co., Memphis.						
Eagle, ...G. C. Turner	Chester	39.57	41.00	8.39	9.00	7.16
American Cotton Oil Co., New York.						
Choice, ...H. G. Hill Est.	Williamsburg..	38.75	41.00	8.34	9.00	8.85
F. W. Brode & Co., Memphis.						
Owl,.............C. H. Smith	Dighton	40.80	41-43	12.17	7-9	5.00
Owl,.............D H. Craig...........	Plymouth......	39.40	41-43	10.84	7-9	6.88
T. H. Bunch, Little Rock, Ark.						
Old Gold,........W. N. Potter & Sons..	Charlemont....	39.62	41.00	11.19	9.00	—
Old Gold,........A. Milot & Son	Taunton.......	39.92	—	10.42	—	8.17
J. B. Garland & Son, Worcester.						
Golden Eagle,....F. Diehl & Son	Wellesley	40.41	41.00	7.00	9.00	8.73
Humphreys, Godwin & Co., Memphis.						
*Dixie,............J. E. Merrick & Co. ..	Amherst.......	37.03	38.5-43	6.55	7-9	—
Dixie,............G. F. Greene Coal Co..	Campello	40.76	41.00	7.63	8.00	7.91
Dixie,............W. J. Meek...........	Fall River	40.94	41.00	7.01	8.00	8.07
*Dixie,............Warner Bros.	Sunderland....	39.36	38.5-43	8.12	7-9	—
Hunter Bros. Milling Co., St. Louis.						
Prime, ...W. E. Bryant Co.	Brockton	40.23	38.50	7.46	6.50	8.22
Prime, ...C. B. Benedict........	Gt. Barrington.	38.21	38.50	7.37	8.00	9.14
Prime, ...Mackenzie & Winslow.	Fall River	38.08	41.00	8.49	7.50	—
Prime, ...J. Cushing & Co.	Fitchburg	40.18	38.50	8.39	8.00	8.06
McCaw Manufacturing Co., Macon, Ga.						
Prime, ...J. W. Doon..........	Natick	40.41	39.00	7.03	9.00	7.66
Prime, ...Taunton Flour & Gr.Co	Taunton.......	38.36	39 00	6.86	9.00	9.44
Blackstone Smith, New Orleans, La.						
Purity, ...Webster Grain Co....	Lawrence	40.93	41.00	8.73	5.00	9.44
Purity, ...Highland Mills.......	NewtonHigh'ds	38.57	41.00	6.72	5.00	9.74

* Meal sold on a basis of 41 per cent protein and refund has been made to retailers, according to rules of Interstate Cotton Crushers Association.

COTTONSEED MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
J. Lindsay Wells Co., Memphis, Tenn.						
Star, ... J. W. Raymond	Concord.......	38.52	41.00	7.07	9.00	9.17
Star, ... Knight Grain Co......	Newburyport ..	39.14	41.00	7.11	9.00	9.33
Highest	....	40 94	—	12.17	—	9.74
Lowest	....	37.03	—	6.55	—	5.00
Average............	....	39.49	—	8.23	—	8.29
Low Grade.						
Florida Cotton Oil Co., Jacksonville, Fla.						
Ropes Bros.	Salem	24.57	25.75	6.70	5.00	15.79
Durham, ... Jaquith & Co.........	Woburn	23.08	25.75	6.79	5.00	15.91

LINSEED MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
1. New Process.						
American Linseed Co., Chicago.						
Cleveland Flax,... Ropes Bros..........	Salem	34.61	36-40	3.17	1-3	—
Cleveland Flax,... Ropes Bros..........	Salem	40.14	36-40	2.82	1-3	—
W. L. Palmer.........	Medway.......	36 95	36-40	3.11	1-3	—
Bryant & Soule	Middleboro ...	38.12	36-40	3.40	1-3	—
Dennison Plummer Co.	New Bedford..	36.95	36-40	4.37	1-3	—
Average	....	37.35	—	3.37	—	—
2. Old Process.						
American Linseed Co., New York.						
N. Paquin & Sons	Fall River	36.15	32-36	5.75	5-7	—
N. Paquin & Sons	Fall River	35.15	32-36	5.58	5-7	—
J. Cushing Co	Fitchburg	37.73	32-36	5 04	5-7	—
Cummings, Chute & Co	Woburn	36.42	32-36	5.49	5-7	—
Kelloggs & Miller, Amsterdam, N. Y.						
W. N. Potter & Sons..	Greenfield	38.00	33-37	6.76	5-7	—
W. N. Potter & Sons..	Gardner	34 01	33-37	6.33	5-7	—
Guy E. Major Co., Toledo, Ohio.						
J. B. Garland & Son ..	Worcester	31.24	30-36	5.27	5-7	—
Mann Bros. & Co., Buffalo, N. Y.						
A. E. Lawrence & Son.	Ayer..........	37.38	34-37	7 40	6-7	—
J. Cushing Co	Fitchburg	33.87	34-37	6.90	6-7	—
J. Loring & Co........	Watertown	37.55	34-37	6.88	6-7	—
Metzger Seed & Oil Co., Toledo, Ohio.						
J. F. Ray.	Franklin	35.87	30-36	6.46	5-7	—
J. F. Ray.	Franklin	37 29	30-36	6.77	5-7	—
Average............	....	35.89	—	6.22	—	—

FLAX FEED.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
H. Jennings, Boston.						
J. W. Doon & Son....	Natick	16.72	16.00	14.34	14.00	—
J. W. Doon & Son....	Natick	17.64	16.00	15.95	14.00	—
A. Altman............	New Bedford..	16.41	16.00	13.17	14 00	—
W. F. Fletcher	Southwick.....	15.36	16.00	11.02	14.00	13.83
G. H. Reed...........	West Acton....	15.44	17.34	10.93	17.37	—
New Occidental Milling Co., Minneapolis.						
Superior, ...W. F. Fillmore	Palmer	16.14	16.00	8.42	14.00	8.03
Average.............	....	16.29	—	12.31	—	—

GLUTEN FEED.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
American Maize Products Co., New York.						
Cream of Corn,... F. G. Morey	Billerica	25.45	23-25	3.69	2.50	—
Cream of Corn,... Prentiss, Brooks & Co.	Easthampton ..	24.35	23-25	3.41	2.50	—
Cream of Corn,... J. F. Ray	Franklin	25.98	23-25	2.47	2.50	—
Cream of Corn... Curley Bros............	Wakefield	28.22	23-25	2.25	2.50	—
Cream of Corn,... Prentiss, Brooks & Co.	Westfield	27.56	23-25	2.64	2.50	—
Cream of Corn,... J. B. Garland & Son...	Worcester	27.29	23-25	2.79	2.50	—
Average.............	....	26.48	—	2.88	—	—
Clinton Sugar Refining Co., Clinton, Ia.						
Clinton, ...W. E. Bryant & Co ..	Brockton	23.87	23.00	3.77	3.00	—
Clinton, ...E. A. Wilbur & Son ..	Mansfield.....	24.74	23.00	4.21	3.00	—
Corn Products Mfg. Co., New York.						
Buffalo, ...G. F. Greene Coal Co .	Campello	25 05	23-25	1.74	2.5-3	—
Buffalo, ...Griffen Bros..........	Fall River	28.32	23-25	2.54	2.50	—
Buffalo, ...N. Paquin & Sons	Fall River	28.65	23-25	2.50	2.50	—
Buffalo, ...J. Cushing & Co......	Fitchburg	28.08	23-25	1.92	2.50	—
Buffalo, ...J. Cushing & Co	Fitchburg	28 34	24-27	3.70	2.50	—
Buffalo, ...W. N. Potter Sons Co.	Hadley........	26.76	23-25	2.55	2.50	—
Buffalo, ...Howard & Smith	Hatfield	25.66	23-25	2.88	2.50	—
Buffalo, ...W. R. Ross Co........	Holyoke.......	24.04	23-25	2.78	2.50	—
Buffalo, ...Conant & Co	Littleton	28.61	23-25	2.82	2.50	—
Buffalo, ...Marlboro Grain Co ...	Marlboro	26.81	23-25	1.83	2.50	—
Buffalo, ...Thorne Bros.	Millis	26.81	23-25	2.97	2.50	—
Buffalo, ...City Mills Co.........	Northampton .	28.67	24-27	3.47	2.50	—
Buffalo, ...A. Culver Co.........	Rockland......	27.86	23-25	1.90	2.50	—
Buffalo, ...Taunton Grain Co....	Taunton.......	27.99	23-25	1.95	2.50	—
Buffalo, ...J. Paull...............	Taunton.......	27.99	23-25	2.59	2.50	—
Average.............	....	27.31	—	2.54	—	—

GLUTEN FEED—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Corn Products Mfg. Co., New York.						
Crescent,.........I. N. Boucher & Son..	East Dedham..	27.60	24-27	1.92	2.50	—
Crescent,.........R. D. Bowen..........	Leominster	27.29	24-27	1.48	2.50	—
Crescent,.........G. M. Foster..........	Lowell	26.41	23-25	2.68	2.50	—
Crescent,.........P. Foisy..............	New Bedford..	27.57	23-25	3.68	2.5-3	—
Average..............	....	27.22	—	2.44	—	—
Diamond, ...A. Dodge Sons Corp..	Beverly	25.27	23-25	3.21	2.50	—
Diamond, ...W. N. Potter & Sons..	Greenfield	24.74	23-25	3.20	2.50	—
Globe,............Mackenzie & Winslow	Fall River	30.05	24-26	1.88	2.50	—
Globe,............W. N. Potter & Sons..	Gardner	27.11	24.26	3.26	2.50	—
Globe,............W. N. Potter & Sons..	Greenfield	26.33	26.00	2.41	2.50	—
Globe,............W. N. Potter Sons &Co	Hadley	28.92	24-27	2.20	2.50	—
Globe,............Stanley Grain Co.....	Lawrence	28.39	26.00	2.28	2.50	—
Average..............	....	28.16	—	2.41	—	—
Pekin,............Mackenzie & Winslow	Fall River	27.03	23-25	2.75	2.50	—
Pekin,............O. F. Metcalf & Sons..	Franklin	28.17	23-25	5.46	2.50	—
Pekin,............Hathaway & McKenzie	New Bedford..	27.11	23-25	1.94	2.50	—
Pekin,............Sprague & Williams ..	S. Framingham	27.64	23-25	1.63	2.50	—
Pekin,............Jaquith & Co.........	Woburn.......	26.76	23-25	3.66	2.50	—
Average..............	....	27.34	—	3.09	—	—
Electric Elevator & Milling Co., Buffalo.						
L. A. Snow.	Upton	25.67	25.00	2.88	2.75	—
J. C. Hubinger Bros. Co., Keokuk, Iowa.						
Mackenzie & Winslow	Fall River	24.57	23.50	2.28	2.60	—
Howe Bros...........	Gardner	22.90	23.50	2.62	2.60	—
J. E. Paull............	Taunton.......	26.17	23.50	2.76	2.60	—
K. K. K. ....P. W. Eaton & Co....	Williamstown..	24.70	23.00	2.61	2.30	—
Average..............	....	24.59	—	2.57	—	—
Huron Milling Co., Harbor Beach, Mich.						
Jenks,............J. Burkhardt..........	Beverly	25.23	23-25	3.86	3.00	—
Jenks,............Lohan Bros...........	Marblehead ...	27.87	23-25	3.16	3.00	—
J. E. Soper & Co., Boston.						
Bay State,........A. N. Whittemore	Worcester	22.99	23.00	3.52	4.00	—
Union Starch & Refin. Co., Edinburg, Ind.						
Union, ...F. F. Woodard & Co..	Fitchburg	24.83	24.00	3.70	3.00	—
Western Glucose Co., Chicago, Ill.						
Western,. ....Milbury Grain Co	Milbury	23.22	23-25	2.69	2.50	—
Western, ...F. Diehl & Son.	Wellesley	24.57	23-25	3.25	2.50	—
Highest	....	30.05	—	5.46	—	—
Lowest	....	23.22	—	1.48	—	—
Average..............	....	26.52	—	2.81	—	—

GLUTEN FEED—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Second Grade (below 23% protein).		%	%	%	%	%
Clinton Sugar Refining Co., Clinton, Ia.						
Clinton, ... F. E. Smith	Amherst	22.35	23.00	4.52	3.00	—
Globe Elevator Co., Buffalo, N. Y.						
Royal, ... M. H. Rolfe Est......	Newburyport .	21.41	20-23	4.79	2-4	—
Piel Bros. Starch Co., Indianapolis, Ind.						
Milford Grain Co......	Milford	20.84	22.50	2.12	3.50	—
J. E. Soper & Co.. Boston.						
Bay State, ... E. E. Cole............	Billerica	22.77	22.00	5.94	4.00	—
Bay State, ... D. Seffens............	Conway	21.76	22.00	5.80	4.00	—
Average.............	....	21.83	—	4.63	—	—

DISTILLERS' DRIED GRAINS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Ajax Milling & Feed Co., Buffalo.						
Ajax Flakes, ... A. F. Sanctuary	Amherst.......	32.73	31-33	13.66	12-14	12.19
Ajax Flakes, ... G. C. Turner	Chester	31.68	31-33	12.67	12.00	12.24
Ajax Flakes, ... C. P. Washburn	Middleboro....	30.73	31-33	13.60	12.00	10.65
Ajax Flakes, ... C. P. Washburn	Middleboro....	28.65	31-33	13.17	12.00	11.13
Ajax Flakes, ... H. G. Puffer Co.......	Springfield	29.75	31-33	12.51	12.00	13.31
Ajax Flakes, ... Walker Grain Co......	North Adams..	33.96	31-33	11.89	12.00	10.92
Average.............	....	31.25	—	12.92	—	11.74
J. W. Biles Co., Cincinnati, Ohio.						
Fourex, ... W. E. Bryant Co	Brockton	33.75	31.00	14.19	11.00	11.37
Fourex, ... J. Cushing & Co	Fitchburg	29.53	31.00	8.93	12.00	12.19
Fourex, ... Cutler Grain Co	S. Framingham	31.73	31.00	11.31	11.00	12.27
Twoex, ... J. E. Merrick & Co....	Amherst	28.69	27-30	9.07	8-12	11.45
Twoex, ... P. W. Eaton & Co	Williamstown..	29.66	27-30	10.29	8-12	11.10
Twoex, ... P. W. Eaton & Co....	Williamstown..	25.58	27-30	8.32	8-12	12.67
Continental Cereal Co., Peoria, Ill.						
Atlas, ... W. N. Potter & Sons..	Greenfield	31.94	31-33	12.80	12-14	11.54
Continental, ... A. C. Boice	Conway	29.62	33.00	12.31	14.00	7.89
Continental, ... J. Shea..............	Lawrence	29.97	33.00	12.12	14.00	10.88
Continental, ... Potter Grain Co......	Shelburne Falls	29.62	33.00	11.92	14.00	7.80
J. D. Page & Co., Syracuse, N. Y.						
Empire State, ... C. Bond..............	Charlton	31.37	28-32	10.95	9-12	11.41
Empire State, ... J. B. Garland & Son...	Worcester	30.67	28-32	10.63	9-12	12.21
Highest	....	33.96	—	14.19	—	13.31
Lowest	....	25.58	—	8.32	—	7.80
Average.............	....	30.54	—	11.69	—	11.29

MALT SPROUTS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
American Malting Co., Buffalo, N. Y.						
Bedford Coal & Gr. Co.	Bedford	32.21	25.00	1.60	2.00	—
Ropes Bros	Danvers	26.59	25.00	1.05	2.00	—
Atlantic Export Co., Milwaukee, Wis.						
W. N. Potter Grain Co	Gardner	23.08	25.00	1.29	2.00	—
J. B. Garland & Son ..	Worcester	29.75	25.00	0.97	1.50	—
J. B. Garland & Son ..	Worcester	27.99	25.00	0.79	1.50	12.40
Chas. M. Cox Co., Boston.						
J. E. Merrick & Co ...	Amherst	26.85	25-27	1.14	1.5-3	—
B. W. Brown	Concord.......	20.71	25-27	1.16	1.5-3	15.20
Malden Grain Co......	Malden.......	24.74	25-27	1.13	1.5-3	11.90
Thatcher & Ireland ...	Littleton	29.04	25-27	1.01	1.5-3	—
Francis Duhne, Jr., Milwaukee, Wis.						
Malden Grain Co.....	Malden........	28.02	25.00	1.04	2.00	—
Robinson & Jones.....	Natick	25.85	25.00	1.23	2.00	9.84
Geo. J. Meyer Malting Co., Buffalo, N.Y.						
F. E. Smith	Amherst	28.50	20.82	0.76	1.15	10.08
William Rahr Sons Co., Manitowoc, Wis.						
P. Foisy..............	New Bedford..	26.15	25.00	0.83	2.00	11.78
Average..............	....	26.88	—	1.08	—	11.87

BREWERS' DRIED GRAINS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Anheuser Busch Brew. Assoc., St. Louis						
N. Hatfield Grain Co..	N. Hatfield....	25.11	24.00	8.07	7.50	14 01
N. Hatfield Grain Co..	N. Hatfield....	24.00	24.00	6.89	7.50	14.29
J. B. Garland & Son ..	Worcester	27.20	24.00	7.55	7.50	13.55
John C. Hattendorf, Chicago.						
H. Bruckman.........	Lawrence	29.13	—	5.68	—	13.05
Hottelet Co., Milwaukee, Wis.						
Holstein. .... Lexington Grain Co...	Lexington	28.87	27.00	7.27	6.00	11.89
Average..............	....	26.86	—	7.09	—	13.36

WHEAT MIDDLINGS.

No. Samples.	Brand.	Manufacturer.	Protein. Found	Protein. Guar.	Fat. Found	Fat. Guar.
	1. Flour.		%	%	%	%
1		Duluth Universal Mills Co., Duluth, Minn..	17.16	17.00	5.59	5.25
1	Lucky	Federal Milling Co., Lockport, N. Y.	17.38	—	6.29	—
1	Fancy	J. A. Hinds Co., Rochester, N. Y..........	15.50	—	4.01	—
1	Extra Macco	A. B. McCrillis & Sons Co., Boston........	15.23	14.00	3.53	3.60
2	XXX Comet......	Northwestern Cons. Mills Co., Minneapolis.	17.49	18.25	4.63	5.25
1		" " " " "	17.83	16.25	6.09	5.25
1	A	Pillsbury's Mills, Minneapolis..............	16.41	14.00	4.30	5.00
3	XX Daisy	" " "	17.05	16.00	4.94	4.50
1	Strong Arm	James Quirk Milling Co., Minneapolis......	17.20	16.00	5.05	4.00
1	Low grade flour ..	Sleepy Eye Milling Co., Sleepy Eye, Minn.	15.75	20.00	2.75	4.50
1	Red Dog	Star & Crescent Milling Co., Chicago......	17.72	14.5-17	5.03	4.5-5.5
1	Vimco............	Valley City Mill. Co., Grand Rapids, Mich..	15.71	15.84	4.73	4.00
1	Winter Wheat....	Voight Milling Co., Grand Rapids, Mich...	16.01	—	4.75	—
3	Adrian	Washburn-Crosby Co., Minneapolis........	17.68	18-20	4.96	4-4.50
1		" " " "	18.42	17.00	6.36	5.00
		Highest	18.42	—	6.36	—
		Lowest	15.53	—	2.75	—
		Average...........................	16.98	—	4.87	—
	2. Standard.					
1	Cream	Aurora Milling Co., Aurora, Mo............	16.85	15.00	4.19	3.18
1	Badger	Berger-Crittenden Mill. Co.,Milwaukee,Wis.	18.34	16.00	4.58	4.00
1	White No. 8......	Chapin & Co., Boston	18.74	14-18	5.81	3-5
2	Wirthmore	Chas. M. Cox Co., Boston	17.42	15.17	5.52	4-5
1		Wm. G. Crocker, Minneapolis	17.46	15.00	5.64	4.00
1		J. G. Davis & Co., Rochester, N. Y.........	17.25	17.55	6.32	4.72
1	Fancy Apex......	Detroit Milling Co., Detroit, Mich.........	15.88	18.00	4.74	5.00
1	Diamond	Duluth-Superior Milling Co., Duluth, Minn.	16.50	16.25	5.06	5.00
1	Hog	" " " " " "	17.95	—	5.06	—
1	Shorts	Dwight Flour Mills, Minneapolis	17.11	14.50	5.34	5.00
1		Eckhardt & Swan Milling Co., Chicago	17.16	—	4.06	—
1	Lucky............	Federal Milling Co., Lockport, N. Y.	18.69	—	5.56	—
1		Groton Milling Co., Groton, S. Dakota	16.59	17.00	5.88	4.00
1		E. Hamilton & Son, Honeoye Falls, N. Y...	15.58	—	4.13	—
1		W. H. Haskell, Toledo, Ohio..............	16.41	—	4.83	—
1		Hecker-Jones-Jewell Milling Co., New York	18.56	15.81	5.05	5.55
1		J. A. Hinds Co., Rochester, N. Y...........	18.07	18.98	6.10	7.38
1	No. (00) Climax...	Humboldt Mill Co., Buffalo, N. Y..........	16.41	—	5.02	—
2		La Grange Mills, Red Wing, Minn.........	18.10	16.00	5.93	5.00
1	Elmco	Listman Mill Co., La Crosse, Wis.	18.69	18.29	6.76	6.11
1	Shorts	Marshall Milling Co., Marshall, Minn......	17.90	17.00	6.04	5.00
1	Powerful	A. B. McCrillis & Son Co., Boston	16.37	15.75	5.85	5.25
2		Millbourne Mills Co., Philadelphia	18.32	13-18	4.39	3-6
2		Moseley & Motley Mill. Co., Rochester, N.Y.	18.15	17.00	5.16	5.20
2		New Prague Fl. Mills Co.,New Prague,Minn.	18.76	14.02	6.24	4.07
1	A	Pillsbury's Mills, Minneapolis, Minn	18.60	15.00	5.55	4.50
1	B	" " " "	17.11	16.00	4.99	4.50

WHEAT MIDDLINGS—(Continued).

No. Samples.	Brand.	Manufacturer.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.
			%	%	%	%
1		Pillsbury's Mills, Minneapolis, Minn.	16.85	14.00	5.48	4.50
1	Quality	Quality Mills, Enterprise, Kansas	19.04	16.65	4.83	4.75
1	Bixota	Red Wing Milling Co., Red Wing, Minn.	18.36	17.00	5.98	4.00
1		Star & Crescent Milling Co., Chicago	16.85	14-16	4.24	3.5-5
1	Pennant	David Stott, Detroit, Mich.	16.83	17.00	4.64	5.50
1	Vimco	Valley City Milling Co., Grand Rapids, Mich.	16.94	—	4.74	—
2		Washburn-Crosby Co., Minneapolis	17.50	15.00	5.50	4.00
1	Wheat and Rye	Wisconsin Milling Co., Menomonie, Wis.	16.85	16.00	4.22	6.00
1	Powerful	Not given	15.71	—	5.48	—
1		"	17.81	18.00	5.95	4.00
		Highest	19.04	—	6.76	—
		Lowest	15.58	—	4.06	—
		Average	17.53	—	5.29	—

WHEAT MIXED FEED.

3	Acme	Acme-Evans Co., Indianapolis, Ind.	17.27	15-17.5	4.32	4-5
1		Akin-Erskine Milling Co., Evansville, Ind.	17.42	16.72	3.93	4.01
1		Alma Roller Mills Co., Alma, Mich.	15.44	—	4.38	—
1	A. B. C.	Annan Burg & Co., St. Louis, Mo.	16.72	14-17	3.88	4-5
1	Arrow	Ansted & Burk Co., Springfield, Ohio	17.03	14.5-15.5	4.55	4-5.5
1	Fancy	E. W. Bailey & Co., Montpelier, Vt.	17.42	—	4.10	—
1	Shorts	Ballard & Ballard Co., Louisville, Ky.	15.79	16.12	4.41	4.51
2	Banner	Banner Milling Co., Buffalo, N. Y.	16.70	—	5.41	—
2	White Satin	Barber Milling Co., Minneapolis	16.46	15.00	4.82	4.50
1		Bemmels Milling Co., Lisbon, N. Dakota	14.66	14-18	5.81	5-7
1	Bulls Eye	Blish Milling Co., Seymour, Ind.	16.36	16.20	4.33	4.90
1	Fancy	C. W. Bowker & Co., Worcester	16.32	16-19	5.09	4-5
3	Erie	Chapin & Co., Boston	16.88	14-18	4.51	3-5
1	Huron	" " "	16.50	15-18	4.87	4-7
1	Pine Tree	" " "	15.79	14-18	4.15	3-5
1	Rutland	" " "	15.66	14-18	4.75	4-6
4	Vermont	" " "	16.69	14-18	4.78	4-6
2	Winter Wheat	" " "	16.02	14-18	4.29	3-5
3	Claro	Claro Milling Co., Lakeville, Minn.	16.09	14-17	5.23	3-5
2	Winter Wheat	Wm. A. Coombs Milling Co., Coldwater, Mich.	16.09	15-18	4.73	3-6
1	Columbia	Chas. M. Cox Co., Boston	16.14	—	5.09	—
1	Newton	" " " " "	16.90	14.85	4.17	3.58
3	Regent	" " " " "	16.82	—	5.32	—
1	Samoset	" " " " "	16.32	—	4.66	—
2	Wirthmore	" " " " "	17.27	16-19	4.70	4-5
3	Boston	Duluth-Superior Milling Co., Duluth, Minn.	17.07	16.00	5.53	4.50
2	E. A. C. O.	Everett, Aughenbaugh & Co., Waseca, Minn.	17.07	15-19	4.87	3-6

WHEAT MIXED FEED—(Continued).

No. Samples.	Brand.	Manufacturer.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.
			%	%	%	%
2	Winged Horse ...	Everett, Aughenbaugh & Co., Waseca, Minn.	15.95	14-19	5.16	3-6
1		Eckhart & Swan Milling Co., Chicago.....	15 88	—	4.39	—
1		Farmers Milling Co., St. Cloud, Minn......	15.09	—	4.10	—
4	Garland	Garland Milling Co., Greensburg, Ind......	16.90	15¼-16	4.24	3.75-4
1	Manhattan	Hecker-Jones-Jewell Milling Co., New York.	16.61	15.94	4.83	5.65
2	Matchless	Hunter Bros., Milling Co., St. Louis, Mo...	17.11	15.00	4.68	4.00
2	Sunshine	" " " " " " " ..	17.02	15.00	4.26	4.00
1		" " " " " " " ..	16.67	15.00	4.58	4.00
2		Kehlor Flour Mills Co., St. Louis, Mo......	16.81	14-16	4.10	4.00
1		Lancenberg Bros. Co., St. Louis, Mo.......	17.34	16.00	4.48	4.00
2	Snow Flake	Lawrenceburg Roller Mills, Law'ceb'g, Ind.	16 93	—	4.44	—
2	Lexington	Lexington Roller Mills, Lexington, Ky.....	15.95	—	4.46	—
3	Uniform	D. L. Marshall Milling Co., Buffalo..	15.53	16-19	4.49	3-5
1	Powerful	A. B. McCrillis & Son Co., Boston.........	16.55	16.50	5.17	5.25
1	Extra Powerful ..	" " " " " " "	17.64	16.00	5.55	5.25
3	Millbourne	Millbourne Mills, Philadelphia............	16.55	13-18	4.48	3-6
3	King	R. P. Moore Milling Co., Princeton, Ind....	16.93	15.00	4.28	4.00
2	Planet............	Northwestern Consol. Mill. Co., Minneapolis	16.99	16.00	5.73	5.25
2		Pillsbury Mills, Minneapolis...............	16.22	14-16	4.67	4-4.5
2	Buckeye....	Quaker Oats Co., Chicago................	15.97	13-17	4.22	4-4.7
1	Fanchon	Quality Mills, Enterprise, Kansas..........	17.44	14.26	4.55	4.00
1	Bixota	Red Wing Milling Co., Red Wing, Minn...	15.88	14.00	5.28	4.20
2	Regular	Russell Flour Co., Albany, N. Y..........	16.50	15.00	5.30	4.50
5	Occidental	Russell-Miller Milling Co., Minneapolis....	16.77	15-18	5.19	4-5
1		Scott County Milling Co., Sikeston, Mo....	16.81	17.00	5.01	4.50
1	Big Diamond.....	Sheffield-King Milling Co., Minneapolis....	15.79	19.00	5.26	4.50
4	Gold Mine	" " " " "	16.57	17.00	5.11	4.50
2	Sleepy Eye	Sleepy Eye Milling Co., Sleepy Eye, Minn.	16.08	12.00	4.59	5.00
1	Heavy	David Stott, Detroit, Mich................	16.37	16.50	4.54	5.00
2	Honest	" " " "	16.13	—	4.66	—
2		Stratton & Co., Concord, N. H.............	15.49	—	4.51	—
1	Monarch	F. W. Stock & Sons, Hillsdale, Mich.......	15.79	—	4.80	—
1	Moosomin........	Sutchliffe, Muir Mill., Moosomin, Sask, Can.	15.44	—	5.01	—
3		Thornton & Chester Milling Co., Buffalo..	16.28	14-18	5.02	3-5
1	Valier's	Valier & Spies Milling Co., Marine, Ill.....	16.19	—	5.16	—
2	Mill Run	Waggoner-Gates Mill.Co., Independence, Mo.	17.86	15.00	4.02	4.00
1	Superior	Washburn-Crosby Co., Minneapolis........	16.70	16 00	5.06	4.50
3	Webster..........	Webster Mill Co., Webster, So. Dakota....	15 78	—	5.33	—
2	Best	Whitman Grain & Coal Co., Whitman.....	17.07	16-18	5.33	4-5
4	Kent	Williams Bros. Co., Kent, Ohio............	15.92	12-18	4.27	2-5
1	Searchlight	Wisconsin Milling Co., Menomonie, Wis...	15.93	16.00	5.06	5.00
1	Columbia.........	Not given.............................	16.06	—	3.28	—
1	Extra Powerful ..	" "	17.00	16.00	5.38	5.25
		Highest	17.86	—	5.81	—
		Lowest............................	14 66	—	3.88	—
		Average..........................	16.49	—	4.74	—

WHEAT BRAN.

No. Samples.	Brand.	Manufacturer.	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.
			%	%	%	%
1		Arms & Kidder, Kansas City, Mo.	16.90	—	4.77	—
1		Amendt Milling Co., Monroe, Mich.	16.99	—	4.10	—
1	Ballard's	Ballard & Ballard Co., Louisville, Ky.	16.46	16.58	3.86	4.60
1	Niagara	Cataract City Milling Co., Niagara Falls, N.Y.	15.84	14.78	5.05	4.12
1	Jersey	Geo. C. Christian & Co., Minneapolis	15.40	13.00	5.11	4.00
1		Cumberland Mills Co., Nashville, Tenn.	16.14	14.50	4.13	4.00
1	Eagle	Eagle Roller Mills Co., New Ulm, Minn.	14.97	14 00	5.00	4.00
1		Eckhardt & Swan Milling Co., Chicago	16.37	—	4.06	—
1		Federal Milling Co., Lockport, N. Y.	15.58	—	5.47	—
2	Cloverleaf	Gardner Mill, Hastings, Minn.	15.20	13 50	5.20	4.50
1	100% Pure	Gwinn Milling Co., Columbus, Ohio	16.72	15-18	4.39	4-6
2	Dreadnought	Hunter-Robinson-Wenz Milling Co., St Louis	16 50	14.50	4.65	4.00
1	Repeater	" " " " " " "	15 58	14.5-17	4.44	3 5-5
1	Anchor	Kemper Mill & Elevator Co., Kansas City	16.50	14 50	4.56	4 00
1		Liberty Mills, Nashville, Tenn.	17.16	14.50	3.63	4.00
1	Bran & Screenings	Lindsborg Mill. & Elevator, Lindsborg, Kans.	17 53	13.00	3.78	4.00
1	Extra Macco	A. B. McCrillis & Son Co., Boston	16.25	14 29	4 31	4.16
1	Powerful Stand	" " " " " " "	15.09	14.25	4 98	4.00
1	Mystic	Mystic Milling Co., Sioux City, Iowa	15.36	14.00	4 49	4.00
1	Seal of Minnesota.	New Prague Flour Mills, New Prague, Minn.	15.23	14.00	5.11	4.03
1		Northwestern Consol. Mill. Co., Minneapolis	15.46	14.25	4.90	4.00
1	Quality	Quality Mills, Enterprise, Kansas	16 74	14.26	3.65	4.00
1		James Quirk Milling Co., Montgomery, Minn.	14.97	14 50	4.77	4.40
1		Star & Crescent Milling Co., Chicago, Ill.	15.84	13-15	3.92	3.5-5
1	Stott's	David Stott, Detroit, Mich.	15.49	16.00	4.34	4.00
1	Vimco	Valley City Milling Co., Grand Rapids, Mich.	15.40	—	4.20	—
2	Voight's	Voigt Milling Co., Grand Rapids, Mich.	14.94	—	4.05	—
1		Washburn-Crosby Co., Minneapolis	15 14	14.50	5.31	4.00
1	Big Jo	Wabasha Roller Mill. Co., Wabasha, Minn.	15.95	15.20	5.09	5.10
1	Mill Run	Waggoner-Gates Mill Co., Independence, Mo.	17.20	15.00	4.30	4 00
1	Snow's Fancy	E. S. Woodworth & Co., Minneapolis	16 41	14.25	5.29	4.00
1	Diamond	Not given	15 20	—	5.17	—
		Highest	17.53	—	5.47	—
		Lowest	14 94	—	3.63	—
		Average	15.92	—	4.57	—

ADULTERATED WHEAT FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
1. Middlings.						
Indiana Milling Co., Terre Haute, Ind.						
Flo Middo, ...F. Diehl.............	Wellesley	11.93	11-13	2.64	2.5-3.5	9.37
New Occidental Mill. Co., Minneapolis.						
Aloras, ...Bedford Coal & Gr. Co.	Bedford.	17.29	16.00	8.03	5 00	—
Aloras, ...Lummus & Parker	Danversport ..	16.41	16.00	6.31	5.00	—
Aloras, ...Conant & Co	Littleton	16.06	16.00	7.24	5.00	—
2. Mixed Feed.						
F. L. Cressey, Boston.						
Indiana,..........A. P. Ames & Co......	Peabody	11.67	10-12.05	2.95	2-3.20	13.57
Indiana Milling Co., Terre Haute, Ind.						
Jersey, ...Mackenzie & Winslow	Fall River	10.18	10-12.05	2.89	2-3.20	16.71
Jersey, ...W. J. Meek	Fall River	12.71	10-12	2.91	2.5-3.5	13.84
Sterling, ...Bedford Coal & Gr. Co.	Bedford	12.86	11.5-13	3.10	3-4	12.46
Sterling,. ....N. Paquin & Sons	Fall River	12.81	11.5-13	2.99	3-4	12.80
A. Waller & Co., Henderson, Ky.						
Blue Grass, ...J. A. Bouvier	New Bedford..	10.75	10.00	2.85	2.50	14.88
Blue Grass, ...J. A. Bouvier	New Bedford..	11.10	9-11	3.61	2-3	15.62
Blue Grass, ...H. H. Capen..........	Spencer.......	11.14	9-11	3.14	2-3	15.79
Blue Grass, ...Curley Bros..........	Wakefield	11.98	9-11	3.02	2-3	14.64
Average.............	....	11.69	—	3.05	—	14.48

DAIRY FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Ajax Milling & Feed Co., Buffalo, N. Y.						
Unicorn, ...F. E. Smith	Amherst.......	27.73	26.00	6.18	6.00	9.28
Unicorn, ...W. N. Potter & Son ..	Charlemont....	27.45	26.00	5.59	6.00	8.86
Unicorn, ...C. Bond.............	Charlton	26.98	26.00	5.10	6.00	8.99
Unicorn, ...B. W. Brown	Concord.......	25.03	26.00	6.56	6.00	8.05
Unicorn, ...Marlboro Grain Co ...	Marlboro	27.47	26.00	8.59	6.00	8.48
Unicorn, ...W. N. Potter Sons Co.	Northampton ..	26.41	26.00	7.50	6.00	8.27
Unicorn, ...Warner Bros	Sunderland ...	26.15	26.00	6.81	6.00	9.00
Ames, Burns & Co., Jamestown, N. Y.						
A. B. C., ...Sykes Coal & Grain Co.	North Adams..	26.85	20-24	10.92	8.00	7.12
J. W. Biles Co., Cincinnati, Ohio.						
Union Grains, ...W. N. Potter Sons Co.	Hadley........	24 66	24.00	7.26	7.00	8.93
Union Grains, ...Cutler Grain Co.......	S. Framingham	25.54	24 00	6.92	7.00	9.96
Union Grains, ...Cutler Grain Co.......	S. Framingham	25.19	24.00	7.14	7.00	8.95
Union Grains, ...H. G. Puffer Co	Springfield	25.23	24.00	6.86	7.00	9.53
Union Grains, ...J. L. Nason	Westboro	24.74	24.00	7.07	7.00	12.91
J. Bibby & Sons, Liverpool, England.						
Oil Cake Feed,....B. W. Brown	Concord.......	20.89	16.00	8.01	7.00	9.54
Oil Cake Feed,....J. Loring & Co.	Watertown	19.31	18.20	8.07	6.80	—
Oil Cake Feed,....E. & A. M. Fullerton.	Brockton	19.13	18.00	8.54	6.80	9.37

DAIRY FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Buffalo Cereal Co., Buffalo, N. Y.						
Creamery Feed. ..Griffin Bros...........	Fall River	20.95	20.00	6.05	5.00	9.19
Creamery Feed, ..F. H. Crane & Son ...	Quincy Adams.	20.97	20.00	4.91	5.00	8.14
H-O Co., Buffalo, N. Y.						
Algrane Milk, ...J. O. Ellison & Co.....	Haverhill......	19.48	14.00	3.95	4.00	11.57
Algrane Milk, ...Lenox Coal Co	Lenoxdale.....	18.57	14.00	3.67	4.00	12.79
Algrane Milk, ...H. E. Noyes..........	Lowell	17.81	14.00	4.20	4.00	12.92
Penna. Primo Feed Co., Harrisburg, Pa.						
*Sylva,............Wallace Grain Co	Clinton........	15.75	14.69	3.57	5.11	11.27
*Sylva,............H. Bruckman	Lawrence	15.79	14.69	3.18	5.11	10.14
St. Albans Grain Co., St. Albans, Vt.						
Farmers' Friend, .P. Foisy..............	New Bedford..	28.30	26-30	5.06	5-7	9.05
Paragon, ...W. R. Ross Co.	Holyoke.......	33.52	28-30	6.54	5-7	11.03
Paragon, ...Bedford Coal & Gr.Co.	Bedford	33.79	28-30	6.06	5-7	10.50

MOLASSES FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Alfalfa Meal Co., Omaha, Neb.						
Payne's Alfalmo, .Taunton Grain Co.....	Taunton.......	12.64	—	0.80	—	17.99
American Milling Co., Chicago.						
Sucrene Dairy, ...Dennison Plummer Co.	New Bedford..	16.50	16.50	4.02	3.50	11.40
Sucrene Dairy, ...Prentiss, Brooks & Co.	Easthampton ..	16.76	16.50	4.76	3.50	13.38
Sucrene Dairy, ...Sprague & Williams ..	S. Framingham	16.19	16.50	4.95	3.50	11.71
Sucrene Dairy, ...G. Methe.............	Springfield	18.07	16.50	5.31	3.50	11.31
Sucrene Horse, ..Prentiss, Brooks & Co.	Easthampton ..	10.84	10.00	3.07	3.00	9.78
Sucrene Horse, ..W. A. Haynes Co.....	Maynard	10.97	10.00	2.27	3.00	10.37
Sucrene Horse, ..G. Methe	Springfield	9.56	10.00	2.78	3.00	9.69
Ames, Burns & Co., Jamestown, N. Y.						
Consolidated, ...Sykes Coal & Grain Co	North Adams..	16.23	16-18	5.63	3.5-4.5	9.84
F. W. Dorr & Co., Newton Center.						
Harvard, ...F. W. Dorr & Co.	Newton Center.	19.00	18-20	3.56	4-6	6.76
Great Western Cereal Co., Chicago.						
Daisy, ...A. E. Lawrence & Son.	Ayer	17.87	14.00	2.01	3.00	9.70
Hunter Bros. Milling Co., St. Louis, Mo.						
Best of All,.......H. C. Bowen & Son...	Cheshire	15.50	15.00	3.20	3.00	16.79
Husted Milling Co., Buffalo, N. Y.						
Regal,............C. F. Pease...........	Chester	11.41	7-9	3.43	3-4	8.52
Husted's,.........A. Dodge Sons Corp..	Beverly	16.32	16-18	3.78	4-6	10.12
Husted's,.........G. H. Pease	Chester	16.72	18-20	2.70	4-5	6.58
Husted's,.........I. N. Boucher & Son..	East Dedham..	17.90	18-20	3.36	4-6	7.08
International Sug'r Feed Co.,Minneapolis						
International, ...Wachusett Grain Co...	Clinton........	16.67	16.50	4.70	3.50	10.94

* Withdrawn from market.

MOLASSES FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.
		Found.	Guar.	Found.	Guar.	
		%	%	%	%	%
Chas. A. Krause Milling Co., Milwaukee.						
Badger, ... City Mills Co.	Holyoke	16.50	16-18	4.88	3.5-4.5	11.52
Badger, ... N. Hatfield Grain Co..	N. Hatfield....	15.01	16-18	3.31	3.5-4.5	11.20
Badger, ... J. B. Bridges & Co....	S. Deerfield ...	15.80	16-18	5.21	3.5-4.5	12.82
Northwest Mills Co., Winona, Minn.						
Sugarota Dairy, .. Potter & Co..........	Athol	18.30	18.00	8.46	4.60	16.75
Sugarota Dairy, .. Lummus & Parker ...	Danversport...	16.85	18.00	5.36	4.50	16.98
Sugarota Dairy, .. Mackenzie & Winslow	Fall River.....	17.42	18.00	6.37	4.50	11.08
Sugarota Dairy, .. Mackenzie & Winslow	Fall River.....	18.22	18 00	6.36	4.50	10.62
Sugarota Dairy, .. Dennison Plummer Co.	New Bedford..	16.72	18.00	6 44	4.50	16.44
Sugarota Dairy, .. J. B. Garland & Son ..	Worcester.....	18.60	18.00	6.68	4.50	17.63
Sugarota Horse, .. A. P. Ames Co........	Peabody	15.27	12.00	5.26	3.50	19.27
Sugarota Swine, .. A. P. Ames Co........	Peabody	17.03	18.00	6.55	4.50	13 06
Quaker Oats Co., Chicago.						
*Molac, ... J. Waite..............	Easthampton ..	13.90	11-13	3.27	3-4	14.46
*Molac, ... G. H. Reed...........	South Acton...	13.56	15.5-17	1.88	3-4	9.81
*Molac, ... C. W. Mead..........	West Acton ...	14.48	15.5-17	3.18	3-4	9.52
Quaker, ... A. Dodge & Son......	Beverly	15.79	16.00	2.86	3.50	13.12
Quaker, ... Sprague & Williams ..	S. Framingham	17 60	16.00	2.87	3.50	13.28
Western Grain Prod. Co., Hammond, Ind.						
Hammond Dairy, . Patrons Co-op. Assoc..	Lowell	16.32	17.00	4.70	3.00	11.02
Hammond Dairy, . Berks're Coal & Gr. Co.	North Adams..	16.72	17.00	4.03	3.00	10.40
Hammond Horse.. Berks're Coal & Gr. Co.	North Adams..	13.30	9.00	2.35	4.00	11.99

RYE FEEDS.

Geo. T. Callahan, Castleton, N. Y.						
G. C. Turner	Chester	15.05	12.00	2.68	2 00	—
Oneonta Milling Co., Oneonta, N. Y.						
Middlings, ... G. H. Reed...........	West Acton ...	15 67	—	3.22	—	—
Potter & Wright, Boston.						
Meal, ... A. Dodge & Son......	Beverly	12.02	—	1.99	—	—
Washburn & Crosby, Minneapolis.						
Middlings......... N. Hatfield Grain Co..	N. Hatfield....	16.23	14.00	3.44	3.00	—

CALF MEAL.

Blatchford Calf Meal Fac., Waukegan, Ill.						
Blatchford's, ... Eastern Grain Co.....	Bridgewater ...	29 04	25 00	5.54	5.00	5.84
Blatchford's. ..... J. W. Doon	Natick	23.26	25.00	4.65	5 00	—

* Withdrawn from market.

CALF MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Chapin & Co., Boston.						
Triangle, ...W. A. Haynes........	Maynard	23.91	22.00	12 87	10.00	—
Great Western Cereal Co., Chicago.						
Gregson, ...C. Bond	Charlton	25.36	25.00	7.27	5.00	4.80
Northwest Mills Co., Winona, Minn.						
Sugarota, ...C. Bond	Charlton	30.05	25.00	6.74	6.00	—
Quaker Oats Co., Chicago.						
Schumacher's, ...A. E. Lawrence & Son	Ayer	20.67	19-21	7.72	8-9.5	—
Schumacher's, ...W. E. Bryant & Co...	Brockton	19.39	19-21	9.86	8-9.5	2.07
Schumacher's, ...J. W. Doon	Natick	19.22	19-21	8.55	8-9.5	—

II. Starchy (Carbohydrate) Feeds.

CORN MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Ground by Retailer.						
E. J. Adams	Gt. Barrington	9.17	—	3.76	—	1.68
A. Culver Co.	Rockland	8.60	—	3.03	—	0.77
Dresser Hull Co.	Lee	9.39	—	3.97	—	1.42
Griswold & Adams	Dalton	9.65	—	3.20	—	2.73
E. F. Howard	Ware	9.21	—	3.82	—	1.88
Wallace Lord	Athol	8.95	—	3.98	—	1.84
W. J. Meek	Fall River	8.76	—	3.00	—	1.14
N. Hatfield Grain Co.	N. Hatfield	9.37	—	4.14	—	1.76
J. B. Norton	Warren	8.29	—	3.22	—	3.76
Prentiss, Brooks & Co.	Westfield	8.95	—	2.78	—	1.71
Prentiss, Brooks & Co.	Westfield	9.13	—	4.02	—	1.83
G. C. Turner	Chester	7.32	—	3.55	—	1.57
Spring'd Flour & Gr. Co	Springfield	9.44	—	4.40	—	1.37
C. P. Washburn	Middleboro	9.30	—	3.12	—	1.76
C. P. Washburn	Middleboro	9.44	—	2.77	—	1.51
E. F. Wilbur & Sons	Mansfield	8.95	—	3.69	—	1.86
Cracked, H. C. Bowen & Son	Cheshire	8.44	—	3.91	—	—
Cracked, Spring'd Flour & Gr. Co	Springfield	9.17	—	4.10	—	—
E. W. Bailey & Co., Montpelier, Vt.						
J. E. Merrick & Co.	Amherst	9.35	—	3.98	—	1.74
Buffalo Cereal Co., Buffalo, N. Y.						
B, Hathaway & McKenzie	New Bedford	10.23	—	5.99	—	2.58
Granulated, Hathaway & McKenzie	New Bedford	9.00	—	1.11	—	—
Mohawk, Lenox Coal Co.	Lenoxdale	8.60	—	2.91	—	0.63
Mohawk, F. H. Crane & Sons	Quincy	8.16	—	2.35	—	0.71
Seneca, Griffin Bros.	Fall River	10.20	—	4.86	—	2.46
J. Cushing & Co., Fitchburg.						
N. Paquin & Sons	Fall River	8.60	—	3.81	—	1.90
C. A. Smith	Dighton	8.86	—	3.66	—	2.12
Cutler Co., North Wilbraham.						
H. H. Capen	Spencer	8.78	—	4.26	—	1.98
J. B. Garland & Son, Worcester.						
C. Bond	Charlton	8.74	—	4.07	—	2.11
Great Western Cereal Co., Chicago.						
H. Bullikan	Franklin	6.49	—	1.20	—	0.32
Husted Milling Co., Buffalo.						
Fancy, Hoosac Val. Coal & Gr. Co	Adams	7.63	—	2.13	—	—
Fine bolted, M. C. Richmond	Adams	7.50	—	1.29	—	—
Narragansett Mill. Co., E. Providence, R. I.						
A, Taunton Grain Co.	Taunton	8.86	—	3.39	—	1.60
B, Taunton Grain Co.	Taunton	8.82	—	2.70	—	2.60
A. Culver Co	Rockland	9.17	—	3.53	—	2.35

CORN MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Quaker Oats Co., Chicago.						
Feed Meal, ...W. N. Potter Grain Co	Gardner	9.39	8.5-10.5	5.21	3-5	2.38
Feed Meal, ...E. A. Cowee	Worcester	9.13	8.5-10.5	4.98	3-5	2.30
F. Dunham...........	Sheffield	9.04	—	5.33	—	2.62
Smith, Northam & Co., Hartford, Conn.						
Bolted, ...W. N. Potter & Sons..	Northampton ..	7.99	—	3.35	—	—
Granulated, ...W. N. Potter & Sons..	Northampton ..	8.91	—	1.85	—	—
J. F. Shine	Dedham.......	8.51	—	6.82	—	3.02
Stratton & Co., Concord, N. H.						
I. J. Powell	Pepperell......	9.17	—	3.97	—	1.95
Average..............	....	8.85	—	3.59	—	1.88

GROUND OATS.

F. H. Crane & Sons ..	Quincy Adams.	11.14	—	5.70	—	6.86
Whole, ...W. S. Harrington.....	Adams	10.36	—	5.25	—	10.09
J. F. Hunt............	Lynn..........	11.14	—	4.87	—	9.82
E. C. Packard	Brockton	11.06	—	3.80	—	8.35
Potter & Co	Athol	11.58	—	4.20	—	9.09
Potter & Co	Athol	10.32	—	3.60	—	7.39
Prentiss, Brooks & Co.	Holyoke.......	12.24	—	4.77	—	9.64
Smith Feed Co	Westfield......	11.98	—	3.16	—	7.15
Average..............	....	11.23	—	4.42	—	8.55

FEED BARLEY.

J. Cushing & Co., Fitchburg.						
N. Paquin & Sons	Fall River. ...	12.25	—	2.49	—	4.80

HOMINY MEAL.

Allen Baker Commission Co., St. Louis.						
Crown, ...L. A. Snow...........	Upton.........	10.23	11.02	8.38	7.70	—
American Hominy Co., Indianapolis, Ind.						
Homco, ...W. E. Bryant & Co...	Brockton	11.69	8.50	7.80	7.70	—
Homco, ...J. Cushing & Co......	Fitchburg	10.62	8.50	9.13	7.00	—
Homco, ...J. B. & W. A. Lamper.	Lynn..........	9.13	8.50	6.22	7.50	—
J. H. Nye	Brockton	11.06	10.24	8.28	7.24	—

HOMINY MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
M. F. Baringer, Philadelphia.						
W. E. Bryant & Co. ..	Brockton	10.44	9.00	8.69	6.00	—
Mackenzie & Winslow.	Fall River	11.84	9.00	10.95	6.00	—
Lexington Grain Co...	Lexington	10.40	9.00	8.46	6.00	—
Buffalo Cereal Co., Buffalo.						
N. Paquin & Sons	Fall River	9.21	10.25	5.75	8.00	2.93
N. Paquin & Sons	Fall River	11.19	10.25	8.60	8.00	—
Hathaway & McKenzie	New Bedford..	10.49	—	8.33	—	—
Chapin & Co., Boston.						
Green Diamond,.. D. J. Harrington......	Turners Falls..	10.75	10-11	7.99	7-9	—
Niagara, ... Lummus & Parker	Danversport...	10.58	10-11	7.97	7-8	—
Chas. M. Cox Co., Boston.						
Paragon, ... Haverhill Grain Co ..	Haverhill......	10.27	10.5-12	8.46	7.5-9	—
Paragon, ... Bryant & Soule.......	Middleboro....	10.53	9.5-12	8.11	7.5-9	—
Paragon, ... J. W. Doon...........	Natick	11.23	10.5-12	8.65	7.5-9	—
Paragon, ... G. H. Reed...........	West Acton ...	10.71	10.5-12	8.59	7.5-9	—
Wirthmore, ... Eastern Grain Co.....	Bridgewater ...	10.53	9.5-12	9.34	7.5-9	—
Wirthmore, ... Wallace Grain Co	Clinton........	10.36	9.5-12	8.36	7.5-9	—
Wirthmore, ... F. F. Woodward & Co.	Fitchburg	11.23	9.5-12	9.81	7.5-9	—
Wirthmore, ... Haverhill Grain Co ..	Haverhill......	9.74	9.5-12	7.69	7.5-9	—
Wirthmore, ... A. T. Knight & Co....	Hudson	11.41	9.5-12	10.30	7.5-9	—
Wirthmore, ... R. D. Bowen	Leominster	10.88	9.5-12	6.58	7.5-9	—
Wirthmore, ... Conant & Co	Littleton	10.32	9.5-12	8.50	7.5-9	—
Yellow, ... C. G. Burnham	Holyoke	10.62	10-12	8.38	7-9	—
Yellow, ... A. D. Potter..........	Orange........	10.49	10-12	8.78	7-9	—
Decatur Cereal Co., Decatur, Ill.						
OXO,............ J. E. Merrick & Co....	Amherst.......	10.40	11.02	8.09	7.70	—
OXO,............ Cutler Co	S. Framingham	10.27	11.02	8.50	7.70	—
OXO,............ H. H. Capen..........	Spencer	11.32	11.02	10.47	7.70	—
Deutsch & Sickert, Milwaukee, Wis.						
Success,.......... Wallace Grain Co	Clinton........	11.14	11.00	9.93	7.00	4.78
Success,.......... C. G. Burnham.	Holyoke	11.32	11.00	10.31	7.00	4.55
Evans Milling Co., Indianapolis, Ind.						
Evan's, ... H. Bruckman	Lawrence	12.29	10 00	7.90	8.00	—
Evan's, ... Webster Grain Co ...	Lawrence	11.41	10.00	9.59	8.00	—
Rodney J. Hardy & Sons, Boston.						
Lenox. .... R. D. Bowen	Leominster....	10.97	10-12	7.67	7.5-9	—
W. H. Haskell & Co., Toledo, Ohio.						
J. O. Ellison Co	Haverhill......	10.40	10.25	8.69	8-10	—
Bliss & Co............	Taunton	10.05	10.25	7.76	8-10	—
Hunter Bros. Milling Co., St. Louis.						
J. Shea	Lawrence	10.05	8.5-10.5	8.14	7-8.5	—
A. D. Potter..........	Orange........	10.79	8.5-10.5	9.53	7-8.5	—
Hunter-Robinson-WenzMil.Co.,St.Louis						
Capital, ... J. B. Garland & Son ..	Worcester.....	10.97	11.02	8.87	7.78	—

HOMINY MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Husted Milling Co., Buffalo.						
F. E. Smith	Amherst	10.97	9-11	8.37	6-8	—
J. A. Bouvier	Fall River	10.05	9-11	7.59	4-6	—
H. E. McEachron Co., Wausau, Wis.						
Lexington Grain Co	Lexington	11.14	11.25	8.25	8.50	—
Miner-Hillard Mill. Co., WilkesBarre, Pa.						
W. N. Potter Sons&Co	Hadley	11.06	10-12	9.16	7.5-9	—
Lohan Bros	Marblehead	11.19	10-12	8.50	7.5-9	—
Taunton Grain Co	Taunton	11.27	10-12	8.98	7.5-9	—
Taunton Grain Co	Taunton	10.97	10-12	7.91	7.5-9	—
Wilson & Holden	Worcester	11.14	10-12	8.86	7 5-9	—
Patent Cereals Co., Geneva, N. Y.						
J. A. Bouvier	New Bedford	10.71	10-11	7.34	7-8	—
Quaker Oats Co., Chicago.						
Curley Bros	Wakefield	10.44	10.25	7.95	8.00	—
Geo. B. Robinson, Jr., New York.						
O. F. Metcalf & Sons	Franklin	11.23	9-11	10.84	6-8	—
J. B. Garland & Son	Worcester	10.88	9-11	11 12	6-8	—
J. E. Soper & Co., Boston.						
Blue Ribbon, ...Mackenzie & Winslow	Fall River	10.90	10.00	7.76	8 00	—
Blue Ribbon, ...Bryant & Soule	Middleboro	10.58	10.00	7.81	8.00	—
Suffern, Hunt & Co., Decatur, Ill.						
Acme, ...A. Dodge & Sons Corp.	Beverly	11.19	9.3-11	9.50	7.1-9	—
Acme, ...J. D. Norton	Warren	11.06	9.3-11	9 11	7.1-9	—
Acme, ...Cutler Co	Warren	10 09	9 3-11	7.54	7.1-9	—
Toledo Elevator Co., Toledo, Ohio.						
†Star, ...F. G. Cover & Co	Lowell	8.65	7-10	6.22	6.5-8	9.48
†Star, ...F. G. Cover & Co	Lowell	8.95	7-9	6.72	5.5-7	9.88
†Star, ...S. L. Davenport & Son	North Grafton	9 09	7-10	6.27	6.50	11.21
†Star, ...Spring'd Flour&Gr.Co.	Springfield	8.51	7-10	5.81	6 5-8	6.62
†Star, ...F. Diehl & Son	Wellesley	9.17	7.00	6.94	6.00	10 15
Highest		11.84	—	11.12	—	—
Lowest		9 21	—	5.75	—	—
Average		11.21	—	8.61	—	—

† Contains ground corn cob, and not sold as straight hominy meal. Not included in average.

PROVENDER.

Manufacturer or Jobber, Brand and Retailer.	Sampled at :	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Ground by Retailer.						
E. J. Adams	Gt. Barrington	9.65	—	3.68	—	4.42
H. C. Bowen & Son	Cheshire	9.30	—	3.35	—	4.41
C. G. Burnham	Holyoke	9.48	—	3.74	—	3.66
F. G. Cover & Co	Lowell	10.71	—	4.66	—	4.46
E. A. Cowee	Worcester	10.36	—	4.23	—	3.65
Dennison Plummer Co	New Bedford	9.13	—	3.32	—	5.28
Dresser Hull Co	Lee	10.01	—	3 87	—	3.06
J. B. Garland & Son	Worcester	10.31	—	3.88	—	5.54
Ham & Co	Woburn	10.71	—	4.00	—	5.10
E. F. Howard	Ware	10 05	—	3.90	—	4.06
H. W. Miller	Pittsfield	10.58	—	4.03	—	5.22
I. Morton & Co.	Plymouth	9.56	—	3.53	—	3.85
J. B. Norton	Warren	9.61	—	3.85	—	5.55
N. Hatfield Grain Co.	N. Hatfield	9 04	—	3.83	—	2.70
Prentiss, Brooks & Co.	Holyoke	9.79	—	3 87	—	3.09
(½ and ½), Red Mill Feed Co	Ashley Falls	10.75	—	4 23	—	5.10
C. H. Smith	Dighton	10.09	—	4.65	—	5.12
Sprague & Williams	S. Framingham	10.09	—	4.07	—	4.05
Spring'd Flour & Gr. Co	Springfield	9.79	—	3.86	—	4.00
L. M. Stanbridge	Greenfield	10.01	—	4.02	—	4.06
G. C. Turner	Chester	9.13	—	3.90	—	2.89
C. P. Washburn	Middleboro	10.97	—	4.47	—	7.39
*Bran and corn, A. F. Sanctuary	Amherst	11.49	—	4.16	—	4.81
Buffalo Cereal Co., Buffalo.						
(½ and ½), Lenox Coal Co	Lenoxdale	10 38	9.00	4.11	4.00	4 27
J. B. Garland & Son, Worcester.						
O. F. Metcalf & Son	Franklin	10.32	—	4 20	—	5.11
Husted Milling Co., Buffalo.						
(½ and ½), G. F. Pease	Chester	10 50	—	4.87	—	7.35
(½ and ½), G. F. Pease	Chester	9 92	—	5.37	—	5.16
Narragansett Mill. Co., E. Providence, R.I.						
Taunton Grain Co	Taunton	8.91	9.00	3.94	3.80	2.60
Smith, Northam Milling Co., Hartford, Ct.						
H. Bullikian	Franklin	9.35	9 00	4.00	4.00	3.11
Stratton & Co., Concord, N. H.						
(½ and ½), I. J. Rowell	Pepperell	9.83	—	3 94	—	3.91
Highest		10.97	—	5.37	—	7.39
Lowest		8.91	—	3.32	—	2.60
Average		9.99	—	4.05	—	4.43

* Not included in average.

CORN AND OAT FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
American Hominy Co., New York.		%	%	%	%	%
Hexagon, ... A. Dodge & Sons Corp.	Beverly	8.60	6-10	5.75	5-8	11.81
Valor, ... Lohan Bros.	Marblehead ...	8.08	6.50	3.69	3.50	8.91
Valor, ... P. Foisy	New Bedford ..	10.14	5-8	3.74	2.5-4.5	10.89
Valor, ... J. W. Wilder	Springfield	7.28	8.00	2.96	3.50	11.33
Buffalo Cereal Co., Buffalo.						
Chop, ... I. J. Rowell	Pepperell	8.58	7-8	3.01	3-4	10.31
Horse, ... Griffen Bros	Fall River	11.65	10-12	5.23	4-5	8.51
Stock, ... C. H. Felker	Brockton	8.86	8-9	5.27	4-5	7.31
Stock, ... A. Culver Co.	Rockland	9.65	8-9	5.33	4-5	6.92
Burbeck & Brett, North Abington.						
All Right, ... Burbeck & Brett	N. Abington ...	9.48	9-11	7.89	4-5	8.07
Chas. M. Cox Co., Boston.						
Charlestock, ... W. J. Meek	Fall River	6.08	6-9	2.56	3-5	17.10
Charlestock, ... J. Altman	New Bedford ..	7.50	6-9	3.41	3-5	12.29
Special, ... C. H. Symmes	Winchester	10.27	9-11	5.75	4-5	12.44
Wirthmore, ... J. E. Merrick & Co ...	Amherst	9.79	10-12	7.02	4-5	7.52
Wirthmore, ... W. R. Ross & Co.	Holyoke	10.09	10-12	7.92	4-5	6.91
Chapin & Co., Boston.						
Pearl, ... J. B. Cover & Co	Lowell	7.68	6-10	3.21	3-5	6.12
J. Cushing & Co., South Acton.						
Acton's Best, ... J. Cushing & Co	South Acton ...	9.92	10-12	7.83	4-5	8.10
F. W. Dorr & Co., Newton Center.						
Matchless, ... F. W. Dorr & Co.	Newton Center.	9.83	10.00	6.97	4-5	7.54
Matchless, ... F. W. Dorr & Co.	Newton Center.	9.74	10-12	7.22	4-5	5.75
Empire Mills, Olean, N. Y.						
Empire, ... J. A. Bouvier.	New Bedford ..	8.43	7.63	3.68	2.97	7.07
J. B. Garland & Son, Worcester.						
Red Tag A, ... J. B. Garland & Son ..	Worcester	11.63	12.00	6.02	3.50	13.48
Red Tag A, ... J. B. Garland & Son ..	Worcester	11.98	12.00	5.61	3.50	10.74
Red Tag B, ... H. W. Kimball	Westboro	8.82	10.00	5.02	3.25	14.61
Red Tag B, ... J. B, Garland & Son ..	Worcester	9.92	10.00	5.33	3.25	15.29
Red Tag B, ... J. B. Garland & Son ..	Worcester	10.58	10.00	5.22	3.25	13.17
Great Western Cereal Co., Chicago.						
Boss, ... Geo. F. Wetherbee Est.	Gardner	8.51	8-10	4.13	3.50	8.68
Boss, ... C. G. Burnham	Holyoke	8.69	8-10	4.72	3.5-5	10.22
Boss, ... Mackenzie & Winslow	Fall River	8.82	8-10	3.11	3.5-5	9.04
Sterling, ... Mackenzie & Winslow	Fall River	11.51	10.00	2.84	4.00	7.06
Sterling, ... E. F. Wilbur & Son ...	Marshfield	10.01	10.00	3.72	4.00	11.00
W. H. Haskell & Co., Toledo, Ohio.						
Haskell's, ... Bliss & Co.	Taunton	9.90	8-10	7.97	4-5	7.16
Haskell's, ... Bliss & Co.	Taunton	10.05	8-10	7.13	4-5	8.51

CORN AND OAT FEEDS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
H-O Co., Buffalo.						
De Fi, ... Webster Grain Co....	Lawrence	7.19	8.30	2.81	3.00	14.81
De Fi, ... Lexington Grain Co ..	Lexington ...	7.37	8.00	2.90	3.00	13.89
N. E. Stock, ... J. O. Ellison Co	Haverhill......	7.99	9.00	5.18	4.00	14.65
N. E. Stock, ... C. G. Burnham	Holyoke.......	8.82	9.00	5.87	4.00	14.09
N. E. Stock, ... E. F. Wilbur & Son ..	Marshfield	8.95	9.00	4.98	4.00	11.53
N. E. Stock, ... Jaquith & Co	Woburn	9.17	9.00	4.98	4.00	11.56
Husted Milling & Elevator Co., Buffalo.						
Husted Stock, ... Mackenzie & Winslow	Fall River	9.06	8-10	4.44	4-6	6.91
Eclipse, ... W. D. French	Sheffield	11.32	9-11	4.92	4-6	7.05
Monarch, ... W. N. Potter Grain Co	Gardner	8.65	7.5-9	4.10	3.5-4.5	7.85
Monarch, ... P. Foisy..............	New Bedford..	9.17	7-9	5.28	3-4 5	8.63
Regal, ... G. H. Pease..........	Chester	8.25	7-9	3.31	3-4	9.93
Imperial Grain & Milling Co., Toledo, O.						
Steam Cooked, ... G. F. Green Coal Co..	Campello......	9.39	10.00	4.18	5.25	3.04
Steam Cooked, ... Mackenzie & Winslow	Fall River	9.74	10.00	4.07	5.25	2.54
Steam Cooked, ... C. G. Burnham.......	Holyoke	9.83	10.00	4.36	5.00	2.62
Steam Cooked, ... G. H. Reed	West Acton ...	10.18	10.00	4.06	5 25	3.39
Corn, oat and barley, C. G. Burnham	Holyoke	8.39	8.90	3.49	3.75	11.58
Corn, oat and barley, G. H. Reed	West Acton ...	8.69	8.90	3.60	3.75	10.80
Malden Grain Co., Malden.						
Excel (XL), ... Malden Grain Co.....	Malden	10.53	12.73	3.77	3.48	5.85
Excel (XL), ... Malden Grain Co.....	Malden	11.14	12.73	3.32	3.48	5.95
Noyes & Colby, Boston.						
New Era, ... E. W. Kenerson	Worcester.....	10.79	10-12	7.61	4-5	7.53
Oneonta Milling Co., Oneonta, N. Y.						
Provender, ... Mackenzie & Winslow	Fall River	8.53	8.75	2.29	3.50	10.45
Provender, ... Potter Bros. & Co.	North Adams..	8.12	8.75	2.14	3.50	6.33
Quaker Oats Co., Chicago.						
Schumacher's, ... N. Paquin & Sons	Fall River	11.01	10-12	4.15	4 5	10.76
Schumacher's, ... N. Paquin & Sons	Fall River	11.49	10.00	4.20	4.00	9.71
Schumacher's, ... H. G. Hill & Co	Williamsburg..	11.14	10.00	3.93	4.00	8.98
Victor, ... H. G. Puffer Co.......	Springfield	7.90	7.5-9	3.46	3-4	9.55
Victor, ... J. Paull & Co	Taunton	7.77	7.5-9	4.06	3-4.5	13.16
Victor, ... J. C. Paull	Taunton	8.82	7.5-9	3.54	3-4	7.10
G. H. Reed, West Acton.						
Our, ... G. H. Reed	West Acton ...	10.44	10.44	4.43	4.43	12.24
Sykes Coal & Grain Co., North Adams.						
Best, ... Sykes Coal & Grain Co.	North Adams..	9.48	10-12	7.33	4-5	7.74
Best, ... Sykes Coal & Grain Co.	North Adams..	10.14	10-12	7.34	4-5	7.80
F. F. Woodward & Co., Fitchburg.						
Veribest, ... F. F. Woodward & Co.	Fitchburg	10.09	10-12	7.99	4-5	6 90
Veribest, ... F. F. Woodward & Co.	Fitchburg	11.43	10-12	7.62	4-5	5 59

FORTIFIED STARCHY FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
American Hominy Co., New York.						
June Pasture,.....P. Foisy..............	New Bedford..	14.26	12-15	9.64	4-8	12.42
J. W. Biles Co., Cincinnati, Ohio.						
Ubiko Horse .....Red Mill Feed Co ...	Ashley Falls...	18.12	16.00	7.43	6.00	6.78
Buffalo Cereal Co., Buffalo.						
Horse, ...W. J. Meek	Fall River	11.45	12.00	5.92	4.50	7.56
Horse, ...F. H. Crane & Son ...	Quincy Adams.	12.60	10-12	5.07	4-5	8.59
Horse, ...Cutler Grain Co	S. Framingham	10.62	12.00	3.88	4.50	7.08
Jacob Burkhardt, Beverly.						
Colonial, ...J. Burkhardt..........	Beverly	14.35	12.00	5.21	6.00	8.41
Colonial, ...J. Burkhardt..........	Beverly	13.51	12.00	5.29	6.00	8.08
Green River Grain Co., Greenfield.						
O. K. Horse, ...W. N. Potter & Sons..	Greenfield	12.29	12.00	4.50	4.25	5.54
O. K. Horse, ...W. N. Potter & Sons..	Greenfield	13.25	12.00	4.43	4.25	5.89
H-O Co., Buffalo.						
Algrane Horse ...G. F. Greene Coal Co..	Campello......	11.41	12.00	4.50	4.50	11.07
Algrane Horse,...Lenox Coal Co........	Lenoxdale	11.58	12.00	4.61	4.50	11.36
Algrane Horse,...Cutler Grain Co... ..	S. Framingham	12.99	12.00	4.52	4.50	11.11
Husted Milling & Elevator Co., Buffalo.						
Husted Horse,....Mackenzie & Winslow	Fall River	13.69	12-14	4.27	4-5	6.13
Quaker Oats Co., Chicago.						
Quaker Dairy,....Torrence, Vary & Co..	Lynn..........	13.34	12-14	3.61	3-4	14.74
Quaker Dairy,....A. P. Ames & Co......	Peabody	18.14	12-14	4.50	3-4	11.80
Ropes Bros., Salem.						
Horse,............Ropes Bros	Salem	15.67	16.00	5.29	5.00	8.00
Horse,............Ropes Bros	Salem	17.68	16.00	5.27	5.00	8.13

ALFALFA FEEDS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
Corno Mills Co., East St. Louis.						
Corno,............J. O. Ellison & Co....	Haverhill......	9.39	10.00	3.56	3.50	12.23
Corno,............J. O. Ellison & Co....	Haverhill......	9.52	10.00	3.71	3.50	14.88
Kornfalfa Feed Mill.Co., Kansas City, Mo.						
Kornfalfa,....... Mackenzie & Winslow	Fall River	10.49	12.00	3.19	4.00	12.87
***Otto Wiess Alf.St.Food Co., Wichita, Kan**						
Alfalfa Oat, ...Pierce & Winn........	Arlington......	13.77	12.00	3.64	3.50	14.82
Alfalfa Oat. ......Torrence, Vary & Co..	Lynn..........	13.38	12.00	3.32	3.50	12.99
Alfalfa Stock, ...Pierce & Winn........	Arlington......	13.34	12.00	4.99	3.50	11.05
Alfalfa Stock, ...Torrence, Vary & Co..	Lynn..........	13.42	12.00	2.99	3.50	12.97
Alfalfa Stock, ...Marlboro Grain Co ...	Marlboro......	11.84	12.00	3.32	3.50	11.09

* Otto Wiess Alfalfa Stock Food Co.

OAT FEED.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Fiber.
		%	%	%	%	%
Chas. M. Cox Co., Boston.						
O. M. F., ...Livingston Grain Co..	Lowell	5.44	5-7	2 80	2-4	25.11
O. M. F., ...Sykes Coal & Grain Co	North Adams..	5.00	5 50	2.59	2.50	26.12
O. M. F., ...G. H. Reed...........	West Acton....	5.79	5-7	2.55	2-4	27.25
H-O Co., Buffalo.						
Jim Dandy, ...N. A. Seymour	Lancaster	8.08	7.50	3.02	2.75	22.42
Jim Dandy, ...Lexington Grain Co ..	Lexington	7.46	7.50	2.92	2.75	22.45

MISCELLANEOUS STARCHY FEEDS.

H. H. Brown & Bros., Boston.						
Dried Grains, ...Lexington Grain Co...	Lexington	12.85	10.00	3.90	2.50	12.03
Chas. M. Cox Co., Boston.						
Barley Feed,......Malden Grain Co.	Malden........	7.24	—	2.03	—	19.36
Husted Milling & Elevator Co., Buffalo.						
Germaline, ...A. Dodge Sons Corp.	Beverly	8.34	9-11	3.13	3-5	—
Germaline, ...Mackenzie & Winslow	Fall River	9.56	9-11	3.88	3-5	—
Larrowe Milling Co., Detroit, Mich.						
Dried Beet Pulp,..W. E. Bryant & Co ..	Brockton......	10.53	8.00	0.36	0.50	19.18
Dried Beet Pulp,..J. A. Bouvier	New Bedford..	8.32	8.00	0.69	0.50	17.99
Dried Beet Pulp,..Bliss & Co............	Taunton	9.88	8-10	0.92	0.5-1.0	21.86
Lyons Beet Sugar Refin. Co.,Lyons,N.Y.						
Dried Beet Pulp,..City Mills Co	Holyoke	11.67	8 00	0.44	0.50	—
Natural Food Co., Niagara Falls, N. Y.						
Shredded wheat waste,W. E. Bryant & Co..	Brockton......	12.11	10.00	2.62	1.50	—
Shredded wheat waste,Ropes Bros.........	Salem	11.49	10.00	1.92	1.50	—
Quaker Oats Co., Chicago.						
Maz-All-Corn Feed, .P. W. Eaton..........	Williamstown .	10.27	9.50	2.34	1.40	1.06
Heffner Milling Co., Circleville, Ohio.						
Ground Corn Cobs,J. B. Norton....	Warren	1.84	—	0.44	—	31.12
Toledo Elevator Co., Toledo, Ohio.						
Star Cotton Feed, N. Hatfield Grain Co..	N. Hatfield....	12.51	10-12	5.28	6.5-8	9.61

III. Poultry Feeds.

MEAT SCRAPS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
First Grade (over 45% Protein).		%	%	%	%	%
American Agric. Chem. Co., New York.						
G. F. Green Coal Co.	Campello	51.95	40-60	14.85	6-8	19.91
Dresser Hull Co	Lee	53.00	40-60	15.38	5-6	20.74
Joseph Breck & Sons, Boston.						
Pierce & Winn	Arlington	47.12	43-50	14.02	12-16	24.70
Burlington Rendering Co., Burlington, Vt.						
D. J. Harrington	Turners Falls	46.77	35-45	14.03	10-15	29.58
Butchers Rendering Co., Fall River.						
A. Milot & Son	Taunton	49.97	40-60	11.80	15-20	26.20
A. Culver Co., Rockland.						
Special, A. Culver Co	Rockland	45.02	46-55	19.50	19-25	23.92
J. C. Dow & Co,, Boston.						
H. Bullikian	Franklin	47.57	43-50	20.23	12-15	22.33
Geo. E. Marsh Co., Lynn.						
Lummus & Parker	Danversport	49.27	45-50	15.72	10-15	25.03
Green & Co.	Marblehead	50.63	45-50	13.20	10-15	26.12
N. E. Dressed Meat & Wool Co., Boston.						
S. B. Green	Watertown	56.38	53-57	14.50	10-15	18.48
Park & Pollard Co., Boston.						
Blue Ribbon, Pierce & Winn	Arlington	*80.81	74-78	10.82	—	1.61
Blue Ribbon, Taunton Grain Co.	Taunton	64.67	60-80	14.15	10-13	7.84
Pawtucket Rend. Co., Pawtucket, R. I.						
Taunton Grain Co.	Taunton	48.79	40-50	14.45	8-12	29.17
Richmond Abattoir, Richmond, Va.						
Rava, Lexington Grain Co.	Lexington	*87.53	85.00	6.16	7.00	2.68
Swift's Lowell Fertilizer Co., Boston.						
Mackenzie & Winslow	Fall River	49.84	40-50	10.98	10-15	28.42
Average		50.84	—	14.83	—	23.26
Second Grade (below 45% Protein).						
Andrews & Spellman, Providence, R. I.						
Anchor, C. B. Benedict	Gt. Barrington	39.14	40-50	9.67	8-10	35.57
Taft Bros	Uxbridge	38.79	25-30	11.63	6-8	38.10
N. Paquin & Sons	Fall River	40.68	25-30	11.71	6-8	35.61
Beach Soap Co., Lawrence.						
H. Bruckman	Lawrence	37.47	40.00	15.69	20.00	35.59

* Not included in average.

MEAT SCRAPS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
		%	%	%	%	%
Dennison Plummer Co., New Bedford.						
Dennison Plummer Co.	New Bedford..	39.66	40-60	9.91	10-15	38.32
J. B. Garland & Son, Worcester.						
J. B. Garland & Son ..	Worcester	40.70	40-50	19.75	10-12	28.66
W. D. Higgins, South Framingham.						
Cutler Grain Co	S. Framingham	37.38	45-65	16.15	20.00	32.16
Home Soap Co., Worcester.						
E. A. Cowee	Worcester	37.60	50.00	20.45	20.00	27.94
A. Lord & Co., Chelsea.						
Mackenzie & Winslow	Fall River	38.48	40-60	16.54	17-19	31.39
W. L. Palmer.........	Medway	35.80	30-60	17.47	17-19	36.89
S. A. Meager Co., Milton.						
F. H. Crane & Sons ..	Quincy Adams.	41.85	40-50	14.23	15-20	28.17
F. H. Crane & Sons ..	Quincy Adams.	44.45	50-55	17.97	15-20	29.04
Pilgrim Rendering Co., Plymouth.						
C. P. Washburn	Middleboro....	32.87	40-60	19.07	10-20	35.32
Ross Bros., Worcester.						
Thatcher & Ireland...	Littleton	38.44	45-50	22.24	15-20	28.90
Springfield Rendering Co., Springfield.						
Prentiss, Brooks & Co.	Holyoke	42.55	40-60	13.24	15-20	33.72
J. A. Torrey, Rockland.						
No. 1,............A. Culver Co..........	Rockland......	44.02	46.00	20.12	19.00	23.56
No. 2,............A. Culver Co..........	Rockland......	40.36	40-45	14.98	15-20	29.04
No. 2,............A. Culver Co..........	Rockland......	44.40	44.00	14.82	19.00	30.25
Whitman & Pratt Rendering Co., Lowell.						
Wilder & Wotton.....	Lowell	43.75	40-50	15.72	10-15	27.53
Average............	....	39.92	—	15.86	—	32.04

MEAT AND BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
American Agric. Chem. Co., New York.						
Bradley's, ...D. Seffens............	Conway	35.58	30.00	10.80	8.00	37.84
Armour Fertilizer Works, Chicago.						
W. F. Filmore........	Palmer........	47.12	42.00	8.57	8.00	29.40
Beach Soap Co., Lawrence.						
Cummings, Chute & Co	Woburn.......	30.98	30.00	9.97	10.00	47.37

MEAT AND BONE MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat Found.	Fat Guar.	Ash.
		%	%	%	%	%
Bowker Fertilizer Co., Boston.						
Mackenzie & Winslow	Fall River	39.88	40.00	11.42	5.00	35.71
Phillips, Bates & Co...	Hanover	43.26	40.00	9.24	5.00	33.01
J. Cushing & Co	Hudson	47.87	40.00	8.80	5.00	31.89
Joseph Breck & Sons, Boston.						
Poultry Meal, ...W. L. Palmer.........	Medway.......	31.41	32-35	10.29	10-12	40.42
Poultry Meal, ...W. L. Palmer.........	Medway.......	30.01	32-35	9.25	10-12	41.80
J. C. Dow Co., Boston.						
Poultry Meal. ....Marlboro Grain Co....	Marlboro......	29.71	32-35	9.51	10-12	39.92
Hinckley Rendering Co., Somerville.						
A. Culver Co..........	Rockland......	35.87	35-50	8.46	8-15	43.07
Swift's Lowell Fertilizer Co., Boston,						
Eastern Grain Co.....	Bridgewater ...	37.97	35-45	12.59	8-15	39.60
Average.............	....	37.24	—	9.90	—	38.18

BONE MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat Found.	Fat Guar.	Ash.
Beach Soap Co., Lawrence.						
Webster Grain Co	Lawrence	12.51	—	8.43	—	10.12
Swift's Lowell Fertilizer Co., Boston.						
A. E. Lawrence & Son	Ayer	25.71	20-25	4.67	3-10	58 50

MILK PRODUCTS.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat Found.	Fat Guar.	Ash.
Geo. L. Harding, Binghamton, N. Y.						
Gran. Milk,.......A. E. Lawrence & Son	Ayer	36.15	43-50	6.47	15-20	27.04

POULTRY MASH AND MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat Found.	Fat Guar.	Ash.
Local Mixtures.						
Morning Mash,...W. E. Bryant & Co....	Brockton	20.32	14.00	6.09	5.00	6.19
Rees W. Davies	Greenfield.....	26.28	—	4.60	—	7.95
O. K.,............C. H. Felker..........	Brockton	14.53	11.88	4.78	4.89	3.65
S. B. Green & Co.....	Watertown	21.59	—	6.45	—	6.28
S. B. Green & Co.....	Watertown	22.29	20.00	6.08	5.00	7.45
Green & Co	Marblehead ...	11.14	11.00	5.07	3.00	6.39
D. F. Howard	Ware	18.16	15.00	3.77	5.00	8.59
Lexington Grain Co ..	Lexington	22.33	18.00	3.94	3.50	11.91
Livingston Grain Co..	Lowell	17.38	10.00	5.88	6.08	3.00
Malden Grain Co.....	Malden........	16.18	—	4.29	—	9.39
Hash,............Ropes Bros...........	Salem	15.09	18.00	4.17	4.00	4.38
L. M. Stanbridge	Greenfield	23.78	—	5.37	—	8.60
Tyler Grain Co.......	Hyde Park	12.64	11.32	6.39	8.47	4.22
F. F. Woodward & Co.	Fitchburg	15.71	11.00	4.68	3.00	4.77

POULTRY MASH AND MEAL—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Ash.
		Found.	Guar.	Found.	Guar.	
		%	%	%	%	%
Chas. M. Cox Co., Boston.						
Wirthmore,.......W. J. Meek...........	Fall River	21.41	20.00	3.56	3.00	7.44
Wirthmore,.......Dennison Plummer Co	New Bedford..	20.09	20.00	2.77	3.00	11.16
Albert Dickinson Co., Chicago.						
Queen,...........J. F. Ray............	Franklin	11.93	10.50	3.18	3.00	3.62
R. D. Eaton Gr. & Feed Co., Norwich, N.Y.						
Perfection, ...Prentiss, Brooks & Co.	Easthampton..	22.99	20.00	3.36	4.00	10.24
Green River Grain Co., Greenfield.						
W. N. Potter & Sons..	Greenfield.....	17.16	16.46	3.63	4.14	4.41
W.N. Potter Sons & Co	Northampton..	15.84	16.46	3.54	4.14	4.08
A. D. Potter..........	Orange........	15.77	16.46	3.69	4.14	3.82
Husted Milling & Elevator Co., Buffalo.						
B. W. Brown	Concord.......	15.40	12-14	6.43	4-5	3.79
Laying Mash, ...F. E. Smith	Amherst	15.75	15-17	4.49	3-4	3.40
Laying Mash, ...H. L. Patrick.........	Hopedale	16.23	15-17	4.76	3-4	3.37
H-O Milling Co., Buffalo.						
Algrane, ...W. J. Meek...........	Fall River	18.34	17.00	5.28	5.50	3.22
Algrane, ...H. Bruckman.........	Lawrence	18.03	17.00	4.81	5.50	3.42
Park & Pollard Co., Boston.						
Dry Mash, ...Hathaway & McKenzie	New Bedford..	22.39	20-23	3.11	—	16.33
Fattening Feed, ..Bedford Coal & Gr. Co	Bedford.......	9.74	10.00	1.98	3.00	1.95
Fattening Feed, ..F. Diehl & Son.......	Wellesley	10.14	—	2.73	—	2.67
Growing Feed,....Hathaway & McKenzie	New Bedford..	14.17	14-15	3.07	3.5-4	4.26
Growing Feed,....Taunton Grain Co....	Taunton.......	17.81	14-15	3.83	3.1-4	2.68
Purina Mills, St. Louis.						
W. E. Bryant & Co...	Brockton......	17.57	17.00	1.65	2.50	4.05
Quaker Oats Co., Chicago.						
American,........A. T. Butler..........	Adams	13.32	14.50	5.72	4.50	2.65
American,........J. F. Hunt............	Lynn..........	13.51	12-14.5	6.02	3-4.75	3.00
American,........D. H. Craig	Plymouth	13.04	12-14	5.19	3.5-4.5	2.91
Spratt's Patent, Ltd., Newark, N. J.						
Patent,..........E. J. Adams	Gt. Barrington.	19.74	20.00	3.16	3.50	3.52

CHICK AND SCRATCHING GRAINS.

Chick.						
Buffalo Cereal Co., Buffalo.						
F. H. Crane & Son....	Quincy Adams.	12.29	12.50	2.01	2.00	1.50
Chas. M. Cox Co., Boston.						
Wirthmore Gritless, Dennison Plummer Co	New Bedford..	11.97	11.00	2.90	3.00	—

CHICK AND SCRATCHING GRAINS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein. Found.	Protein. Guar.	Fat. Found.	Fat. Guar.	Ash.
		%	%	%	%	%
E. Crosby & Co., Brattleboro, Vt.						
Rees W. Davies	Greenfield	11.32	11.00	2.17	3.00	—
Thos. W. Emerson, Boston.						
Gem, Chas. G. Jordon	Weymouth	11.23	—	3.25	—	2.16
Great Western Cereal Co., Chicago.						
Sterling, G. F. Wetherbee Est.	Gardner	9.83	12.00	2.81	3.00	—
Green & Co., Marblehead.						
Green & Co	Marblehead	12.64	—	4.82	—	—
Green River Grain Co., Greenfield.						
W. N. Potter & Son	North Adams	10.53	11-12	3.98	3.5-4.5	—
Husted Milling & Elevator Co., Buffalo.						
Chick Cr'k'd Corn, HoosacVal.C'l & Gr.Co	Adams	8.34	—	2.84	—	—
Park & Pollard, Boston.						
Gritless, Hathaway & McKenzie	New Bedford	11.01	13 76	2.56	2.77	—
Purina Co., St. Louis.						
Star, W. E. Bryant & Co.	Brockton	9.92	9.00	3.63	3.00	9.43
N. Paquin & Sons	Fall River	12.11	11.00	4.22	3.60	2.18
P. W. Eaton & Co.	Williamstown	11.49	11.00	3.75	3.60	—
Moses H. Rolfe Est., Newburyport.						
M. H. Rolfe Est	Newburyport	10.36	12.50	3.00	4.00	—
Ross Bros., Worcester.						
Wyandotte, Brown Bros	Northbridge	8.95	8.25	2.48	2.25	13.04
Wyandotte, I. J. Rowell	Pepperell	9.65	8.25	2.41	2.25	11.98
Springfield Flour & Grain Co., Springfield						
Spring'd Flour & Gr.Co	Springfield	11.02	11.00	2.13	3.00	—
H. K. Webster Co., Lawrence.						
High Grade Cereal, H. K. Webster Co.	Lawrence	10.32	12.00	2.87	3.00	—
Scratching Grains.						
Local Mixtures.						
Buckwheat, W. S. Harrington	Adams	10.79	—	2.40	—	—
Buckwheat, N. Paquin & Son	Fall River	10.23	—	2.39	—	—
Wheat Screenings, C. G. Jordan	Weymouth	16.14	—	3.14	—	—
Blended Grains, W. E. Bryant & Co.	Brockton	10.27	—	3.29	—	—
E. A. Cowee & Co.	Worcester	10.62	10.00	2.87	3.00	—
Green & Co	Marblehead	12.07	10.00	3.69	2.00	—
W.H.Cunningh'm&Son	Malden	10.44	10.00	3.16	2.00	—
Cutler Co.	S. Framingham	10.32	10.00	2.76	3.00	—
W. P. Griffen	Pittsfield	10.62	—	3.75	—	—
HoosacVal.C'l & Gr.Co	Adams	10.44	10.09	3.06	3.17	—
HoosacVal.C'l & Gr.Co	Adams	10.09	—	3.17	—	1.64

CHICK AND SCRATCHING GRAINS—(Continued).

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Ash.
		Found.	Guar.	Found.	Guar.	
Local Mixtures (Continued).		%	%	%	%	%
Moses H. Rolfe.......	Newburyport..	11.19	12.50	4.31	4.00	—
H. K. Webster Co....	Lawrence	10.16	10.00	3.01	3.00	—
H. K. Webster Co....	Lawrence	9.92	10.00	3.14	3.00	—
Veribest, ...F. F. Woodward & Co.	Fitchburg	11.32	11.00	3.95	3.00	—
Buffalo Cereal Co., Buffalo.						
Griffin Bros	Fall River	11.10	—	3.29	—	—
Chas. M. Cox Co., Boston.						
W. J. Meek	Fall River	10.36	10.00	3.19	3.00	—
Cutler Co., North Wilbraham.						
King, ...L. H. Kirk	Wakefield.....	11.06	—	3.01	—	—
Cyphers Incubator Co., Buffalo.						
Pigeon, ...S. B. Green & Co......	Watertown	12.34	10.59	3.80	3.57	—
Albert Dickinson Co., Chicago.						
Globe, ...J. F. Ray	Franklin.......	10.44	10.50	2.99	3.00	—
Globe, ...Spring'd Flour & Gr.Co	Springfield	10.05	10.00	2.56	3.00	13.60
General Flour & Feed Co., Buffalo.						
Honest, ...Patrons' Co-op. Assoc.	Lowell	11.06	—	2.85	—	—
Great Western Cereal Co., Chicago.						
Sterling, ...G. F. Wetherbee Est..	Gardner.......	10.27	11.00	3.68	3.00	—
Green River Grain Co., Greenfield.						
B. S. No. 2, ...A. D. Potter..........	Orange........	10.67	10-11	3.37	3.5-4.5	—
B. S. No. 2,.......W. N. Potter Sons Co.	Northampton..	10.36	10-11	3.57	3.5-4.5	1.60
H-O Co., Buffalo.						
Algrane,..........W. J. Meek...........	Fall River	11.37	11.00	3.21	3.50	1.76
Narragansett Mill. Co.,E.Providence,R.I.						
Chick Cr'k'd Corn,A. Culver Co.........	Rockland......	8.34	—	1.75	—	—
Park & Pollard Co., Boston.						
Intermediate, ...Thorne Bros..........	Millis	10.62	10.00	3.37	3.00	—
Spring'd Flour & Gr.Co	Springfield	11.01	10.00	4.39	3.00	2.10
Purina Mills, St. Louis.						
Mackenzie & Winslow	Fall River	11.14	11.00	3.27	3.60	—
Mackenzie & Winslow	Fall River	11.49	11.00	3.40	3.60	1.84
Quaker Oats Co., Chicago.						
Schumacher's,....Prentiss, Brooks & Co.	Holyoke.......	10.79	10.50	3.08	3.00	1.60
G. T. Savage Poultry Supply Co., Boston						
Intermediate, ...L. H. Kirk............	Wakefield.....	11.14	10-11	2.73	2.5-3	—
Standard, ...C. H. Symmes........	Winchester....	11.06	10-11	3.73	2.5-3	—

CLOVER AND ALFALFA MEAL.

Manufacturer or Jobber, Brand and Retailer.	Sampled at:	Protein.		Fat.		Fiber.
		Found.	Guar.	Found.	Guar.	
		%	%	%	%	%
Amer. Alfalfa Mill. Co., Kansas City, Mo.						
American Alfalfa,. H. K. Webster Co.....	Lawrence	16.50	14.00	1.69	1.50	27.56
Cyphers Incubator Co., Buffalo.						
Mealed Alfalfa,... N. Tufts & Co........	Somerville.....	17.77	17.90	2.22	4.00	19 00
Thos. Emerson Co., Boston.						
Cut Clover,....... J. F. Kirk	New Bedford..	11.06	12.00	2.45	2.00	25 27
Cut Clover,....... J. Loring & Co	Watertown	11.45	12.00	2.51	2.00	25.19
Great Western Cereal Co., Chicago.						
Alfalfa, ... H. Bullikian..........	Franklin	15.44	14.00	1.34	3.00	—
Alfalfa, ... Spring'd Flour & Gr. Co	Springfield	14.57	14.00	1.17	3.00	34.70
Kansas Pure Alf. Mill. Co., Wichita, Kan.						
Alfalfa, ... Malden Grain Co	Malden	14.83	16.00	1.24	2.02	32 01
Nebraska Alfalfa Mill Co., Lexington, Neb.						
Alfalfa, ... Curley Bros	Wakefield.....	15.32	14.00	1.47	1.50	27 75
Alfalfa, ... Smith Feed Co	Westfield......	15.88	14.00	1.49	1.50	28.46
Newton Alfalfa Mills, Newton, Kan.						
Alfalfa, ... A. E. Lawrence & Son.	Ayer	15.84	—	1.41	—	26.85
Purina Mills, St. Louis.						
City Mills Co.........	Holyoke.......	18.16	16.00	1.90	2.00	25.31

A TALK ABOUT THE INSPECTION.

I. Protein Feeds.

Cottonseed and Linseed Meal. Pages 7-10.

At the present time cottonseed meal is scarce and high. It is believed, nevertheless, even at prevailing high prices to be an economical source of protein for milk production. Owing to its high protein and low carbohydrate content, it is not advisable to have the grain ration consist wholly of cottonseed meal but it forms an excellent mixture with many feeds especially those rich in starch and relatively low in protein.

Of the 53 samples reported, 17 fell below their guarantee in protein content. Of these, however, only 9 showed a discrepancy of more than 1 per cent.

While the chemical composition of the meal obtained from seed grown in 1908 was quite satisfactory, that obtained from this year's crop, judging from the samples already analyzed, promises to be of somewhat inferior quality. This is explained by some on the ground that early in the season many mills sold short and are now endeavoring to increase their output by the addition of hulls and linters.

The Inter-State Cottonseed Crushers' Association at its annual meeting held at Memphis, May 19-20-21, 1909, established the following rules for grading cottonseed meal:

Rule 12, Section 1. *Choice cottonseed meal* must be finely ground, perfectly sound and sweet in odor, yellow, free from excess of lint, and by analysis must contain at least 8 per cent of ammonia (41.00 per cent protein) or 49 per cent of combined protein and fat.*

Section 2. *Prime cottonseed meal* must be finely ground, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint and by analysis must contain at least 7.50 per cent of ammonia (38.50 per cent protein) or 46 per cent of combined protein and fat.*

* The station endorses the ammonia or nitrogen but not the combined protein and fat guarantee as a basis for settlement. A lot of meal may contain the requisite 49, 46 or 43 per cent of combined protein and fat, but through faulty extraction or for some other reason, not the necessary nitrogen, ammonia or protein equivalent. Thus, if a 49 per cent combined guarantee should contain 11 per cent of fat, it would contain only 38 per cent of protein instead of the necessary 41 per cent. Inasmuch as cottonseed meal is purchased primarily for its nitrogen or protein, it is believed to be fairer to adhere to the nitrogen or protein content of the meal as a basis of settlement. In Massachusetts it is illegal to present a combined protein and fat guarantee.

Section 3. *Good cottonseed meal* must be finely ground, of sweet odor, reasonably bright in color, and by analysis must contain at least 7 per cent of ammonia (36.00 per cent protein) or 43 per cent of combined protein and fat.*

Nitrogen, Ammonia and Protein Equivalents.

Nitrogen, ammonia and protein are relative terms as both ammonia and protein are determined from the nitrogen content of the meal.

One per cent of nitrogen equals 1.2 per cent ammonia equals 6.25 per cent of protein.

One per cent ammonia equals .83 per cent nitrogen equals 5.2 per cent protein.

One per cent protein equals .17 per cent nitrogen equals .20 per cent ammonia.

PERCENTAGES.

Nitrogen.		Ammonia.		Protein.
5.75	equals	7.00	equals	36.00
6.10	"	7.40	"	38.00
6.25	"	7.60	"	39.00
6.40	"	7.80	"	40.00
6.56	"	8.00	"	41.00
6.70	"	8.20	"	42.00
6.90	"	8.40	"	43.00

AVERAGE ANALYSES AND RETAIL PRICES.

	High Grades. 1907.	Medium Grades. 1907.	High and Medium Grades. 1907.
No. Samples,	20	56	76
Protein (per cent),	42.45	38.76	39.73
Fat (per cent),	9.11	9.05	9.07
Price a ton,	$33.00	$32.78	$32.84

	High Grades. 1908.	Medium Grades. 1908.	High and Medium Grades. 1908.
No. Samples,	31	10	41
Protein (per cent),	43.07	39.19	42.12
Fat (per cent),	9.27	8.41	8.94
Price a ton,	$32.18	$32.20	$32.19

	High Grades. 1909.	Medium Grades. 1909.	High and Medium Grades. 1909.
No. Samples,	32	21	53
Protein (per cent),	42.62	39.49	41.38
Fat (per cent),	8.60	8.23	8.46
Price a ton,	$34.12	$32.55	$33.48*

Two lots of low grade cottonseed meal were found which sold for substantially the same price as the high grade product. While these meals were properly guaranteed as to their content of protein and fat, their feeding value is not much over one-half that of choice meal. This inferiority is due to a liberal admixture of hulls which seriously decreases digestibility as well as protein and fat content.

Because of the exceptionally high prices now prevailing for cottonseed meal, buyers cannot be too careful in purchasing. They should carefully scrutinize the guarantee and make sure that 41 per cent protein is guaranteed for choice, 38.5 per cent for prime and 36 per cent for good meal. It is safer, when purchasing in car lots, to ask that a sample be submitted to the experiment station as a check on the guarantee. (For special instructions for sampling cottonseed meal see circular 25 issued by the station.)

The linseed meals analyzed were all of good quality. The demand for this product is evidently so great that the manufacturers are able to secure a price somewhat above that secured for other high grade concentrates. It is an excellent source of protein for the dairy ration and it is to be regretted that its cost prevents its general use by Massachusetts dairymen.

AVERAGE ANALYSES AND RETAIL PRICES.

New Process.

	1906.	1907.	1908.	1909.
No. Samples,	7	7	6	5
Protein (per cent),	35.82	35.89	35.09	37.35
Fat (per cent),	2.51	3.16	3.28	3.37
Price a ton,	$32.46	$32.67	$33.50	$36.00

Old Process.

	1906.	1907.	1908.	1909.
No. Samples,	19	12	9	11
Protein (per cent),	33.57	35.27	34.94	35.89
Fat (per cent),	7.76	7.71	6.73	6.22
Price a ton,	$34.00	$34.64	$35.44	$36.81

* It should be borne in mind that this is an average figure for the year just past and that at present cottonseed meal is bringing a much higher price.

Flax Feed, so called, is in reality ground flax screenings. Its chemical composition and character are uncertain, depending upon the relative amounts of inferior flaxseed and weed seeds present. The weed seeds impart to the material a bitter taste. While it may be fed in limited amounts mixed with high grade feed stuffs, it cannot be placed in the same class. Its commercial value is also decidedly less.

Gluten Feed.
Pages 10-12.

Gluten feed, next to the wheat by-products, continues to be one of the most generally distributed concentrated feeds. The past season the samples examined have been almost without exception quite uniform in composition and entirely free from harmful adulteration. The slightly low protein content in a few instances can be attributed to a faulty separation of starch or to an inferior corn. It is hoped that the recent prosecution by the Federal authorities of a manufacturer for placing upon the market gluten feed falling noticeably below its guarantee, will have a salutary effect upon those manufacturers who, in years previous, have offered a product bearing a higher guarantee than the feed could maintain. In so far as the writer has been able to judge the gluten feeds now offered show less acidity than in years past. This condition was referred to at length in our last bulletin.

Coloring matter is still used in certain brands of gluten feed. The amount employed is evidently so small as not to be injurious and feeds thus treated are usually so marked in accordance with the National Food and Drugs Act. The practice of coloring, while it appeals to the whims of consumers, is to be regretted as it in no way improves the quality of the feed ; buyers are urged to be governed not by color but by the guarantee, taste and mechanical condition of the feed stuff.

AVERAGE ANALYSES AND RETAIL PRICES.

	1907.		1908.		1909.	
	First Grade.	Second Grade.	First Grade.	Second Grade.	First Grade.	Second Grade.
No. Samples,	52	16	46	31	50	5
Protein (per cent),	25.97	21.52	25.52	21.22	26.52	21.83
Fat (per cent),	3.23	4.53	2.83	3.04	2.81	4.63
Price a ton,	$30.76	$31.83	$32.48	$32.66	$32.68	$32.00

Distillers' and Brewers' By-Products. Pages 12-13.

Distillers' Dried Grains consist of the dried residue from the manufacture of distilled spirits from corn, rye and other cereal grains. As the process of manufacture utilizes practically all of the starch contained in the seed, the residue is relatively low in this ingredient and high in protein, fat and fiber. The better product is derived from corn and should contain from 30 to 33 per cent protein and from 10 to 14 per cent fat. On account of their bulky nature these grains can be used in the place of wheat bran for lightening the grain ration and they may be considered an economical source of protein. It is believed that a higher guarantee than can be easily maintained is often placed upon distillers' grains. These grains were not found very generally distributed.

AVERAGE ANALYSES AND RETAIL PRICES.

	1906.	1907.	1908.	1909.
No. Samples,	22	27	17	18
Protein (per cent),	29.85	31.03	30.21	30.54
Fat (per cent),	11.75	12.35	8.25	11.69
Price a ton,	\$28.18	\$30.72	\$32.89	\$34.00

Malt sprouts are obtained from barley in the process of malting and consist of the barley sprout together with more or less hulls, light barley and occasionally a considerable number of weed seeds, When sprouts are fairly free from ash, dirt, hulls and weed seed they usually form an economical concentrate. If fed in any considerable amount (more than 2 lbs. daily) they should be moistened before feeding.

With one exception the samples collected were of good quality. One sample fell some 4 percent below its protein guarantee and also contained an unusually large amount of fiber.

AVERAGE ANALYSES AND RETAIL PRICES.

	1906.	1907.	1908.	1909.
No. samples,	6	13	9	13
Protein (per cent),	27.66	25.91	27.61	26.88
Fat (per cent),	1.61	1.20	0.89	1.08
Price a ton,	\$21.13	\$23.56	\$26.75	\$27.67

Brewers' grains are not extensively used locally, most of the grains finding an outlet abroad or as a component of molasses and other proprietary feeds. The five samples collected were of good quality and maintained their guarantees.

AVERAGE ANALYSES AND RETAIL PRICES.

No. samples,	5
Protein (per cent),	26.86
Fat (per cent),	7.09
Price a ton,	$29.75

Wheat By-Products. **Pages 14-17**

The wheat by-products are found on the market far in excess of all other kinds of feed. They are dependable, safe and with few exceptions free from adulteration. Wheat feeds do not come under the requirements of the Massachusetts Feeding Stuffs Law, therefore it has been thought best, in order to save space, to tabulate the results somewhat differently from the method followed for other feed stuffs.

Flour Middlings. Under this heading is grouped red dog flour together with middlings containing a considerable proportion of flour. Standard middlings are often put upon the market and offered as flour middlings. A good grade of flour middlings forms an excellent and economical source of digestible carbohydrates (starchy matter) as well as protein. They are particularly valuable when used with a feed deficient in starch such as distillers' grains. The quality of the samples reported was quite satisfactory.

Standard Middlings were, as a whole, of good quality. Several samples containing ground screenings and one sample containing ground corn cobs are reported under the head of adulterated wheat feeds. These feeds were tagged to conform to the law and the buyer could not be deceived if the guarantee was noted.

Wheat mixed feeds should contain, with the exception of the screenings, all the by-products of the flour mill. In actual practice, however, the term appears to be rather elastic and occasionally includes feeds which appear to be much like finely ground wheat bran. It is believed that some brands of wheat mixed feed are compounded of bran, middlings and low grade flour instead of being a mixture of the entire by-products of the flour mills. There is no reason why such a product, if carefully mixed in correct proportions, should not be just as valuable for feeding purposes as the entire "mill run" article. A satisfactory grade of wheat mixed feed is to be preferred to wheat bran, both as regards digestibility and protein content.

Wheat bran, on account of its bulky nature and safe feeding qualities, will continue to be used as a component of many grain rations. It is, however, a comparatively expensive protein feed on account of its relatively low digestibility. The fact that a number of reputable manufacturers are now marking their wheat bran as containing "bran and screenings" should not be taken to indicate that they are putting out a less desirable product than formerly. It is understood that a great deal of the bran offered has contained more or less of the screenings of the wheat, from which the bran is a by-product. This method of marking is intended simply to conform to the requirements of the National Pure Food Law. Excessive amounts of screenings in bran must be considered as an objectionable adulteration.

AVERAGE ANALYSES AND RETAIL PRICES.

Wheat Middlings, Flour.

	1906.	1907.	1908.	1909.
No. samples,	26	16	28	20
Protein (per cent),	17.67	17.62	17.16	16.98
Fat (per cent),	4.83	4.76	4.69	4.87
Price a ton,	$25.79	$30.39	$32.80	$33.56

Wheat Middlings, Standard.

	1906.	1907.	1908.	1909.
No. samples,	35	28	47	43
Protein (per cent),	17.30	16.78	17.14	17.53
Fat (per cent),	5.39	5.30	5.09	5.29
Price a ton,	$24.62	$28.50	$31.02	$30.04

Wheat Mixed Feed.

	1906.	1907.	1908.	1909.
No. Samples,	67	97	133	124
Protein (per cent),	16.29	16.35	16.19	16.49
Fat (per cent),	4.71	4.86	4.65	4.74
Price a ton,	$23.99	$28.93	$31.12	$30.17

Wheat Bran.

	1906.	1907.	1908.	1909.
No. samples,	31	58	52	38
Protein (per cent),	15.11	15.60	15.47	15.92
Fat (per cent),	4.77	4.89	4.53	4.57
Price a ton,	$23.18	$29.67	$29.40	$28.65

Adulterated Wheat Feeds. Page 18.

Under this heading are grouped wheat middlings, containing screenings, as well as middlings and wheat mixed feeds containing ground corn cobs. So far as is known these feeds, when offered for sale in Massachusetts, are tagged to conform to the requirements of the statute and no one need be deceived as to their true composition.

AVERAGE ANALYSES AND RETAIL PRICES.

	Middlings and Screenings Alonas Brand.	Standard Middlings for Comparison.	Middlings and Ground Corncobs.
No. samples,	3	43	1
Protein (per cent),	16.59	17.53	11.93
Fat (per cent)	7.19	5.29	2.64
Price a ton,	$27.67	$30.04	$30.00

	Adulterated Mixed Feed.	High Grade Mixed Feed for Comparison.
No. samples,	9	124
Protein (per cent),	11.69	16.49
Fat (per cent),	3.05	4.74
Fiber,	14.48	8.20*
Price a ton,	$28.00	$30.17

It has been found by actual experiment that a high grade wheat mixed feed contains 73 percent of digestible matter while wheat feed adulterated with cob contains only 62 percent; hence, on the basis of digestible matter if genuine wheat feed is worth $30.17, adulterated wheat feed would be worth only $25.54 per ton.

Dairy Feeds. Pages 18-19.

Under the head of dairy feeds are classed those compounded proprietary feeds which contain several by-products and show 15 or more percent protein. They are usually recommended as a complete grain ration for dairy stock. Such mixtures

*Average 732 samples.

ought not to contain over 9 to 10 percent of fiber. Many feeds of this character are sold at such high prices that the economical feeder will not use them.

A. B. C. cattle feed, of which but one sample was collected, fully maintained its guarantee, but was bitter and hence unpalatable.

Unicorn dairy ration, according to the manufacturer's statement, contains wheat gluten (glutola), corn gluten feed, cottonseed meal, hominy meal, linseed meal, malt sprouts, and wheat bran. This feed fully maintained its guarantee. The six samples collected gave the following average percentage composition: protein 27.03, fat 6.30, fiber 8.81. The average price was $32.67 per ton. It is an excellent feed of its kind but is a trifle high in protein to be fed by itself. The addition of 2 pounds of corn meal to each 5 pounds of the dairy feed would make a more satisfactory ration.

Union grains, according to the manufacturer's statement, contain corn, distillers' grains, cottonseed meal, linseed meal, wheat middlings, wheat bran, hominy meal, malt sprouts and a small percentage of salt. This feed fully maintained its guarantee. The six samples collected gave the following average percentage composition: protein 25.07, fat 7.05, fiber 10.06. The average price was $33.00 per ton. It is an excellent feed of its kind.

Ubiko horse feed fully maintained its guarantee. It was clean and sweet, contained no inferior offal and could be considered an economical concentrate for horses.

Buffalo creamery feed maintained its guarantee, the average analysis being protein 20.96 percent, fat 5.48 percent, fiber 8.14 percent. At an average price of $34.50 per ton it could hardly be considered an economical feed.

Bibby's oil cake feed is an imported product consisting largely of ground cottonseed, carob bean, cereals or their by-products, fenugreek and salt. It resembles in chemical composition standard wheat middlings and has approximately the same feeding value. This feed is quite favorably known in England but is not used extensively in this country. It could not be considered a perfect balanced ration for dairy animals.

Algrane milk feed, because of its high fiber and relatively low protein content, could not be considered an ideal dairy ration. The average analysis for the three samples collected was as follows: protein 18.60 percent, fat 3.94 percent, fiber 12.43 percent, and the average price was $33.00.

Ropes horse feed was a local product of good quality, and fully maintained its guarantee.

Paragon dairy feed contained a large proportion of cottonseed meal together with other by-products.

Farmers' Friend feed, according to the manufacturer's statement, contains cottonseed meal, Buffalo gluten feed, linseed meal, malt sprouts, distillers' grains, bran and hominy meal. On account of the high percentage of protein the use of this would furnish the dairyman an opportunity of utilizing home grown corn. Three pounds of corn meal daily together with five pounds of this feed would make, it is believed, a satisfactory ration. The price asked was $33.00 per ton.

Molasses Feeds.
Pages 19-20.

The number of brands of molasses feeds offered for sale in the Massachusetts market is increasing. Practically all of the molasses feeds consist of second grade cereal grains or their by-products and grain screenings (all of which aid in absorbing the added molasses), together with one or more high grade concentrates used to increase the protein content. On account of the nature of their composition they sell for somewhat less than many feeds found in the retail market.

Alfalmo feed consisted of alfalfa meal as an absorbent to which molasses has been added. The sample examined could not be considered as valuable as wheat bran for feeding, although it sold for about the same price.

Sucrene dairy feed, according to the statement required by law, consists of cottonseed meal, oats, barley, wheat, grain screenings, molasses and one-half per cent salt. The formula of the Sucrene horse feed is probably quite similar except for a less amount of cottonseed meal.

The Sucrene feeds collected averaged as follows:

	Sucrene Dairy Feed.	Sucrene Horse Feed.
No. samples,	4	3
Protein (per cent),	16.88	10.46
Fat (per cent),	4.76	2.71
Fiber (per cent),	11.96	9.95
Price a ton,	$28.75	$29.67

Best of All Dairy Feed maintained its guarantee, but was very bitter. A microscopic examination showed it to contain a large number of unground weed seeds.

Husted's Molasses Feed, of which three samples were collected, averaged as follows:

Protein (per cent),	16.98
Fat (per cent),	3.28
Fiber (per cent),	7.93
Price a ton,	$30.33

Badger Dairy Feed fell slightly below its protein guarantee.

AVERAGE ANALYSIS.

No. samples,	3
Protein (per cent),	15.77
Fat (per cent),	4.47
Fiber (per cent),	11.85
Price a ton,	$27.67

Sugarota Feeds varied very much in fiber content, several samples containing an excessive amount, probably due to the presence of flax bran. Consumers are advised against purchasing feeds containing large amounts of fiber.

AVERAGE ANALYSIS.

	Dairy Feed.	Horse Feed.	Swine Feed.
No. samples,	6	1	1
Protein (per cent),	17.69	15.27	17.03
Fat (per cent),	6.61	5.26	6.55
Fiber (per cent),	14.92	19.27	13.06
Price a ton,	$28.80	$29.00	$28.00

Molac Dairy and *Quaker Molasses Feed* were both products of the Quaker Oats Co. The Molac is no longer manufactured. The fiber content of the Quaker feed is too high to render its use economical.

AVERAGE ANALYSIS.

	Molac.	Quaker.
No. samples,	3	2
Protein (per cent),	13.98	16.40
Fat (per cent),	2.78	2.87
Fiber (per cent),	11.26	13.20
Price a ton,	$28.67	$28.00

Hammond's Dairy Feed, according to the manufacturer's statement, contains corn, oats, barley, distillers' grains, cottonseed meal, grain screenings, malt sprouts, and pure cane molasses. The formula for Hammond's Horse Feed was probably quite similar, except that the protein concentrates were present in less amounts. The horse feed exceeded its protein guarantee by about 4 per cent.

AVERAGE ANALYSIS.

	Dairy Feed.	Horse Feed.
No. samples,	2	1
Protein (per cent),	16.52	13.30
Fat (per cent),	4.37	2.35
Fiber (per cent),	10.71	11.99
Price a ton,	$28.00	$30.00

But one sample each of *Consolidated, Daisy, Harvard, International* and *Regal Molasses Feeds* was collected. They practically maintained their guarantees, and were of average quality.

Calf Meals.
Pages 20-21.

Five varieties of this material are reported. They are intended as a whole or partial substitute for milk in the feeding of young calves. All of these meals will undoubtedly serve as a partial milk substitute for calves intended for dairy purposes, after three weeks from birth. The station is giving some attention to this matter.

II. Starchy (Carbohydrate) Feeds.

Ground Grains.
Pages 22-23.

Corn Meal. Forty-one samples of corn meal were reported. The entire ground corn kernel is referred to in many localitles as corn chop, while the term corn meal is applied to the milled product, from which most of the bran and a little of the protein matter have been separated. This distinction is not generally recognized by the smaller Massachusetts millers. A number of the samples here reported refer to the milled or bolted product. It has a more attractive appearance than the straight ground kernel, but has somewhat less protein and fat. For the feeding of animals the writer prefers the entire corn kernel ground. In one instance it is believed that some ground cob had been added by a Massachusetts miller. The party has been cautioned.

AVERAGE ANALYSIS.

No. samples,	41
Protein (per cent),	8.85
Fat (per cent),	3.59
Fiber (per cent),	1.88
Price a ton,	$30.79

Ground oats. Eight samples of ground oats were analyzed, all of which were free from adulteration. The highest fiber content was that obtained from a sample of whole oats which was of an exceptionally fine appearance.

Hominy Meal.
Pages 23-25.

Hominy meal is a pure corn by-product, from which part of the seed has been removed in the manufacture of hominy and brewers' grits. It has substantially the same feeding value and can be substituted for corn meal wherever the latter can be used to advantage. It contains slightly more protein and considerably more fiber and fat than clear corn, and correspondingly less starchy matter. In every case, so far as determined, the hominy collected was free from adulteration except in the case of the Star brand, in which the fact that this article contained ground corn cob was plainly stated upon the guarantee tag.

The average retail prices as given by dealers showed that hominy meal sold for about one dollar per ton more than corn meal. The Star brand brought practically the same price as corn meal, but could not be considered as valuable. It does not show good business sense to pay $30.00 or more per ton for an article containing ground cobs in any considerable proportion.

AVERAGE ANALYSES AND RETAIL PRICES.

	1906.	1907.	1908.	1909.
No. samples,	63	40	47	51
Protein (per cent),	10.54	10.71	10.20	11.21
Fat (per cent),	8.48	8.25	7.79	8.61
Price a ton,	$24.32	$27.50	$31.88	$31.72

Star Feed.

No. samples,	5
Protein (per cent),	8.87
Fat (per cent),	6.39
Fiber (per cent),	9.47
Price a ton,	$30.75

Corn and Oat Feeds. Pages 26–28.

Provender. Thirty samples of provender were examined. It is believed that they were free from adulteration. On account of the relative price of corn and oats, millers occasionally use considerably more corn than oats. The average analysis of 17 samples of ground oats showed an average fiber content of 8.47 per cent. The average fiber content of 93 samples of corn meal was 1.9 per cent. A mixture of corn and oats, whose fiber content closely approaches that of oats, may fairly be regarded as adulterated with oat residues made up largely of oat hulls.

Corn and Oat Feeds. Under this heading are grouped mixtures containing corn or hominy meal, together with oat hulls, light oats and oat middlings. Other cereals and by-products are occasionally present, but no mixtures are included which contain over 12 per cent protein. When such feeds are free from mold and rancidity, and do not contain over 10 per cent fiber, they can often be profitably used in the feeding of horses, but they are not economical constituents of the dairy ration. With one exception, these mixtures ranged in price from $29 to $34 a ton. The Imperial feed retailed for $40, and was a straight corn and oat product, in which the corn predominated.

Provender, as the term is understood locally, means a mixture of straight corn and oats ground together. The term as used in connection with Oneonta corn and oat provender is misleading, the latter being a mixture of corn together with oat by-products. Charlestock, Special, Red Tag A, Red Tag B, De Fi and New England Stock feeds, while they contained over 12 per cent fiber, indicating the presence of a large amount of oat hulls, sold for as much as feeds which contained less of the latter material.

Fortified Starchy Feeds. Page 29.

Under this heading are grouped those feeds consisting of some carbohydrate or starchy base, usually corn and oat residues, to which has been added a little high grade protein concentrate in order to increase the protein percentage. These mixtures contain from 12 to 15 per cent protein. They are intended, more particularly, for horses, and if *clear* and *sweet* can be considered reasonably satisfactory as an oat substitute. The price asked was about the same as for the corn and oat feeds. The station does not recommend them as economical for dairy animals.

Oat Feeds.
Page 30.

Oat feed is a by-product of the breakfast food factories, and consists largely of oat hulls together with more or less oat middlings, light oats, sweepings and chaff. It is usually very low in protein and quite high in fiber. Such material is often used by local millers as a component of provender or other mixtures. The price asked for oat feed is usually considerably in excess of its feeding value. Its value, comparatively speaking, is no greater than that of an average quality of hay.

Alfalfa Feeds.
Page 29.

Here are classified feeds which contain more or less ground alfalfa, the use of which as a component of feed mixtures is becoming quite common. *Feeders cannot afford to pay grain prices for alfalfa hay*, it being decidedly more economical to purchase the high grade concentrates unmixed, and to depend for roughage upon home grown English, alfalfa and clover hays, and corn silage.

Corno Horse and Mule Feed, with alfalfa as a component, fell only slightly below its guarantee of 10 per cent protein, and 3.50 per cent fat. The average analysis of two samples collected was protein 9.46 per cent, fat 3.64 per cent, and fiber 13.56 per cent.

Kornfalfa Feed consists of alfalfa, corn and oats. This sample fell below its guarantee but, according to the statement of the manufacturers, it represented one of the early shipments, and the guarantee is now maintained.

Sylva Stock Food has been withdrawn from the market.

Otto Wiess Alfalfa Stock Food, according to a statement on the tags, is made up of alfalfa, corn chop, bran, shorts, linseed oil meal, and three-fourths of a per cent of salt. It practically maintained its guarantee of protein and fat.

Otto Wiess Alfalfa Oat Food consisted of alfalfa, oats, corn chop, bran, linseed oil meal and three-fourths of a per cent of salt. It maintained its guarantee of protein and fat, and our examination substantially confirms the statement of composition.

These feeds ranged in price from $34 to $38 a ton, and must be considered very expensive as a feed for dairy stock. Neither are they particularly economical as an oat substitute for horses.

Miscellaneous Feeds.
Page 30.

Mellen's Dried Grains are the by-product from the manufacture of Mellen's Food. At the price quoted, $23 a ton, they could be considered fairly economical.

Barley Feed is evidently a by-product bearing the same relation to barley that oat feed does to ground oats. It was not guaranteed.

Feed Barley has a composition somewhat resembling oats. Next to oats, barley is considered a most satisfactory feed for horses. Feed barley is frequently imperfectly developed and likely to be a little moldy; such a product is better suited for poultry.

Husted Germaline is a proprietary feed quite rich in soluble carbohydrates. The analysis showed it to be quite similar to corn meal in composition, and fully as valuable for feeding.

Dried Beet Pulp is the dried residue remaining after the extraction of the juice from the sugar beet in the manufacture of beet sugar. One ton of dried pulp is substantially equivalent to five tons of average corn silage. Placing a value of $20 on five tons of silage, a ton of dried pulp should not cost more, whereas its present selling price is $26. It is believed not to be good economy for farmers to buy pulp in place of home-grown silage.

A ton of dried pulp has from 80 to 90 per cent of the feeding value of an equal amount of corn meal. When the supply of home-grown corn is exhausted or limited, beet residue, plain or mixed with molasses, may be substituted for fattening or as one-third of the grain rations for dairy animals; the balance of the grain ration should consist of protein concentrates. Before feeding, the dried pulp should be moistened with two to three times its weight of water.

III. Poultry Feeds.

Animal By-Products.
Pages 31-33.

Meat Scraps. A good grade of meat scrap should be free from taint and should not contain an excess of bone, moisture or fat. The poultryman who purchases meat scrap can readily satisfy himself in regard to the freshness of the article, and should also note the guarantee of protein and fat. The samples reported in this bulletin differ very greatly in composition, and the buyer will do well to note the analyses given.

Blue Ribbon scraps formerly tested over 80 per cent of protein. One sample collected recently tested about 65 per cent and bore a 60 per cent guarantee. It seems probable that these goods do not have the same composition as when first placed on the market.

Rava Meat Meal deserves special mention in that it is practically pure, dried lean meat.

Meat and Bone Meals are preferred by some poultrymen. They contain considerably more bone than meat scrap, and sell at a lower figure. The samples reported practically maintained their guarantee, but showed a noticeable variation in chemical composition.

Poultry Mashes and Meals. **Pages 33-34.**

Many of the poultry mashes offered are mixed locally, and are not generally distributed. They sold at an average figure of about $2.00 per hundred. It is believed that fully as satisfactory mixtures can be prepared at home at a saving of twenty cents or more per hundred pounds. Following are several sample mashes which, in the writer's estimation, will prove equally as satisfactory as the commercial mixtures.

FOR MATURE BIRDS.

I.	II.
20 lbs. wheat bran,	50 lbs. wheat bran,
40 lbs. corn meal,	100 lbs. corn meal
10 lbs. fine middlings,	75 lbs. wheat middlings,
10 lbs. linseed meal,	75 lbs. cut clover or alfalfa.
10 lbs. gluten feed,	
10 lbs. meat scraps.	
Cost per hundred, $1.65.	Cost per hundred, $1.53.

FOR YOUNG CHICKS.

60 lbs. corn meal,	10 lbs. linseed meal,
10 lbs. wheat bran,	10 lbs. beef scrap (fine).
10 lbs. flour middlings,	

Cost per hundred, $1.65.

Chick and Scratching Grains. **Pages 34-36.**

Eighteen samples of chick feed were collected, most of which were free from an excessive amount of weed seed and grit. In a number of instances it is believed that the mixture would have been improved were less millet present. Star Chick Feed contained grit and a considerable amount of weed seed. Wyandotte Chick Feed contained grit. In both instances the buyer was paying grain prices for crushed stone. Grit was not noted in any of the other feeds. It can be obtained at a much lower cost in the form of finely crushed oyster shell, gravel or coarse sand.

Thirty samples of scratching grains, two samples of buckwheat and one sample of wheat screenings are reported. The Globe Scratch Feed was the only sample found to contain grit and oyster shells. A sample of the same brand collected later was free from these materials. Geeen's, Purina and Standard brands contained an objectionable amount of weed seed. The seeds most generally used in compounding these scratching grains are corn, Kaffir corn, wheat, barley, oats, buckwheat and sunflower. Peas, charcoal, millet, cracked linseed cake, grit, oyster shells, flax seed, rye, wheat screenings, milo maize, hulled oats and meat scrap were also found in some of the samples. The price asked averaged about $2 per hundred. A mixture consisting of ½ cracked corn, ¼ wheat and ¼ barley would probably be as satisfactory, and would not cost over $1.75 per hundred if home mixed.

Alfalfa Meal.
Page 37.

Nine samples of alfalfa meal and two samples of cut clover are reported. The better grades of alfalfa and clover meals should not contain over 25 per cent of fiber. Two of the samples contained over 30 per cent, indicating that they were over-ripe when cut or else many of the leaves had been lost through faulty curing. Early cut clover or alfalfa carefully dried makes an excellent food for winter feeding.

WEED SEEDS IN MOLASSES FEEDS,

Since the advent of molasses feeds and the extensive use of grain screenings as a component, much has been written against their use, not only on account of the possible toxic effect of the seeds, but principally because of the likelihood of bringing many undesirable and pernicious weeds onto the land through the medium of manure. Some manufacturers state that before the seeds are used, their germinating power has been largely destroyed. The claim is also made that molasses feeds contain no more weed seeds than are often found in hay and oats. Admitting the partial truth of this statement, it is also true that they certainly do contain many more than the high grade concentrates such as cottonseed meal, linseed meal, gluten feed and the wheat by-products. On account of unfavorable comments, manufacturers have attempted to further destroy the viability of the weed seed by grinding the screenings, and most of the feeds now offered contain fewer whole seeds than formerly.

We have attempted to determine approximately the total number of seeds, as well as the number germinating in a definite amount of molasses feeds collected in the Massachusetts markets during the winter of 1909, and the results follow in tabular form:

TABULATED DATA.*

Name of Feed.	Whole Seeds per pound.	Number Germinating.	Per Cent Germinating.
Badger Dairy	725	none	none
Badger Dairy	453	none	none
Best of All	3356	1451	40
Consolidated	272	none	none
Daisy	272	none	none
Husted's	544	none	none
International	1179	635	54
Molac Dairy	2086	453	22
Molac Dairy	816	none	none
Payne's Alfalmo	90	none	none
Regal	none	none	none
Sucrene Dairy	1360	272	20
Sucrene Dairy	1542	635	41
Sucrene Dairy	2540	635	25
Sucrene Horse	2177	272	13
Sugarota Dairy	3175	816	23
Sugarota Dairy	3175	635	20
Sugarota Dairy	997	272	27
Sugarota Dairy	1270	544	43
Sugarota Horse	816	272	33
Sugarota Swine	2449	1179	48

* This work was done by G. H. Chapman, assistant botanist at the station.

RESULTS OF THE WORK.

1. The different feeds varied to a considerable extent in whole weed seed content, as did also different samples of the same brand. This condition depended not only upon the character of the material used, but also upon the thoroughness of grinding.

2. It is worthy of remark that of the twenty samples found to contain weed seed, seven showed none that germinated, and in no case did over one-half of the seed sprout.

3. The seeds identified were crabgrass, foxtail, bindweed, ladies' thumb, lambs' quarters, charlock, wild turnip, plantain, common sorrel, dock and tumbleweed.

4. It should be remembered that, with few exceptions, feeds of this character are mixtures of inferior material with that of recognized value; the intelligent purchaser should not be led to consider such mixtures of equal worth with high grade concentrates.

5. Our results indicate that most molasses feeds contain fewer whole seeds than formerly, and that their germinating power has been noticeably reduced. At the same time the present condition in case of most of the feeds is far from satisfactory.

WEIGHT OF SACKED FEEDS.

From time to time the experiment station has been requested by jobbers in feeding stuffs to make check weights on sacked feeds. Up to this time but little attention has been given to this matter, but data recently secured show that while the Massachusetts law states *explicitly* that the *net weight* of each package should be attached the practice has been with very few exceptions to state gross weight as net.

When feed stuffs sold for $15 a ton, and less, the difference in value between net and gross weight of sacked feeds amounted to comparatively little, but at present the "value difference" is much greater. According to the statement of a large bag manufacturing concern, the average weight of a new sack such as is ordinarily used for 100 pounds of feed, is 11 to 11¼ ounces. The sacks used for a ton of feed would, therefore, weigh about 14 pounds, and those used for a twenty-ton car would weigh about 280 pounds. Two hundred and eighty pounds of feed at $32 a ton, would be worth $4.48.

The difference between net and gross weight was not the only variation noted, and it is believed that in several instances the cause of the short weights observed was due to gross carelessness, if not to intentional deception. The variations in weight of sacked feeds can probably be accounted for by some of the following reasons:

1. Carelessness in sacking.
   - a. Failure to check automatic scales.
   - b. Allowing scales to get out of adjustment.
   - c. Loss from sacks after weighing and before sewing.

2. Change in moisture content of the feed. In this case, even where the original weighing is correct, if a considerable time elapses before it reaches the consumer a shrinkage in weight may occur.

Where feeds are sacked directly from the drier the feedstuff may take on several pounds of water on standing. Molasses feeds may shrink in weight due to drying out. It should be remembered, however, that in the case of a feed which contains any considerable amount of water at the time of weighing, the consumer is paying grain prices for water or at the rate of about 3 cents a quart.

3. A loss in weight due to handling and shipping, caused by an occasional torn sack and to sifting, accounts for a slight shrinkage. Cottonseed meal is often shipped in second hand and inferior sacks, in which case the loss is likely to be quite pronounced.

4. A deliberate attempt to give short weight, and consumers should be on their guard against such deception.

Here follows a summary of the net weights on a number of ton lots of feed stuffs weighed by experiment station officials on retailer's sealed scales:

SUMMARY.

	KIND OF FEED.	Total weight a ton. (lbs.)	Highest weight single sack (lbs.)	Lowest weight single sack (lbs.)	Average single sack (lbs.)	Excess for one ton. (lbs.)*	Shortage for one ton. (lbs.)*
1	Cottonseed meal....	1989.75	100.50	99.00	99.49	—	24.25
2	" "	1984.50	100.00	98.50	99.23	—	29.50
3	" "	1969.25	103.00	96.50	98.47	—	44.75
4	O. P. Linseed meal.	1991.00	100.00	99.00	99.55	—	23.00
5	Gluten feed........	2014.00	103.00	97.00	100.70	—	—
6	" "	2004.50	101.50	99.00	100.23	—	9.50
7	Distillers' grains.....	2028.50	107.50	93.75	101.43	14.50	—
8	Wheat middlings...	2014.00	101.50	99.50	100.70	—	—
9	" " ...	2011.00	102.00	99.00	100.55	—	3.00
10	" " ...	2015.75	101.00	100.25	100.79	1.75	—
11	Wheat mixed feed..	2011.00	102.00	99.50	100.55	—	3.00
12	" " " ..	1968.75	101.50	96.00	98.44	—	45.25
13	" " " ..	2016.00	101.25	100.25	100.80	2.00	—
14	Wheat bran........	2008.00	101.50	99.00	100.40	—	6.00
15	" "	2009.25	101.50	100.00	100.42	—	4.75
16	Dairy feed.........	1999.75	100.25	99.50	99.99	—	14.25
17	Molasses feed......	1916.75	100.50	89.75	95.84	—	97.25
18	Hominy feed.......	2007.00	101.50	99.00	100.35	—	7.00
19	Corn and oat feed..	2018.00	102.50	97.50	100.90	4.00	—
20	" " " " ..	1998.25	101.00	99.00	99.92	—	15.75
21	" " " " ..	2040.50	103.00	101.00	102.00	36.50	—

* Taking 2014 lbs. as the weight of gross ton (feed 2000 lbs plus sacks 14 lbs.)

The three lots of cottonseed meal all ran low. It is known that two lots were packed in new sacks carefully sewn. Allowing a value or $36 per ton, or 1.8 cents per pound, the money loss on the three lots would be 44, 53 and 81 cents per ton.

The one lot of linseed meal weighed ran 23 lbs. short., the average weight of a sack being only 99.5 lbs.

The two lots of gluten feed were quite uniform, and there was evidently an attempt to give one ton net weight.

Distillers' grains showed an excess of 14¼ lbs. Different bags of this material tend to vary very much in weight, in this instance there being a difference of about 14 lbs. between the weight of the heaviest and lightest sack. It is believed that these wide variations were due to careless weighing.

With one exception the weights on the wheat by-products were very satisfactory. Lot No. 12, which ran 45 lbs. short, was found in the same storehouse as lot No. 11.

In the one lot of dairy feed, No. 16, an attempt was evidently made to give gross weight, as the average weight per sack was about 100 lbs.

The lot of molasses feed fell nearly 100 lbs. short, with an average weight of about 96 lbs. per sack.

The lot of hominy weighed was quite satisfactory.

Of the three lots of corn and oat feeds, No. 19 was evidently weighed net and No. 20 gross. No. 21 ran 36 lbs. over, with an average of 102 lbs. per sack, evidently an instance of manufacturer's scales out of adjustment.

On account of the small amount of data presented, it would not be wise to draw too positive conclusions. The results indicate, however, that gross weight is quite often given in place of net; and further, that carelessness, if not intentional deception, are not uncommon. It is the intention of the experiment station to follow this matter more closely in the future.

AN OPEN LETTER ABOUT LOW-GRADE BY-PRODUCTS.

J. B. Lindsey.

(a) WHAT THEY ARE AND THEIR FEEDING VALUE.

Under this classification may be mentioned oat and barley residues, cottonseed hulls, rice hulls, wheat and flax screenings, and ground corn cobs.

Oat and barley residues, which consist of grain hulls, middlings and mill sweepings, contain from 50 to 75 per cent of hulls and have from 40 to 60 per cent of the feeding value of corn meal.

Cottonseed hulls contain very little protein, some 40 per cent of fiber, and are quite indigestible. They are sold in the South at from $6 to $8 a ton, and are in no way economical for Northern feeders.

Rice hulls are very low in protein, high in ash and fiber, and are digested with great difficulty. They are not suited for feeding purposes, creating a serious irritation of the membranes of the stomach and intestines. They should never be incorporated into cattle or horse feeds.

Wheat screenings contain the small shrunken wheat kernels, pieces of straw, grain hulls and a great variety of weed seeds. They are quite bitter and must have an inferior nutritive value. Their wholesale price in large lots is about $16 a ton, Boston basis. Unless the viability of the seeds is destroyed by heating or grinding, the use of such material is in no way advised.

Flax screenings are similar to wheat screenings excepting that the inferior wheat kernels are replaced by imperfectly developed flax seed. They likewise contain more protein and fat than the screenings from wheat, and have a somewhat greater nutritive value.

Ground corn cobs contain 2 to 3 per cent of protein and over 30 per cent of fiber. While they possess some nutritive value derived from the fiber and extract matter, they are decidedly out of place as a component of any reputable proprietary grain mixture.

(b) THEIR USE IN PROPRIETARY FEEDS.

One has only to study the pages of this bulletin or of similar publications put out by other experiment stations, to note the large and ever increasing number of proprietary feeds offered for sale. These mixtures may be classed under such general heads as dairy feeds, molasses feeds, and corn and oat or stock feeds. Nearly all of these mixtures *contain one or more of the several by-products in varying amounts.* Thus, most of the dairy feeds contain oat residues as a prominent constituent; the molasses feeds have both oat residues and grain screenings as components; the corn and oat, or stock feeds contain large amounts of the cereal residues together with more or less corn, often of an inferior quality; while the alfalfa feeds have ground alfalfa as a basis. Rice hulls have been rarely found in feeds offered in Massachusetts. Ground corn cobs are mixed with wheat bran and sold under such names as Indiana, Jersey and Blue Grass mixed feeds. To the unobserving the ground cob, when thus mixed, may be taken for wheat middlings. In case of adulterated wheat bran the nature of the addition is stated upon the tag, and the buyer has only himself to blame if he purchases and pays full prices for such material.

It seems evident, from the large number of mills engaged in the manufacture of proprietary feeds, that the industry must be a profitable one. There is no reason why particular attention should be called to the sale of any of the above mentioned by-products,* providing they are sold for just what they are and at prices commensurate with their value. When, however, they are disguised and incorporated into mixtures for which extravagant claims are made, and when as a result of such claims they are sold at prices above their real value, it is time that attention should be called to the fact. Furthermore, it is believed that local dealers *make a much greater profit* on feeds of this kind than on staple grains and high-grade by-products. This, in a measure, explains their wide distribution. Why, Mr. Dairyman, are you willing to pay $30 to $35 per ton for feeds containing large amounts of oat hulls, inferior corn, ground corn cobs, and grain screenings? It is surely much more economical to buy clear wheat middlings, corn meal, distillers' grains, gluten feed and cottonseed meal. Such goods are sold on a minimum margin of profit. *Is the dairy business so profitable, or are you so generous, that you are willing to pour your surplus gold into the coffers of dealers and manufacturers of this class of feed stuffs. Just think of this matter seriously!!*

* Rice hulls excepted.

TYPES OF BALANCED RATIONS.

By J. B. Lindsey.

Because of the high prices of all concentrated feeds, dairymen are frequently in doubt as to the kinds to be selected and the amount to be fed in order to secure the best returns for the money invested. Farmers selling cream to the creamery, or located where there is not a quick demand for milk, probably will not find it economical to feed over 5 pounds of purchased grain daily, and will use maximum amounts of hay and silage (1 to 1½ bushels of silage and what hay the animal will eat clean). If the silage is well eared, 1½ pounds each of cottonseed meal and flour middlings, sprinkled over the silage to distribute it, will produce a fairly well balanced ration, and prove helpful in maintaining the milk flow. If corn meal is a home product rather than silage, mix by weight ¼ bran, ½ corn and cob meal and ¼ cottonseed meal (100 pounds bran, 200 pounds corn and cob meal and 100 pounds cottonseed meal), and feed 5 to 6 quarts daily, together with one feeding of cut or shredded corn stover and what hay the animal will clean up.

Producers of market milk generally find it advisable to feed somewhat more grain, and a number of combinations are suggested which will produce satisfactory balanced rations when fed with what hay the animal will eat clean (18 to 24 pounds a day), or with one bushel of corn silage and 10 to 16 pounds of hay.

I.

125 lbs. bran.
100 lbs. flour middlings.
100 lbs. gluten feed.
Mix and feed 6 to 8 lbs. (7 to 9 qts.) daily.

II.

125 lbs. bran.
100 lbs. corn or hominy meal.
100 lbs. cottonseed meal.
Mix and feed 6 to 8 lbs. (7 to 9 qts.) daily.

III.

100 lbs. wheat bran.
100 lbs. gluten feed.
35 lbs. cottonseed meal.
Mix and feed 7 lbs.(8 to 9 qts.) daily.

IV.

125 lbs. malt sprouts.
100 lbs. corn or hominy meal.
125 lbs. gluten feed.
Mix and feed 7 lbs. (6½ to 7 qts.) daily.

V.

75 lbs. wheat bran.
150 lbs. corn and cob meal.
100 lbs. cottonseed meal.
Mix and feed 6 to 8 lbs. or quarts daily.

VI.

100 lbs. distillers' grains.
100 lbs. malt sprouts.
150 lbs. corn meal.
50 lbs. cottonseed meal.
Mix and feed 7 lbs. (7 to 8 qts.) daily.

VII.

150 lbs. distillers' grains.
150 lbs. standard middlings.
100 lbs. corn or hominy meal.
Mix and feed 7 lbs. or qts. daily.

VIII.

150 lbs. wheat bran.*
200 lbs. gluten feed.
Mix and feed 7 lbs. (8 to 9 qts.) daily.

IX.

200 lbs. dried brewers' grains.
100 lbs. corn meal.
50 lbs. cottonseed meal.
Mix and feed 7 lbs. (9 qts.) daily.

X.†

300 lbs. bran.
100 lbs. flour middlings.
100 lbs. corn meal.
100 lbs. ground oats.
300 lbs. gluten feed.
100 lbs. linseed meal.
Mix and feed as desired.

The cost of a pound of the several mixtures at the present time is from 1.5 to 1.6 cents. It is believed that the above selections are more economical on the basis of their content of nutritive material than most of the sugar feeds and other proprietary mixtures.

In general, it may be said that the *amount of grain* to be fed daily depends (a) upon the size of the cow, (b) daily milk yield, and (c) the local market value of the milk. The richer the milk, the more food is required to produce a given amount ; and *vice versa*.

Seven pounds of the above mixtures is a fair average amount for cows weighing 800 to 900 pounds, which are yielding 10 quarts of 4 per cent milk. For every 2 quarts of milk yielded in excess of this amount the grain ration may be increased by one pound.

RATIONS FOR YOUNG STOCK.

Young dairy stock may receive one peck or more of silage daily, depending upon their size, in addition to what hay, corn stover or other coarse fodder they will eat clean ; or the entire roughage may consist of hay. Grass and clover rowen form a very desirable feed for growing animals. In addition to the above, it is usually advisable to feed from 1 to 3 pounds daily of a grain mixture reasonably rich in protein and ash.‡ Any of the above mixtures will prove satisfactory. The writer has found mixtures by weight of ½ wheat bran and ½ flour middlings ; or ½ bran, ¼ corn meal and ¼ flour middlings ; or even ½ bran and ½ corn meal, quite satisfactory. A ration composed of late-cut hay and corn meal would not be desirable, it lacking both in flesh and bone forming material (protein and ash).

* Malt sprouts can be substituted for one-half the bran if prices warrant it.

† Ration designed for cows on test ; rather expensive for ordinary purposes.

‡ If the roughage consists largely of grass or clover rowen, two pounds daily of a mixture of bran and corn meal, or even of corn meal alone, will prove satisfactory.

MARKET PRICES OF CATTLE FOODS FOR 1909.

FEED STUFFS.	Monthly Wholesale Ton Prices—1909.												Average.
	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Cottonseed Meal	$29.25	$29.56	$29.94	$31.75	$33.88	$32.44	$30.65	$31.00	$31.75	$33.32	$34.25	$35.00	$31.90
Linseed Meal (N. P. and O. P.)	32.19	32.44	33.09	33.10	33.08	—	—	—	33.50	33.75	34.50	35.45	33.46
Gluten Feed (sacked)	30.80	30.90	30.90	29.54	28.50	29.75	29.94	30.10	30.85	30.35	29.85	30.67	30.18
Gluten Feed (bulk)	29.40	29.40	29.40	27.76	27.47	28.71	28.90	29.28	29.81	29.48	28.90	29.49	29.00
Distillers' Dried Grains	32.75	33.00	33.00	32.25	31.25	31.50	31.50	31.38	31.38	31.75	31.88	33.00	32.05
Malt Sprouts (sacked)	—	25.00	25.35	23.25	23.21	23.54	24.00	—	—	—	—	—	24.06
Flour Middlings (Red Dog)	30.81	31.19	31.50	31.55	32.56	33.31	33.15	32.81	32.20	31.63	30.06	30.35	31.76
Standard Middlings (shorts)	27.01	28.47	28.50	28.83	30.19	29.26	27.80	26.76	26.43	26.38	26.22	27.13	27.75
Mixed Feed	27.85	29.10	29.72	29.60	30.94	30.38	28.90	27.66	27.15	26.94	26.63	27.35	28.52
Bran, Spring	24.88	27.31	27.73	27.70	29.06	27.31	25.50	24.25	24.25	24.13	24.13	25.55	25.98
Bran, Winter	25.88	27.69	28.31	28.65	30.50	29.19	25.95	24.56	24.50	24.38	24.94	26.10	26.72
Hominy Meal (sacked)	28.48	28.53	28.90	28.93	31.26	31.35	31.04	30.04	29.45	28.25	28.34	28.22	29.40
Hominy Meal (bulk)	27.85	27.13	27.40	27.65	29.90	30.56	29.82	28.98	28.65	26.98	26.92	27.34	28.27
Corn Meal	26.60	27.80	28.80	30.00	32.80	32.80	31.20	30.20	29.80	27.20	27.40	27.40	29.33
Corn, No. 2 yellow	25.06	26.70	27.24	29.17	30.76	30.74	29.70	28.81	28.63	25.63	26.67	25.53	27.89
Oats, No. 2 clipped white	36.50	37.88	38.81	39.19	41.13	41.88	37.94	32.44	29.19	29.63	29.75	31.38	35.48
Rye, No. 1	30.35	31.02	33.20	33.52	34.66	36.06	33.56	28.20	27.95	29.10	29.99	29.99	31.47
Feed Barley	28.68	29.52	31.19	30.98	33.57	36.70	30.86	26.69	25.02	25.65	26.60	27.81	29.44

BULLETIN No. 133. FEBRUARY, 1910.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT

STATION.

GREEN CROPS

FOR

SUMMER SOILING.

BY J. B. LINDSEY.

This bulletin contains a description of those green fodders and fodder combinations best suited for summer soiling in Massachusetts; it also states method of planting, time of cutting and how they should be fed to the best advantage. A chapter is devoted to fertilizer mixtures for forage crops and tables show the composition of these crops, and the pounds actually digestible in definite weights of the green material.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

STATION STAFF:

CHARLES A. GOESSMANN, PH.D., LL.D.	*Honorary Director and Consulting Chemical Expert.*
WILLIAM P. BROOKS, PH. D.,	*Director and Agriculturist.*
JOSEPH B. LINDSEY, PH. D.,	*Vice Director and Chemist.*
GEORGE E. STONE, PH. D.,	*Botanist.*
CHARLES H. FERNALD, PH. D.,	*Entomologist.*
FRANK A. WAUGH, M. SC.,	*Horticulturist.*
J. E. OSTRANDER, C. E.,	*Meteorologist.*
JAMES B. PAIGE, D. V. S.,	*Veterinarian.*
HENRY T. FERNALD, PH. D.,	*Associate Entomologist.*
EDWARD B. HOLLAND, M. SC.,	*Associate Chemist* (Research Sec.).
HENRI D. HASKINS, B. SC.,	*Chemist in Charge* (Fertilizer Sec.).
PHILIP H. SMITH, B. SC.,	*Chemist in Charge* (Feed and Dairy Sec.).
FRED C. SEARS, M. SC.	*Pomologist.*
FRED W. MORSE, M. SC.,	*Research Chemist.*
ERWIN S. FULTON, B. SC.,	*Assistant Agriculturist.*
EDWIN F. GASKILL, B. SC.,	*Assistant Agriculturist.*
LEWELL S. WALKER, B. SC.,	*Assistant Chemist.*
JAMES C. REED, B. SC.	*Assistant Chemist.*
CARL D. KENNEDY, B. SC.	*Assistant Chemist.*
J. F. MERRILL, B. SC.	*Assistant Chemist.*
GEORGE H. CHAPMAN, B. SC.,	*Assistant Botanist.*
J. K. SHAW, M. SC.,	*Assistant Horticulturist.*
JOHN N. SUMMERS, B. SC.,	*Assistant in Entomology.*
H. J. FRANKLIN, PH. D.,	*Assistant in Entomology.* (Cranberry Inves.)
JAMES T. HOWARD,	*Inspector.*
ROY F. GASKILL,	*Assistant in Animal Nutrition.*
C. M. DAMON,	*Observer.*

Annual reports and bulletins on a variety of subjects are published These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

Green Crops for Summer Soiling

By J. B. Lindsey.

CONTENTS.

In 1901 the station presented a bulletin, No. 72, entitled Summer Forage Crops, which contained a concise description of those green crops best suited to the needs of Massachusetts farmers. The edition of this bulletin has long since been exhausted, and in response to frequent inquiries the present bulletin is presented, containing the results of our more recent experience at the station with this class of crops. All of the fodder and fodder mixtures herein described have been grown upon the grounds of the station and fed to the station herd. They have been frequently analyzed, and in most cases their digestibility determined.

A. PASTURAGE AND PASTURE GRASS.

It is believed that, whenever possible, dairy animals should be pastured during five months of the year. The open air, sunlight and exercise resulting are certainly most desirable and beneficial, especially after the long confinement of the late autumn and winter months. The change from dry feed to the succulent grasses and herbs is likewise advantageous and acts as a tonic to the entire system.

Superiority of Pasture Grass.

Pasture grass is superior to most forage crops for the following reasons: (a) It contains pound for pound more protein than the cereal fodders, the numerical relation of the protein to the carbohydrates (nutritive ratio) in the case of the former being as 1 to 5, while in case of the latter it is from 1 to 8 to 1 to 12. (b) Pasture grass contains less woody fiber than the coarse fodders of the cultivated fields, and is consequently more tender and digestible. (c) It probably has a more desirable flavor, the animals seeming to prefer it to the fodders and grass nearer maturity.

If the cereal fodders and grasses were cut when two or three inches high they would have fully as much, or even more protein, and be equally as digestible as the mixed pasture herbage; as they continue in growth, however, the carbohydrates, including the fiber, are developed to a greater extent than the protein, and they have a wider nutritive ratio and a lesser degree of digestibility.[1]

Soiling a Substitute for Pasturage.

Unfortunately most pastures, owing to neglect and continuous cropping, have become quite inferior, and dairy animals depending upon them for their food supply are often obliged to travel over large areas, and even then do not secure sufficient food to keep them in good flesh, and to maintain the milk flow. The droughts, so likely to occur during the summer months, often render it necessary—if the herd is to be kept in a profitable condition—to furnish additional food, even should the pasture be usually satisfactory. Again, some dairymen do not have sufficient pasturage, while others, in the vicinity of large towns, have little or none. When, therefore, pasturage is not obtainable or only to a limited extent, it becomes necessary to supply other food to take its place, and frequently a system of partial or entire soiling is adopted.

The chief objections to the growing of summer green crops are the time and labor consumed in their production. It becomes necessary to prepare numerous small pieces of land at frequent intervals, and to cut and draw small quantities of fodder to the barn every two or three days. Work of this character is time-consuming, and frequently interferes with more extended farm operations. For this reason some dairymen prefer to supplement pasturage with hay and grain, believing it to be more economical. No definite rules can be laid down to govern all cases. Each one will have to study his own conditions and follow the system best suited to his particular needs. The writer believes that animals should receive a portion of green food during the growing season. If this portion can be secured from pasturage he is inclined, from the standpoint of economy, to

[1] Clover and other legumes, if cut in early bloom, contain fully as much protein and are nearly as digestible as pasture grasses.

make up the balance with hay and grain, supplementing more or less with clover, and fodder corn. In case the dairymen is without pasturage he may combine soiling with hay and grain feeding. In the latter case, approximately 50 pounds daily of green feed may be given together with one feeding of hay and 4 to 8 pounds of grain. Rations for summer soiling will be discussed more fully further on.

The Summer Silo as a Supplement.

Corn silage is quite often used as a substitute for pasture grass and green forage, especially in those sections where frequent and long-continued droughts are prevalent. The silo should be so constructed as to expose a less surface area to the air than during the winter months.

The writer does not favor silage as a summer feed whenever other forage can be economically supplied. The corn, as is well known, undergoes many changes in the silo, and among other products a considerable amount of different acids is formed. It is these acids which render the ensilage sour and, in the judgment of the writer, they are decidedly objectionable as a food ingredient if fed continuously. It is believed to be preferable, from the standpoint of health, to supply the animals during the summer with freshly grown green forage, and leave the fermented material for the long period during which other more desirable green feed is not to be obtained.

B. DESIRABLE GREEN FORAGE.

Classified into Legumes and Non-legumes.

Forage crops may be divided into two classes—legumes and non-legumes. Botanically these two classes have many distinct characteristics. It is only necessary to state in this connection that the legumes are to be distinguished from the non-legumes by having the "butterfly flowers," by being able to take nitrogen from the air and by containing at the same stage of growth considerably more protein than the non-legumes. The most desirable legumes are the vetch, pea, soy bean, clover and alfalfa.

The *vetch* closely resembles the pea in its habits of growth and general appearance; it has, however, finer stems and leaves. There are two species used for fodder purposes—the spring vetch (Vicia sativa) and the sand or winter vetch (Vicia villosa). The vetches and peas are useful chiefly for green forage, to be grown together with the cereal fodders, the latter plants furnishing a desirable support.

The *soy bean*, of which the medium green is the preferable variety, has its chief use in Massachusetts as a green forage.

Alfalfa will produce a large amount of green material, but experience at this station has shown that its place is likely to be partly usurped by grasses after two or three years. It seems probable that it is not likely to prove decidedly superior to clover in the New England farm economy.[1]

Among the most desirable non-leguminous forage plants may be mentioned rye, wheat, barley, oats, corn, millet, sorghum, as well as the grasses usually grown for hay.

Order of Description.

In describing the various fodders and fodder mixtures, those available in the late spring will first be mentioned, and a description will follow of those best suited for the summer and autumn months. Following this general description will be found a table briefly summarizing the most important facts such as the time of sowing, seed to the acre, area to be sown, and approximate time of cutting.

Rye and Wheat.

Rye sown broadcast about September first, at the rate of two bushels to the acre, gives the earliest green feed, being often ready to cut May 20th. The chief objections to this crop are that it grows woody quite rapidly after it begins to blossom, rarely lasting in satisfactory condition over 8 days, and that it frequently imparts an objectionable flavor to the milk.

Wheat may be sown at the rate of two bushels to the acre, the same time as rye, and will be ready to cut by May 30th. It will remain in good condition for feeding several days longer than the rye.

Wheat and Sand Vetch.

The land should be plowed, harrowed, and 1½ bushels of wheat and 1 bushel of vetch to the acre sown broadcast about September first, and covered not too deeply with a wheel or other harrow. A good growth may be expected before cold weather, which should be left uncut as a mulch. Cutting should begin just as the

[1] See special circular No. 18 on Alfalfa put out by this station; also, page 8 of this bulletin.

wheat heads show themselves, which in our locality is the last of May This green crop will remain in feeding condition for 12 to 14 days. If more of the fodder mixture has been produced than can be fed green, the balance may be made into hay. The yield will vary from 6 to 10 tons of green fodder to the acre, depending upon the fertility of the soil, rainfall, and spring temperature. Immediately after the removal of the crop the land may be planted to Hungarian, barnyard millet or corn. In one season, from the same piece of land, we have secured at the rate of 10 tons of green wheat and vetch and 17.6 tons of fodder corn to the acre, containing nutriment equivalent to 5 tons of well-cured hay. The wheat and vetch mixture is hardy, and will contain approximately 3.40 per cent of protein equal to 12 to 15 per cent in air dry material. Because of the cost of the vetch seed it is doubtful if the ordinary dairyman can afford to grow the mixture; but the milk producer in the vicinity of profitable markets, who receives an extra price for his milk, may find it of value as an early green feed.[1]

Vetch sown by itself is not satisfactory for forage, as it is recumbent in its habit of growth and rots badly, especially if the weather is moist. It has been highly recommended by Shamel[2] as a cover crop to follow tobacco. Sown broadcast about September 1 at the rate of 1½ bushels of seed to the acre, it grows rapidly and makes a good covering before winter. We have grown 9 to 10 tons of green material to the acre, cut June 2, equivalent to some 120 pounds of nitrogen. This plant appears to be valuable as a forage crop grown together with a cereal, and likewise as a cover crop and producer of humus for sandy soils and as a gatherer of nitrogen.

Clover or Grass and Clover. The green crop that would naturally follow the wheat and vetch is clover or grass and clover. If a grass and clover mixture is preferred the grasses should be of the varieties blossoming in early June. The following seed mixture costs about six dollars per acre: Alsike or red clover, 8 pounds; orchard grass, 6 pounds; tall oat grass, 8 pounds; and Kentucky blue grass, 6 pounds. The seed should be sown in early August, if possible, in order to enable the clover to become well established before winter. The yield will

[1] For a fuller report on this crop, see Fifteenth Report of the Hatch Experiment Station, pp. 63-67.

[2] Conn. Expt. Sta. Bull. 149, 1905.

be from 6 to 8 tons to the acre, and cutting can usually begin as the first blossoms appear, generally about June 7. Two-thirds of an acre would be ample for 10 cows ten days. If more has been grown than can be fed green, the balance can be made into excellent hay. If allowed to stand until late bloom, the mixture becomes tough and less digestible. A second cutting of several tons to the acre can be obtained if the rainfall is sufficient. Land thus seeded can be cropped for two successive years.

Clover grown by itself is believed on the whole to be fully as satisfactory as the grass and clover mixture. The 15 to 20 pounds of seed necessary to the acre can be secured for about two-thirds the cost of the mixture. The first cutting can be made nearly as early as the grass and clover, and the yield will be as large. A second and occasionally a third cutting can be secured, and the clover seeding will generally yield good returns for two consecutive years. The seed may be sown in early August, or it may be seeded in the corn after the last hoeing. If seeded in the corn and the land is in good heart no fertilizer need be applied until the close of the following year of growth, when an application of 200 pounds of high-grade sulfate of potash and 600 pounds of phosphatic slag will prove decidedly helpful to the growth of the second year. Two and perhaps three cuttings may be expected the first season, with a total yield of 13 tons of green material to the acre, equivalent to 3,000 pounds of digestible matter, including 500 pounds of digestible protein. If more is secured than is needed for soiling, the balance may be made into hay. If hayed, it should be cut in early blossom, allowed to wilt, raked into winrows, cocked, covered with hay caps and thus cured. The cocks should be moved every few days to prevent the killing out of the sprouting plants beneath. On the day of drawing to the barn, the cocks may be opened and aired. The use of hay caps is strongly recommended; they protect from rain, check a too rapid drying and will amply repay for their cost and for any extra labor. If clover is cut in late blossom and hayed by the usual method, it furnishes a very inferior fodder.[1]

Alfalfa can be used in place of clover for green forage. The first cutting, after the field has become established, will be ready about June 20, a second cutting in early August, and a third about Sep-

[1] See the excellent article on Clover by W. P. Brooks in Report of the State Board of Agriculture for 1906.

tember 5. It may, therefore, take the place of the first seeding of peas and oats, and the second seeding of barnyard millet. Alfalfa has thus far proved itself an uncertain crop in Massachusetts. It occasionally winter kills, and is quite likely to be partially replaced by the grasses after two or three years. It is very nutritious and highly relished by stock, and farmers are advised to try it as an experiment at first, rather than as a sure crop for green forage in a sequence with others. The following points are important and must be observed :

1. Do not try to grow it on land with a hardpan subsoil, or where the water table is within six or eight feet of the surface. It needs well-drained land, free from hollows that will permit of standing water.

2. The land should be in a good state of fertility. Apply a ton of lime to the acre, preferably in the autumn and harrow thoroughly; plow in a fair dressing of barnyard manure[1] in the spring, and likewise add 800 pounds of basic slag, 300 pounds of high grade sulfate of potash and 100 pounds of nitrate of soda to the acre. Apply also a few hundred pounds of soil secured from an old alfalfa field. The land should be well fitted, the soil being made almost as fine as for an onion bed. The seed may be sown in early May at the rate of 30 pounds to the acre, together with one-half bushel of oats as a nurse crop, the latter checking the growth of weeds. Cutting should begin just as the first blossoms appear. If allowed to stand late, it is very likely to be attacked by blight, and is also less digestible. If more is obtained than is needed for soiling, it may be cured in the same manner as described for clover.

3. If sown in the spring with oats, the first cutting may be expected about July 20, and another in early September. It is doubtful if more than two comparatively light crops are secured the first season. After the last cutting a growth of six to eight inches will generally take place, which may be allowed to stand as a winter mulch.

4. Another method tried with success at this station consists in plowing the land in the spring, and applying the lime at once, to be followed by frequent harrowings until late July to kill the weeds. The manure[1] and fertilizer should then be added, the land harrowed

[1] If land is rich, manure may be omitted.

fine, and the alfalfa seed sown without a nurse crop. It is always advisable to put on the lime some time previous to the barnyard manure and seed. The growth during the fall should be allowed to remain uncut in order to serve as a winter protection to the roots.

5. If an alfalfa field becomes well established, a yearly application either in the autumn or spring of 800 pounds of phosphatic slag and 300 pounds of high grade sulfate of potash is recommended. In case 500 pounds of acid phosphate are used in place of 800 pounds of phosphatic slag, it is advised to apply a ton of lime to the acre every three or four years. Patience, perseverance and a careful study of the peculiarities of the alfalfa plant are necessary before success is likely to be achieved.

Oats and Peas. Oats and Canada field peas make the best green crop to follow clover. Generally, it is advisable to make three sowings: the first as early as possible in the spring—April 20 to 25—and the second and third, fifteen and thirty days later. One and one-half bushels each of the oats and peas is the usual quantity to the acre. They both may be sown broadcast at the same time after the land is plowed and thoroughly harrowed in with a wheel-harrow, or the peas may be first sown and four to five days later the oats, the latter being covered with an Acme or similar harrow. The first sowing will be ready about June 25, and cutting should begin as soon as the oats show the head. The average yield from the second and third sowings is not likely to be as heavy, as the crop matures more quickly during the warm weather. Oats and peas will remain in condition to cut for 10 or 12 days. The average cow will consume from 50 to 80 pounds daily until the feed becomes tough. One-third of an acre will generally furnish 10 cows with sufficient green feed for 12 days. (See page 17 for amount of green food to be fed daily.)

Oats and *spring vetch* have also been grown successfully at the station. They are equally as digestible as the oats and peas, and will generally yield as heavily. Should the spring prove dry, however, the vetch is likely to make a poor growth, the oats taking the larger part of the available moisture. Vetch seed is also more costly than peas.

Hungarian grass may be seeded on land from which the first cutting of peas and oats has been removed. If seeded the first week in

July it will be ready to cut September 10 to 15. It also makes a satisfactory green feed for August if sown early in June, but barnyard millet is usually preferred, owing to the greater yield. The usual quantity of Hungarian seed is one-half to one bushel to the acre. Clover, or barley and peas, can also be sown on the land from which the oats and peas have been removed.

Barnyard Millet. This variety of millet (Panicum crus-galli) resembles ordinary barnyard grass in its general appearance. It is now quite extensively used as a green feed, especially for August, and the seed can be purchased of all large seed houses. It is not, in the writer's judgment, as satisfactory a feed as corn, containing more woody fiber, and proving somewhat less digestible, especially as it approaches maturity. It is a warm weather plant similar to corn, but will not stand dry weather as well, is a heavy feeder, and will do best upon a warm, moist soil. It makes a very rapid growth when the temperature is high, and it has its place among the desirable forage crops.

If sown broadcast, 14 quarts of seed are sufficient for one acre. The first seeding may be made May 15 (upon land that has been well harrowed) and covered with a smoothing harrow. Should the weather prove cold during May and early June, the millet will make a slow growth and have a yellow, sickly appearance, but with the advent of a few warm days this condition will be rapidly overcome. A second and third seeding may be made at intervals of 20 and 15 days respectively. The first seeding will be ready to cut August 1 and the other sowing will follow, so that green feed may be secured from this crop during all of August if desired. Cutting should begin even before the heads appear, and can be continued for 10 or 12 days. After it is well headed it becomes tough, and animals are likely to refuse a considerable portion of the stem. This variety of millet does not make a satisfactory hay because of its coarseness and the consequent difficulty in drying. An average yield is about 16 tons to the acre, although half as much again is occasionally reported by those who have grown it upon fertile, moist soils.

Corn is par excellence the most satisfactory and economical green feed for late August and for September. The writer generally uses such sweet varieties as Potter's Excelsior and Stowell's Evergreen, while Longfellow, Pride of the North and Rustler White Dent are also excellent for late autumn feeding. Corn has the advantage of not toughening like many other crops, and of furnishing an increasing amount of palatable and digestible material as it approaches maturity.

Soy beans originally imported from Japan, have been used with some success as a forage crop. The most satisfactory variety for Northern conditions is believed to be Brooks' medium green, the seed of which can be procured of most large seed dealers. It grows 2½ to 3 feet high, needs no support and its stems are thickly set with leaves. The usual quantity of seed to the acre is 16 quarts, sown with the aid of an Eclipse or other planter in rows 2½ feet apart. The planter should be regulated so as to drop the seed about an inch apart in the row. The crop may be cultivated in the same manner as corn, and will be ready to feed early in September. The yield will be from 6 to 10 tons of green fodder to the acre.

Corn and Beans. A mixture of early corn and soy beans has proved a desirable forage crop for the last ten days of August and the first two weeks of September. The corn has been sown with an Eclipse corn planter in rows four feet apart, and the beans planted with a hand planter in the same rows with the corn, one lot of beans being placed every few inches. Good success has also been had by mixing the corn and beans together in the proportion of 10 quarts of corn and 7 quarts of beans and planting the mixture with the aid of an Eclipse planter. The crop is to be cultivated in the same manner as corn. The first seeding should be made May 15 and the second about June 5. One-third of an acre will be sufficient for 10 cows two weeks. The first seeding will be ready to cut August 20 and the second the first week in September. The yield to the acre will be in the vicinity of 12 tons, equivalent to about 3,600 pounds of digestible matter. The above mixture will furnish rather more protein than corn, but the cost of the bean seed is more and the labor of cultivation and harvesting is somewhat increased, which, in the writer's judgment, makes up for the increased value of protein secured.

Early Amber Sorghum. Sorghum has been tried for forage purposes and proved its worth. It may be seeded broadcast on May 20 to 25, at the rate of 50 to 60 pounds of seed to the acre. It needs warm weather for its development, in which case it will be ready to cut about August 20, and the fodder will remain in good condition for some 18 days. In case of a cool summer the growth of the crop will be retarded, its normal sugar content will not be reached, and it will hardly reach a sufficient degree of maturity for cutting before frosts appear. It is a heavy yielder when the season is favorable, some 20 tons of green material to the acre being produced on reasonably fertile soils. It is considered rather more nutritious than barnyard millet, but is not equal to corn.

Barley and Peas. Barley and peas furnish a satisfactory green crop during the first three weeks of October; they are not injured by light frosts. One and one-half bushels each to the acre may be sown together the first of August, and deeply harrowed in with a wheel harrow. The yield will not be as large as in case of oats and peas, six tons to the acre being about an average crop. The land from which the oats and peas were taken earlier in the season can be utilized, thus producing two crops in one year, equivalent to four tons of hay to the acre. Should the month of August be unusually dry, this crop might prove a failure, especially on light soils. We have generally been successful with it on a medium loam. It is stated that in the vicinity of the sea-coast peas will not grow late in the season owing to the dampness of the atmosphere due to numerous fogs. Barley may be grown by itself if it would thrive under such conditions. Some farmers thus situated have grown cabbage as a late forage crop. Cabbage is quite nutritious, but the labor involved in caring for it is considerable and it is a heavy feeder. The most desirable heads may be marketed to advantage and the poorer portion of the crop fed to the animals.

SUMMARY OF GREEN CROPS.

(Basis Ten Cows.)

KIND.	Seed per acre.	Approximate time of seeding.	Area.	Approximate time of cutting.
Rye, . . .	2 bus.	Sept. 1.	$\frac{1}{3}$ acre.	May 20—May 30.
Wheat, . . .	2 bus.	Sept. 1.	$\frac{1}{3}$ "	May 25—June 8.
Wheat and Sand Vetch*	1½ bus. wheat, 1 bu. vetch.	Sept. 1.	$\frac{1}{3}$ "	May 25—June 8.
Clover, . . .	15 to 20 lbs.	Aug. 1.	$\frac{1}{2}$ "	June 9—June 25.
Grass & Clover†	8 lbs. clover, 8 lbs. tall oat grass, 6 lbs. orchard grass 6 lbs. Kent'cky blue	Aug. 1.	$\frac{1}{2}$ "	June 9—June 25.
Oats and Peas,	1½ bus. each.	April 25.	$\frac{1}{3}$ "	June 25—July 6.
" "	1½ bus. each.	May 5.	$\frac{1}{3}$ "	July 6—July 17.
" "	1½ bus. each.	May 20.	$\frac{1}{3}$ "	July 17—July 28.
Barnyard Millet,	14 quarts.	May 20.	$\frac{1}{4}$ "	July 28—Aug. 8.
" "	14 quarts.	June 5.	$\frac{1}{4}$ "	Aug. 8—Aug. 18.
" "	14 quarts.	June 20.	$\frac{1}{4}$ "	Aug. 18—Aug. 28.
Sorghum,§ . .	60 lbs.	May 25.	$\frac{1}{3}$ "	Aug. 18—Sept. 10.
Sweet Corn,‖ .	15 quarts.	May 15.	$\frac{1}{2}$ "	Aug. 18—Sept. 10.
Corn (field),‖ .	15 quarts.	May 25.	—	Sept. 10.
Barley and Peas,	1½ bus. each.	July 25—Aug. 1.	$\frac{2}{3}$ "	Oct. 5—Oct. 20.

* Wheat and vetch may be used in place of wheat if desired.

† Grass and clover may be used in place of clover if desired.

§ Sorghum may be used in place of the last seeding of barnyard millet and the first seeding of corn if desired.

‖ Soy beans may be sowed with the corn if desired, in the proportion of 10 qts. corn and 7 qts. beans; the mixture can be planted with the aid of an Eclipse or similar planter. (See page 12.)

COST OF SEEDS.

	Approximate cost a bushel, 1910.	Pounds to the bushel.
Winter wheat, . . .	$2.00	60
Canada field peas. . . .	1.90	60
Sand (winter) vetch, . .	5.40	60
Soy beans (medium green), . .	4.75	58
Alfalfa, ...	12.00	60
Barnyard millet, . . .	2.35	35
Sorghum (early amber), . .	3.50	50
Tall oat grass, . . .	3.50	12
Orchard grass, . . .	2.75	14
Kentucky blue grass, . .	2.75	14

Practically all of the seeds can be procured at our New England agricultural warehouses and seed stores.

C. FERTILIZERS FOR FORAGE CROPS.

It is decidedly poor economy to attempt to grow forage crops on poor, unfertilized soils. Intensive rather than extensive culture should be the motto of the producer. Naturally, the amount of manure or commercial fertilizer to be applied will depend upon the previous treatment and present condition of the land.

Barnyard Manure and Chemicals. Six cords of barnyard manure under average conditions may be considered a reasonable application to the acre. Soils quite deficient in available plant food will require double this amount applied for a series of years before they become highly productive. Frequently, when the supply of manure is limited, it may be advisable to apply 3 or 4 cords to the acre, and supplement with commercial fertilizers. In such cases the following mixture is suggested :

Nitrate of soda, . .	50 pounds.
Acid phosphate, . .	200 pounds.
Muriate of potash, . .	100 pounds.

In case of crops sown in the fall—wheat and vetch or grass and clover—the barnyard manure may be used at the time of seeding, if the soil requires it, and an application of chemicals similar to the above made if necessary in the spring.

If clover or other legumes are grown by themselves, the nitrate of soda may be omitted. Clover sick land will be greatly benefited by the application of 1000 to 2000 pounds of slaked lime to the acre. If refuse lime from the lime kilns cannot be obtained (agricultural lime) ordinary barrel lime may be used. It should be placed in small piles in the field and allowed to slake before spreading.[1]

Chemical Fertilizers Entirely. When it is desired to grow forage crops with the aid of chemical fertilizers exclusively, the following mixtures are suggested per acre for land in a fair state of fertility. In case of poor soils the amount may be increased one-third to one-half:

I. Wheat and vetch, grass and clover, to be applied at the time of seeding.

Nitrate of soda, . . .	50 pounds.
Phosphatic slag, . .	600 pounds.
Muriate or sulfate of potash,	150 pounds.

Top dress in the spring with 100 pounds nitrate of soda. If clover or other legumes[2] are grown exclusively, the spring top dressing with nitrate may be omitted.

II. For oats and peas, barley and peas, and millet:

Nitrate of soda, . .	100 pounds.
Tankage, ...	300 pounds.
Acid phosphate, . .	300 pounds.
Muriate of potash, . .	150 pounds.

III. For soy beans:

Nitrate of soda, . .	100 pounds.
Dry ground fish, . .	200 pounds,
Acid phosphate, . .	300 pounds.
Sulfate of potash, . .	200 pounds.

IV. For corn (no stable manure):

Nitrate of soda, . .	150 pounds.
Tankage, ...	500 pounds.
Acid phosphate, . .	300 pounds.
Muriate of potash, . .	200 pounds.

The above fertilizers may be sown broadcast.

---

[1] Barnyard manure should not be applied until several weeks after liming.

[2] See special instructions for fertilizers for clover and alfalfa on pages 8-9.

V. For corn (in addition to manure):

Nitrate of soda, . .	100 pounds.
Acid phosphate, . .	200 pounds.
Muriate of potash, . .	100 pounds.

Use in the hill or drill.

D. FEEDING FORAGE CROPS FOR MILK PRODUCTION.

When forage crops are grown to supplement pasturage, the feeding of a reasonable amount at night is quite satisfactory. In case pasturage is very deficient, another feeding may be given in the morning, or what is preferable, the morning feed may consist of a grain mixture:

I.	II.
100 pounds gluten feed.	100 pounds gluten feed.
100 pounds bran or mixed feed.	100 pounds hominy meal.
Mix and feed 2 to 4 quarts.	Mix and feed 2 to 4 quarts.

Some grain is to be preferred as a supplement to green fodder in order to increase the daily protein supply. In case clover constitutes the green forage, the grain may be omitted, or it may consist of corn or hominy meals in place of those above suggested.

Should summer soiling be practiced exclusively, it is advised to feed 10 pounds of hay daily, together with what green forage the animals will eat clean, which will amount to from 40 to 50 pounds in case of average sized cows. The writer does not consider it wise to feed more than the above amount of coarse green feeds daily for the reason that an excess produces an exceedingly laxative condition of the bowels. Animals fed in excess of 50 pounds are likely to become noticeably thin in flesh. In addition to the hay and green fodder, it will usually prove economical to feed from 4 to 7 quarts of the following grain mixtures daily:

I.	II.
125 lbs. bran.	125 lbs. bran.
100 lbs. flour middlings.	100 lbs. corn or hominy meal.
100 lbs. gluten feed.	75 lbs. cottonseed meal.

III.	IV.
75 lbs. bran.	150 lbs. bran.
150 lbs. corn and cob meal.	200 lbs. gluten feed.
75 lbs. cottonseed meal.	

V.	VI.
200 lbs. dried brewers' grains.	200 lbs. dried distillers' grains.
100 lbs. corn or hominy meal.	150 lbs. flour middlings.
50 lbs. gluten feed.	50 lbs. corn meal.

The selection of the particular ration to be used will naturally depend upon the presence and cost of the several grains in the local markets.

E. COMPOSITION AND DIGESTIBILITY OF FORAGE CROPS.

The following table is divided into two parts. One headed *composition*, represents the total percentages or pounds in 100 of the different ingredients contained in the various fodders, and the other, headed *digestibility*, shows the percentage or pounds in 100 *actually digestible.* The table is made up largely from the analyses and digestion work carried out at this station, although other sources have been drawn from when necessary.[1] In many cases the analyses and digestion tests are too few in number to secure any very satisfactory averages. Single samples of different fodders and fodder mixtures show quite noticeable variations in composition and digestibility, depending on weather conditions, fertility of soil, and stage of growth.

The average analyses of the several groups as presented in the table, give a more correct idea of the probable composition of the cereal fodders, legumes and fodder mixtures, than does the analysis of a single fodder in the group. The same holds true concerning digestibility.

The table shows as much digestible protein in the cereal fodders as in the fodder mixtures, the latter being a combination of a cereal fodder and a legume. This is due primarily to the difference in the amount of water present. The fodder mixtures naturally contain more protein than the cereal fodders.

---

[1] Vermont Experiment Station Bulletin 81, and Bulletins Nos. 11 and 77, Office of Experiment Stations.

TABLE No. 1. Figures equal percentages, or pounds in 100.

KIND.	Composition.							Digestibility.					
	Number of analyses.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Dry matter.	Protein.	Fiber.	Nitrogen-free extract	Fat.	Nutritive ratio.
I. Non-legumes.													
(a) Pasture grass, . .	—	80.0	2.0	3.5	4.0	9.7	0.8	13.8	2.3	3.0	7.0	0.4	1: 4.8
(b) Cereal fodders,													
Rye fodder, . . .	7	76.6	1.8	2.6	11.6	6.8	0.6	14.7	1.9	6.6	4.6	0.4	1: 6.4
Barley fodder, . .	6	75.2	2.0	3.4	6.5	12.0	0.9	16.4	2.4	4.0	8.5	0.5	1: 5.7
Oat fodder. . . .	4	75.0	1.7	2.3	8.4	11.08	0.8	15.0	1.7	4.4	7.4	0.6	1: 8.0
Average, . .		**75.4**	**1.8**	**2.8**	**8.8**	**10.1**	**0.8**	**15.2**	**2.0**	**5.0**	**6.8**	**0.5**	**1: 6.7**
(c) Millets.													
Barnyard millet, . .	4	80.0	1.8	1.8	6.9	9.2	0.3	14.2	1.2	5.0	6.6	0.2	1:10.7
Hungarian grass, . .	2	74.0	2.1	2.6	7.0	13.8	0.5	17.4	1.7	5.0	9.4	0.3	1: 8.9
Average, . .		**77.0**	**1.9**	**2.2**	**7.0**	**11.5**	**0.4**	**15.8**	**1.5**	**5.0**	**8.0**	**0.3**	**1: 9.5**
(d) Corn.													
Fodder corn,* . . .	40	79.8	1.1	2.0	4.3	12.1	0.7	13.7	1.2	2.6	9.0	0.5	1:10.7
Sweet fodder corn, .	21	79.1	1.3	1.9	4.4	12.8	0.5	14.8	1.2	2.8	9.9	0.4	1:11.4
Average, . .		**79.5**	**1.2**	**1.9**	**4.4**	**12.5**	**0.6**	**14.3**	**1.2**	**2.7**	**9.5**	**0.5**	**1:11.1**
(e) Grasses.													
Orchard grass,† . .	4	73.0	2.0	2.6	8.2	13.3	0.9	15.1	1.6	5.0	7.3	0.5	1: 8.5
Tall oat grass,† . .	3	69.5	2.0	2.4	9.4	15.8	0.9	14.9	1.2	5.2	9.2	0.5	1:13.1
Kentucky blue grass,†	5	69.1	2.4	3.2	8.3	16.1	0.9	17.3	1.8	5.2	8.5	0.4	1: 8.2
Timothy,†	14	65.1	2.0	2.8	10.4	18.7	1.0	22.3	1.3	5.8	12.3	0.5	1:14.9
Red Top,†	5	64.8	2.3	3.3	9.4	19.1	1.2	22.5	1.6	5.3	12.6	0.6	1:12.1
Average, . .		**68.3**	**2.1**	**2.9**	**9.2**	**16.6**	**1.0**	**22.4**	**1.5**	**5.6**	**12.5**	**0.6**	**1:13.5**
II. Legumes.													
Alfalfa, ...	3	76.0	1.8	3.9	8.3	9.7	0.4	14.9	2.8	3.9	7.0	0.2	1: 4.1
Canada peas, ...	8	85.0	1.3	3.2	4.3	5.8	0.4	9.6	2.6	1.9	4.4	0.2	1: 2.6
Red clover, ...	13	80.0	1.8	3.1	5.7	8.8	0.6	13.2	2.0	3.0	6.3	0.4	1: 5.2
Alsike clover, . . .	8	80.0	2.3	3.3	5.4	8.5	0.5	13.2	2.2	2.9	6.1	0.3	1: 4.5
Winter vetch, ...	7	85.0	2.1	3.4	4.4	4.7	0.4	10.7	2.8	2.8	3.6	0.3	1: 2.6
Spring vetch, ...	4	85.0	1.4	2.7	4.5	6.1	0.4	10.7	2.2	2.8	4.7	0.3	1: 3.8
Soy beans,‡	16	80.0	2.2	4.1	5.3	7.8	0.6	13.0	3.2	2.4	6.0	0.3	1: 2.9
Average, . .		**81.6**	**1.8**	**3.4**	**5.4**	**7.3**	**0.5**	**11.6**	**2.5**	**2.8**	**5.4**	**0.3**	**1: 3.6**
III. Fodder Mixtures.													
Wheat and winter vetch,	4	80.0	1.6	3.4	6.4	8.1	0.5	13.8	2.6	4.4	5.9	0.3	1: 4.3
Orchard grass and clover,	1	80.0	1.5	2.4	6.5	9.0	0.6	13.0	1.4	3.6	6.5	0.4	1: 8.1
Tall oat grass and clover,	2	80.0	1.5	2.7	5.8	9.5	0.5	13.0	1.6	3.2	6.9	0.3	1: 6.5
Oats and peas, . . .	9	80.0	1.6	3.3	5.6	8.6	0.9	13.0	2.5	3.4	5.8	0.6	1: 4.3
Oats and vetch, . . .	3	80.0	1.8	2.9	6.3	8.3	0.7	13.4	2.2	4.3	5.7	0.3	1: 4.9
Millet and peas, . . .	1	80.0	1.8	2.4	7.5	8.0	0.3	13.0	1.8	4.5	5.4	0.2	1: 5.7
Corn and soy beans, .	1	80.0	1.3	2.8	4.3	11.2	0.4	12.8	1.9	2.3	8.3	0.3	1: 6.0
Barley and peas, . .	9	80.0	1.8	3.6	5.0	8.8	0.8	13.0	2.9	2.5	5.9	0.5	1: 3.3
Average, . .		**80.0**	**1.6**	**2.8**	**6.0**	**9.0**	**0.6**	**13.1**	**2.0**	**3.5**	**6.3**	**0.4**	**1: 5.6**

* Flint varieties. † In bloom. ‡ Variety uncertain (probably in pod.)

TABLE No. 2.

Pounds of digestible dry matter, protein and carbohydrates (the latter including fat multiplied by 2.50) in different weights of the several fodder groups.

Pounds of Fodder.	Dry matter.	Protein.	Carbohydrates.	Dry matter.	Protein.	Carbohydrates.	Dry matter.	Protein.	Carbohydrates.
	Pasture Grass, 1: 4.8.			Cereal Fodders, 1: 6.7.			Millets, 1: 9.8.		
10	1.40	0.2	1.1	1.50	0.2	1.3	1.6	0.2	1.4
25	3.50	0.6	3.0	3.80	0.5	3.3	3.9	0.4	3.5
50	6.90	1.2	6.0	7.60	1.0	6.6	7.9	0.8	6.9
60	8.30	1.4	6.6	9.10	1.2	7.9	9.5	0.9	8.3
75	10.40	1.7	8.0	11.40	1.5	9.8	11.9	1.1	10.4
100	13.80	2.3	11.0	15.20	2.0	13.1	15.8	1.5	13.8
	Corn Fodder, 1: 11.1.			Grasses, 1: 13.5.			Legumes, 1: 3.6.		
10	1.40	0.1	1.4	2.2	0.2	2.0	1.16	.25	.9
25	3.60	0.3	3.4	5.6	0.4	4.9	2.90	.63	2.3
50	7.20	0.6	6.8	11.2	0.8	9.8	5.80	1.25	4.5
60	8.60	0.7	8.1	13.4	0.9	11.8	6.96	1.50	5.4
75	10.70	0.9	10.1	16.8	1.1	14.7	8.70	1.88	6.8
100	14.30	1.3	13.5	22.4	1.5	19.6	11.60	2.50	9.0
	Fodder Mixtures, 1: 5 6.								
10	1.30	0.2	1.1						
25	3.30	0.5	2.7						
50	6.60	1.0	5.4						
60	7.90	1.2	6.5						
75	9.80	1.5	8.1						
100	13.10	2.0	10.8						

BULLETIN No. 134. MAY 1910.

MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION.

THE HAY CROP,

BY

WILLIAM P. BROOKS.

This bulletin, a reprint of a portion of Bulletin No. 3 of the Massachusetts State Board of Agriculture, is published through the courtesy of the Hon. J. Lewis Ellsworth, the secretary of the Board. It contains three papers written originally for the Crop Reports of the Board, and now reissued by it in bulletin form. The subjects treated are, "The Hay Crop," "The Management of Mowings," and "Clovers." The first paper discusses the position and importance of the hay crop in Massachusetts, and shows that average yields are far below what they should be. It presents the results of numerous experiments and makes suggestions as to methods of seeding and the use of manures and fertilizers, both in preparation for the crop and for top-dressing. The second paper discusses the value of the different more important species of grasses and clovers, and gives mixtures adapted to different soils and purposes. It considers fertilizers in their relations to these crops, and gives advice as to reseeding, general management and the suppression of the more important weeds common in mowings. The third paper points out the reasons for the great value of clovers on the farm, describes the leading agricultural varieties, and tells how to grow them most successfully and profitably.

Requests for bulletins should be addressed to
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION.

STATION STAFF.

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publication on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

CONTENTS.

THE HAY CROP IN MASSACHUSETTS.[1]

BY PROF. WM. P. BROOKS, DIRECTOR MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

In Massachusetts the relative importance of the hay crop is much greater than in the United States as a whole. This crop occupies nearly three-fourths of the improved area of our farms. The last State census reports the total improved area in farms as 902,000 acres. The hay crop occupies 660,000 acres. Large as is this proportion, the tremendously preponderating importance of grass as a crop becomes yet more evident when we consider the area devoted to pasturage, which the last State census reports to have been 1,119,000 acres. There is, of course, little doubt that much of this so-called pasture was occupied to a considerable extent with trees, bushes, ferns and numerous other forms of vegetation other than grass. The total annual value of the farm products of Massachusetts, according to the last State census, was $52,880,000. The hay crop is reported by the same census to have been worth $12,491,000. The value of this crop, therefore, amounted to nearly one-fourth of the value of all our agricultural products combined. A large portion of our dairy products is derived from the pastures, and dairy products are reported by the last census to have amounted to $16,234,000, or nearly 31 per cent of the total value of our agricultural products.

The facts to which attention has been called make it perfectly evident that the grass crop is one deserving careful consideration. It occupies an exceedingly large proportion of our total area, and anything which can be done to increase the product will do much to increase the prosperity

1 "Agriculture of Massachusetts," 1904.

of our farmers. Great as is the importance of the grass crop at the present time, its relative prominence shows a tendency to increase. This tendency is due in considerable measure to the fact that the production of the grass crop involves relatively little labor; and, in periods of general prosperity especially, it seems to be increasingly difficult for the farmers to secure satisfactory help. Many of them, therefore, are increasing the already large proportion of their farms devoted to grass.

Our numerous cities and villages, while using considerable hay imported from the west and Canada, furnish good markets for the surplus hay crop in most sections of the State. It does not seem probable, therefore, that the relative importance of the grass crop in Massachusetts' agriculture will decrease in the near future.

Our survey of the facts pertaining to the aggregate production and value, while interesting, does not throw light upon the question as to whether the results now attained by our farmers can be regarded as satisfactory. To determine this point we must know not the aggregates but the returns per acre. The last United States census reports the average product of hay per acre in the entire country to be 1.1 tons. The average product in Massachusetts is reported to be exactly the same. Such a product is far below the possibilities, as all good farmers will at once admit. If the average returns from the area devoted to the production of hay in Massachusetts could be increased to the extent of 1 ton per acre, the value of our agricultural products would be raised fully $8,000,000 per annum. Such an increase must mean greatly increased prosperity among our farmers, provided the increase can be produced at a figure materially below its value. That it can be so produced it will be my effort to show in this article.

Argument is not needed to convince the better farmers of the State that this is possible, for few of them are satisfied with crops of less than from 2 to 3 tons per acre, while many of them doubtless make much of their grass land yield annual crops averaging fully 3 tons per acre. Mr. George M. Clark of Higganum, Conn., has in recent years written a great deal concerning the hay crop and methods of increasing it. It may be doubted whether his methods can be in all respects recommended; but thorough tillage of some sort in preparation for grass and careful fertilization are essentials, and Clark's influence and example have been vastly useful in stimulating improvement. He claims to produce from 5 to 6 tons of hay per acre annually in two crops. Under his system of management the profits have doubtless been large. His investment in labor and fertilizers is heavy; but the tremendous crops obtained prove profitable, in spite of the heavy outlay.

Upon the college farm at Amherst we have not upon the average equalled the crops reported by Clark. We have not, however, as a rule, expended more than a small proportion of as much in labor and in fertilizers as he reports. Our profits are perhaps not inferior to those which he has obtained. The area devoted to hay on the college farm averages about 75 acres, and the average product per acre is often equal to 2½ tons. This result is obtained under the following conditions: About 30 acres out of the 75 are kept permanently in grass. Most of this area has not been plowed for about twenty years. It is managed in part as a park, but is mown twice annually. During a great part of the time it has received an annual dressing with fertilizers at an average cost of perhaps $5 per acre. The portion of the college farm managed in rotation is usually left in grass three years, and receives no top-dressing of any kind during the time it is in grass, the crop of grass being produced on the residual fertility remaining after the hoed crops, which usually occupy the ground two or three years out of every five or six years. The average crop on the old mowings amounts to about 2 tons per acre; on the rotation mowings the average must be close to 3 tons.

We possess the most exact records concerning one of the fields of the experiment station. This field has an area of a little more than 9 acres. Most of it was seeded about 1893, and none of it was reseeded until the summer of 1902. Between 1893 and 1902 the average yield for the entire area was 6,619 pounds. In 1902 the average was less, for a part of the land was plowed after the first crop and re-seeded in August. This portion of the land, however, gave us in 1903 the heaviest crop we have ever obtained, the average per acre for the entire area for that year amounting to 8,104 pounds. The average yield for the entire period, 1893 to 1903 inclusive, has amounted to almost exactly 6,600 pounds per acre. The average cost of the manure or fertilizer applied to this land annually amounts to about $12 per acre; the annual cost of securing the crop to a little over $8; the annual profit on the crop to about $20 per acre. The figures given, which are verified by the most accurate records, make it sufficiently evident that land of the right character devoted to the production of hay may be made exceedingly profitable. It appears to me evident that the 9 acres under discussion must have an actual value to an intelligent farmer of at least $350 per acre. The average profit, whatever we may hold concerning the value of the land, amounts to more than five per cent annual return on the figure which has been named.

The facts which have been cited make it perfectly evident that the possibilities of the hay crop are vastly beyond the actual results obtained by the average farmer. It may be objected that the land of the college farm at Amherst is especially adapted to grass; that it is better than the average land of the State. Both of these statements are undoubtedly true; but, on the other hand, the value of the hay crop in Amherst is lower than in the average town of the State, and the chances for profit on the crop in most sections must under intelligent management be nearly equal to the chances for profit in Amherst; for the crops to which reference has been made have not been produced by extravagant use of manure or fertilizer, nor under any system of management not practicable for the average farmer of the State. The average mowings of the State are sadly neglected. Their owners practise, at least, as if they expected "out of nothing to get something." Every season whenever rainfall is deficient and the weather hot we read in the crop reports that "grass in the old mowings is suffering, and will be a very short crop." These old mowings are neglected mowings.

They have not been manured or fertilized, or they have not been recently reseeded; and it is unreasonable to expect they will give good crops, unless the conditions are unusually favorable.

The character of soil which best suits grass is pretty generally understood. The strong, retentive soils which hold moisture well are the natural grass lands. The production of hay upon these can be made most easily profitable; but by suitable selection of varieties of grasses and clovers, even some of the lighter soils may be made to yield profitable crops. On the other hand, the State contains large areas of low lands which suffer at the present time from excess of water, and which are producing an inferior quality of hay for this reason. In many cases such areas can be converted into very profitable mowings if they be first drained. A considerable portion of the 9-acre field in Amherst to which reference has been made was of this character, and the methods of improvement adopted here will be first discussed.

Drainage of Land to be used for Mowing.

Partial drainage by means of open ditches will in many cases greatly improve the character of the herbage produced in land which is naturally wet, but the only thoroughly satisfactory method of improvement is tile drainage. Many no doubt hesitate to undertake tile drainage through fear of inability to carry out the work properly; others are deterred from undertaking it because of the cost. The limits of this article will not permit a full description of the methods to be followed in underdrainage; but the operation, unless the location is such as to offer unusual difficulties, is not very difficult, and no farmer of ordinary capacity need hesitate to undertake it; and the cost, while considerable, will prove a profitable investment, provided the work is carefully done. Many a tract of land in the State, at present producing a crop of swale hay, and which for the production of such hay is worth possibly $20 to $25 an acre, can at an expenditure of $50 to $60 per acre be made to return a good income on a valuation of from $150 to $200.

Preparation of the Soil for Grass.

The fact that very thorough and careful tillage in preparation for crops of all kinds is usually profitable is increasingly appreciated in recent years; and Mr. Clark must be credited with having done much good in emphasizing the desirability and profitableness of thorough preparation of the soil for grass. When practicable, it seems to be best to plow land which is to be seeded to grass some weeks previous to sowing the seed, and to give sufficient shallow tillage by means of harrows to bring the surface into a thoroughly fine and mellow condition. If seeding is to be done in the spring, it will in most cases be best to plow in the fall, and to complete the preparation in the spring by the use of such harrows as are adapted to the conditions. The disc harrows are very valuable in sod land and in working strawy manures under, but the final preparation should be given by the use of harrows which do not work as deep, and which leave the soil smooth. The Acme harrow is a good implement to follow the disc, while the smoothing harrow is almost always best for the final preparation of the soil for seed. The best condition for the growth of the grass in most soils is obtained by plowing sufficiently long before seeding to permit the soil to settle somewhat, so that when the seed is sown the soil shall be moderately compact underneath, and light and mellow to the depth of a few inches only. When breaking up an old mowing and reseeding without the introduction of a hoed crop, it is best to plow the land as soon as convenient after the first crop of hay is harvested, and then harrow sufficiently often to keep down all weeds and to maintain the surface in mellow condition until the proper time for sowing the seed arrives. In the case of the experiment station mowing, to which reference has already been made and which is referred to again later in this article, the first crop of hay was harvested June 25. The land was plowed on July 16. Between that date and the date of seeding, which was August 14, the land was harrowed with a disc harrow eight times, and final preparation given with the Acme and smoothing harrow just previous to sowing the seed. The crop of the following year, concerning which particulars are given later, was an exceedingly large one. The season of 1903, it is true, was exceptionally favorable for grass, but the very satisfactory results obtained are believed to have been due in no small degree to the very thorough preparatory tillage which the land received.

Whenever seed is sown in soil which is imperfectly prepared, a considerable proportion of it must fail to germinate, and the result is an imperfect sod. There are frequent bare spots, in which weeds will later start; and, even if this were not the case, it would be found impossible to secure the largest crops of which the land is capable unless the surface is completely covered with grass.

The Selection of the Seeds.

For the past dozen years we have grown in the experiment station in Amherst something like 60 or 65 species of grass annually, each occupying a plot of about one square rod. During all this time these species have been under close observation, and records of their yield in some years and of their general condition have been kept. During this time, moreover, a considerable number of different mixtures of grass seeds have been tried on the different fields of the college farm. As a result of the observations on all these species and the trials of different mixtures above referred to, the conclusion has been reached that in ordinary rotation farming, where the land is left in mowing only some three or four years, to be followed by hoed crops for two or three years, there is no mixture of seeds which will prove more widely adapted to the conditions than the usual mixture of timothy, red-top and clovers. It is the belief of the writer, however, that these seeds should be sown in somewhat larger quantities than are usually advised. The necessity for a close turf, covering every inch of the ground, has been referred to. Such turf is more certainly secured with heavy seeding. It is the belief of the writer, further, that the mammoth red clover should usually be used in this mixture rather than the common red clover, as the former matures more nearly at the same time with timothy and red-top. Most of the soils upon the college farm are retentive of moisture, and on these soils some alsike clover is invariably included in the mixture. Alsike is finer than the red and mammoth clovers, and is especially adapted to moist soils. The mixture of seeds which we usually use is as follows: —

	Pounds.
Timothy,	18
Red-top,	8
Mammoth clover,	5
Alsike clover,	4

If a more permanent mowing is desired, it is believed to be best to include other species, for under most conditions timothy does not prove permanent. It gradually gives place to species which are less valuable for hay, — in the eastern part of the State and on the lighter soil in many cases to sweet vernal, farther inland and on the stronger soils to Kentucky blue-grass. The last, although a splendid pasture grass, produces too little top to prove altogether satisfactory in mowings. There is, it is true, no variety of hay which sells so readily in most sections as timothy; but for the reasons stated it seems best to reduce the quantity of timothy, and to introduce species which are more persistent in all cases where the mowing is to be permanent. Among such species the fescues promise to prove the most valuable; and a mixture of seeds in which I have considerable confidence for permanent mowings is as follows: —

	Pounds.
Timothy,	6
Red-top,	8
Red clover,	5
Alsike clover,	4
Kentucky blue-grass,	4
Meadow fescue,	6
Tall fescue,	4

The two mixtures of seeds which have been given were sown on the experiment station grounds in Amherst in the summer of 1902, under conditions which make comparison of the results for the first year possible. The mixture including the larger amount of timothy gave a yield in two crops at the rate of about 5 tons to the acre, while the mixture including the fescues gave a yield at the rate of about 4¼ tons per acre. The timothy mixture is in the first year clearly superior to the other; but it is expected that the fescue mixture will maintain its quality better, since the fescues, which have underground stems similar to those of witch grass, are not likely to be displaced by Kentucky blue-grass to the same extent as the timothy.

On soils which incline to be light, orchard grass proves to be one of the most valuable and persistent grasses, and the following mixture of seeds is recommended: —

	Pounds.
Orchard grass,	15
Tall oat grass,	5
Italian rye grass,	3
Perennial rye grass,	3
Awnless brome grass,	5
Red clover,	6
White clover,	2

The number of seed mixtures, each of which under some circumstances may prove adapted to the situation, might be almost indefinitely extended, but space forbids further discussion of this branch of the subject: —

Methods of Seeding.

The three principal methods of seeding land to grass which will be discussed in this article are: first, spring seeding with a nurse crop; second, late summer or fall seeding; third, seeding in corn.

Spring Seeding with a Nurse Crop.

This system of seeding land to grass is, according to the writer's observation, still one of the most common followed by our farmers. It is of course oftentimes attended with satisfactory results. Grass can usually be depended upon to make a good start if sown early in spring with a suitable nurse crop; but it far too frequently happens that when the nurse crop is removed (which must usually be late in June or during the month of July) the exposure of the young grass to the hot sun seriously weakens if it does not destroy a considerable proportion of it. At the season of the year when the nurse crop is removed we have our hottest weather, and not infrequently at the same time a marked deficiency of rainfall. With hot and persistently dry weather following the removal of the nurse crop damage to the young grass is certain to be serious on all except the naturally moist and the richer soils. For the reasons which have been indicated, the writer regards this method of seeding as one of the least desirable.

Late Summer or Fall Seeding.

Grass which is sown in suitably prepared soil during the latter part of summer without a nurse crop seldom fails to do well, and where the system of rotation makes it possible to have the land clear at the right time, or in cases where mowings are to be broken up and immediately reseeded, this seems to the writer to be the best time. In many cases seeding is delayed until the middle of September or later, but if this be the case the clover seed is usually left out to be sown the following spring. With suitable weather in spring clover often makes a good start if sown in this way, but a full crop cannot of course be expected the same season. Better results are obtained if the land can be seeded sufficiently early to make it safe to include the clover with the grass seeds. The reseeding of the mowing in the experiment station, which has been several times referred to, was eminently successful. The clover passed through the winter perfectly, and constituted a large proportion of the crop of hay produced. The month of August is, in the writer's opinion, the best month for seeding to mixed grass and clover; and the most satisfactory results are likely to be obtained if the seed can be got in not later than about the middle of that month.

Seeding in Corn.

Among the various methods which the writer has tried for seeding to grass and clover, he has found the system of sowing in growing corn at the time of the last cultivation, usually from July 20 to August 5, to give most satisfactory results. The culture of the corn must be level, and it must be kept free from weeds. Just previous to sowing the seed a spike-tooth cultivator should be used, which will leave the surface fine and mellow. The quantity of seed used should be rather larger than may be required when it is sown alone, as a part of it fails to reach the ground, being caught and retained by the broad leaves of the corn. Dog-day weather should be selected for sowing the seed; and if it can be scattered upon the freshly cultivated surface just before the heavy showers which occur so frequently during dog-days, the seed will need no covering, and will often have germinated within forty-eight hours from the time of sowing. The shade of the corn crop is favorable to the retention of moisture, and on all except the driest soils there will be moisture enough to keep the young plants growing. The corn protects from the sun, but does not crowd. It is not likely to lodge and stifle the young grass, as a crop of small grain so often does. It is preferable that the seeding be done in a crop of corn destined for the silo. This being carried from the field at once, the grass has the most favorable time of the year to spread and gather strength for the winter. If the corn is grown for grain and must be stooked, there is no great difficulty; but the young plants will be killed where the stooks stand, and these spots must be reseeded either late in autumn or early the following spring. Grass and clover sown in accordance with the method just described become fully established before winter, and are less liable to injury than when sown later. They become sufficiently strong to give a full crop the following year. It is best that the corn be cut low, and the field should be rolled the following spring as soon as it becomes sufficiently firm not to be cut up by horses. Rolling at that time breaks down the corn stubble, which is then brittle, and it will be noticed in the hay to a less extent even than is the stubble of a small grain.[1]

When land is seeded in corn, the work must be done by hand; but if the field is clear, there are a number of machines which will do satisfactory work. Machines of the type of Cahoon's broadcast seed sower will put in any of the seed mixtures which have been given. One objection to machines of this class is the fact that the seed is thrown

[1] Brooks's "Agriculture," Vol. II., p. 426.

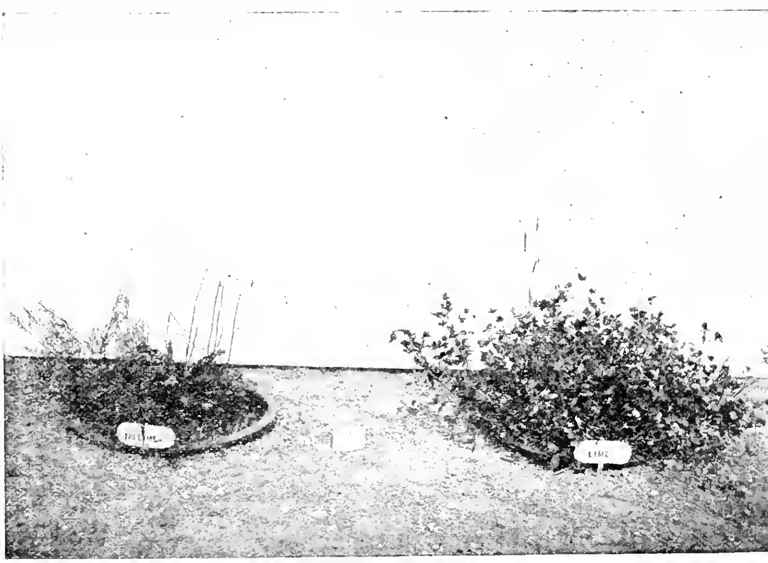
high into the air, so that satisfactory work can be done only when the weather is relatively calm. The wheelbarrow seed sowers will do somewhat more even and satisfactory work, but these will handle only the relatively small and heavy seeds; the long and chaffy seeds cannot be satisfactorily distributed by the use of these machines. A mixture of timothy, red-top and clovers can be sown with a machine of this type in a thoroughly satisfactory manner.

Manuring Grass Lands.

The question of the proper selection and use of manures and fertilizers for grass lands may be best considered under two general heads: first, manuring in preparation for the crop; second, top-dressing.

Manuring in Preparation for the Crop.

It seems best at the outset under this topic to state as briefly as may be possible some of the facts which seem to be best established as regards the general effects of manures and fertilizers. Some of these facts are equally important in considering the selection of manures and fertilizers for top-dressing. Our mowings almost always contain two classes of plants, — grasses and clovers. The manurial requirements of these two classes of plants are, in one important respect, wholly different. Both grasses and clovers require a considerable amount of nitrogen, clovers more than grasses; but the grasses must take all the nitrogen which they require from the soil, while the clovers, if conditions be right, can get most if not all of the nitrogen they require from the air. Whenever land is occupied by two or more species of plants, there is a struggle between the different kinds for its possession. If we make the conditions favorable to clovers and less favorable for grasses, the former will predominate. Whether the mowing will produce chiefly grasses or largely clover, depends, then, not alone upon the seed sown, but upon the condition of the soil as regards available nitrogen and available mineral elements of plant food, such as phosphoric acid, potash and lime. If available nitrogen is relatively abundant, then grasses will predominate; if the other elements are relatively abundant, while nitrogen is present only in small amounts, the clovers are likely to predominate. If this is to be the case, however, it is important that all the other conditions required by clover shall be right. Good drainage, thorough tillage and freedom from free acid are essential. From many parts of the State come reports that clover does not thrive. This in many cases is doubtless due to the fact that the soil con-



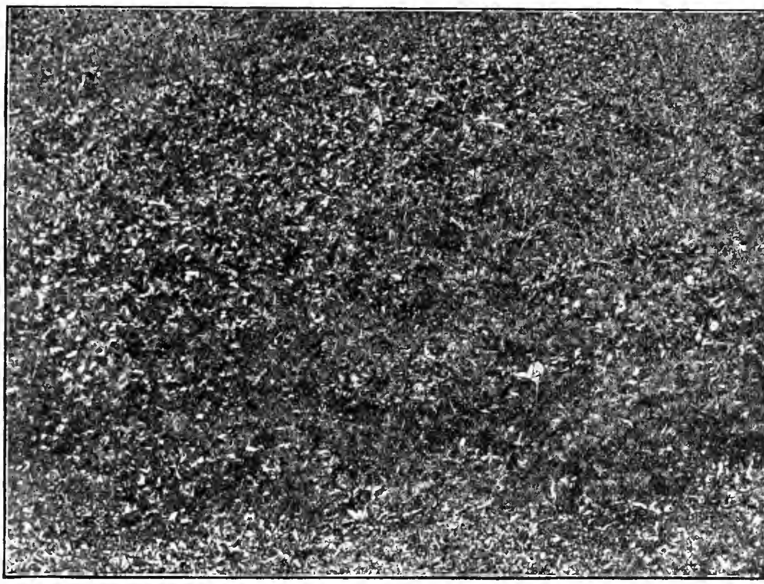
EFFECT OF LIME ON PROPORTION OF CLOVER.

tains free acid. Under such circumstances a heavy application of lime spread on the rough furrow and deeply worked in with a disc harrow will be likely to prove effective. The cut which is here presented shows the effect of liming in a striking manner. Both cylinders were filled with carefully mixed soil, taken from one of the fields of the college farm. Both received an application of the same amounts of nitrate of soda, dissolved bone-black and muriate of potash, and in addition one cylinder received an application of lime at the rate of 1 ton per acre. After the application of the fertilizers and the lime, the same kinds and quantities of mixed grass and clover seeds were sown. The result is a most striking demonstration of the efficacy of lime in bringing a sour soil into condition for the production of clover.

In order that the clover may have the capacity to take the nitrogen it needs from the air, it must have the assistance of the bacteria which live in nodules (which are about as large as the head of a pin) on its roots. These bacteria can be supplied either by the application of a few hundred pounds per acre of soil from a field where the nodules are found to be abundant on the clover, or by the use of a special culture prepared in the United States Department of Agriculture. It is not believed, however, that it will often be found essential to supply these bacteria. Clover has been so long and so generally grown in this section, that these bacteria are practically everywhere abundant; and the nodules will develop upon the roots of clover in practically all situations, provided the conditions essential to the life and activity of the bacteria (which are, in brief, good drainage, thorough tillage and aeration and freedom from free acid) exist. The supply of nitrogen in the air which the clover bacteria under the right conditions bring within the reach of the crop is practically unlimited. It pays, therefore, to make the supply of the elements which clover must take from the soil exceedingly abundant, and among the elements needed potash is one of the most important. In preparation for clover, it is believed that the application of from 200 to 300 pounds of a high-grade potash salt, or double that quantity of the low-grade sulfate of potash, will in most cases be useful.

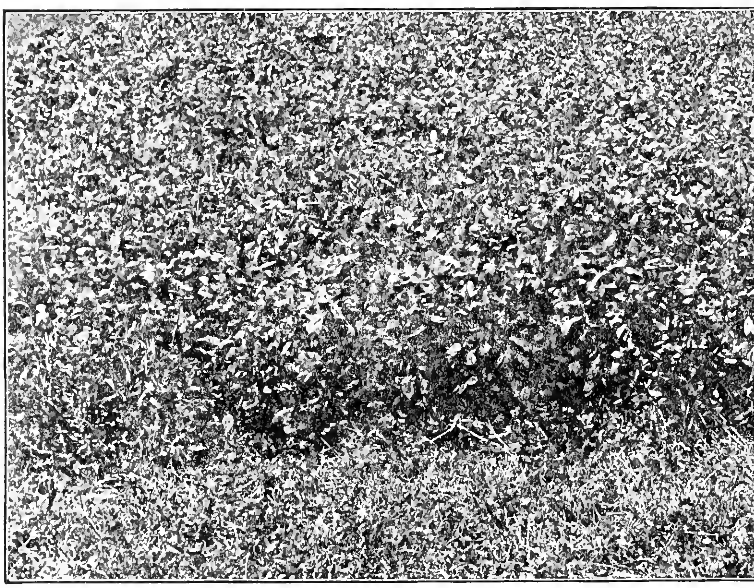
If manure is carefully saved and applied in moderate amounts, clover often does well; but if any considerable proportion of the urine of the manure has been suffered to waste, or if the manure has been exposed to the leaching action of rainfall, there will be a deficiency of potash, which is found chiefly in the urine, and which, being soluble, is easily washed out. If, then, it be desired to bring land on which manure has been used for previous crops into good condition for producing a hay crop rich in clover, it will usually be best to supplement the manure by means of an application of potash. From 125 to 150 pounds of a high-grade potash salt per acre, applied in connection with manure to the previous crop, will almost invariably largely increase the proportion of clover in the hay crop when the land is seeded. If fertilizers alone are used for the preceding hoed crops, these must be rich in potash if clover is to thrive when the land is seeded.

Upon the college farm at Amherst we have for about thirteen years applied potash to two plots of one-quarter acre



CLOVER ON MURIATE OF POTASH MAKES A POOR GROWTH.

each at the rate of about 250 pounds per acre of a high-grade potash salt. To two other plots the same salt has been applied at the rate of about 150 pounds per acre. When this land is seeded, the hay crop where the larger amount of potash is used is considerably larger and contains a much greater proportion of clover than where the smaller quantity of potash is used. In 1902 the larger application of potash gave a yield at the rate of 6,772 pounds per acre; the smaller application of potash yielded at the rate of 5,252 pounds per acre. For a full understanding of the conditions in this experiment, it should be further stated that the quantity of nitrogen applied to the two sets of plots is substantially the same, while the plots receiving the lighter application of potash annually receive an application of acid phosphate at the rate of about 1,100 pounds per acre, and the plots receiving the larger amount of potash receive acid phosphate at the rate of about 200 pounds per acre. The fertilizer applied where the lesser amount of potash is used is substantially the same in its composition as average corn fertilizers; while the other, as will have been



CLOVER ON SULFATE OF POTASH MAKES A FINE GROWTH.

noted, contains far less phosphoric acid and much more potash.

The kind of potash salt to be selected for clover is a matter of much importance, and experimental results at Amherst have indicated again and again that the sulfate is likely to prove decidedly superior to muriate or to kainit. The cuts presented herewith illustrate the difference in the growth of clovers on the two salts in a striking manner. These two plots were side by side, and both had been manured with equal quantities of fine-ground bone and potash for some eight or ten years. The growth on the sulfate of potash, it will at once be seen, is most decidedly superior to the growth on the muriate. The persistent use of the latter, as indicated by the investigations of Dr. Goessmann, appears to cause the loss through leaching of a large amount of lime, and it is perhaps this effect which makes it impossible for the clover to thrive. The difference in the growth of clover on these two salts of potash is invariably greater in relatively wet than in dry seasons.

Conditions affecting the Growth of Timothy and Red-top. — Whenever the soil is abundantly supplied with manure or fertilizers which supply nitrogen in relatively large amounts, timothy will be found relatively abundant in the mowing, unless the soil be sour. If it be sour, the red-top will predominate, while, as already stated, there will be little or no clover. If, then, it be desired to produce first-class timothy hay for sale, the farmer should make sure that his soil is not sour; and if found to be so, he must apply lime, as already advised for clover. On soils which are not sour, heavy applications of barnyard manure bring the land into good condition for timothy; and if it be desired to produce market hay, it will usually be best not to use potash largely in connection with the manure for the crops preceding the grass. For market hay, heavy applications of nitrogen manures or fertilizers and relatively light applications of materials containing either potash or phosphoric acid should be the rule.

Top-dressing Grass Lands.

Throughout the State manure is quite largely used for top-dressing grass lands, and every good farmer knows that fine crops of hay can be produced through its use. It may be doubted, however, whether the manure on many of our farms might not be more advantageously used in most cases upon the plowed lands. The elements of value contained in the manure are most certainly conserved for the use of the following crop when the manure can be incorporated with the soil. When it must lie upon the surface, it is subject to some loss, chiefly in two ways: first, by the escape of ammonia into the air; and second, by wash over the surface. Further, the manure, unless fine, tends to kill the grass to some extent. The necessity for a close turf for the production of maximum hay crops has been alluded to. If numerous little areas are prevented from full development because covered by lumps of manure, the result must be a not unimportant decrease in the crop. For all these reasons, it is the belief of the writer that under average farm conditions manures should be mainly used on the plowed land, and fertilizers depended upon for top-dressing grass lands. Whenever manure is chiefly depended upon for top-dressing, the grasses will be found to be relatively prominent, for manure is relatively rich in nitrogen. The use of manure, therefore, is likely to lead to the production of a good grade of hay for market. Manure, if to be used for top-dressing, should be at least partially rotted. It is best to put on in the fall, and a manure spreader is a very desirable implement for the work.

The selection of fertilizers for top-dressing grass lands must be determined largely by the character of hay which it is desired to produce, and it should also be varied according as the mowing is permanent or used in rotation for hoed crops. On mowings which are used in rotation for hoed crops, and where the production of market hay is the object, nitrate of soda should be the most prominent among the fertilizers used; and, while the quantities which it will pay to apply must of course vary with the conditions, the following mixture is suggested: —

	Pounds.
Nitrate of soda, ...	175 to 200
Acid phosphate, ...	50 to 100
High-grade sulfate of potash, ...	50 to 100

These materials should be mixed and applied about May 1. For similar mowings, where a large proportion of clover in the hay is desired, the following mixture of materials is suggested: —

	Pounds.
Acid phosphate, ...	100
Basic slag meal, ...	400
High-grade sulfate of potash, ...	150 to 200

These materials should be mixed and applied either late in the fall or very early in the spring.

For permanent mowings, as well as for those used in rotation, nitrate of soda should be prominent if the production of market hay is the object. The quantity of this fertilizer which may be used must be determined largely by experience. An application which may be safely used on some soils or in some localities will cause the grass to lodge seriously in others. The usual range in quantity which may be profitably used is from about 150 to 250 pounds per acre. The following mixture of materials, although not yet tested for a long period of time on the college grounds at Amherst, is recommended with much confidence: —

	Pounds.
Nitrate of soda,	150 to 250
Basic slag meal,	300 to 400
High-grade sulfate of potash,	75 to 100

For the permanent mowings, where hay rich in clover is desired, an annual application of basic slag meal, 400 to 600 pounds, and high-grade sulfate of potash, 125 to 200 pounds, will, it is believed, give good crops. The mixture of materials containing nitrate of soda should be put on about May 1, the other mixture late in the fall or early in spring.

It will be readily understood that the mixtures suggested by no means exhaust the possibilities, and they may not under all conditions prove the most desirable. Thus, for example, wood ashes may in many localities give the most profitable returns when used on mowings in which clover is desired. These may take the place of the slag meal and potash mixtures which have been suggested. The ashes will supply a large amount of lime, as well as potash and phosphoric acid. Fine-ground bone is also under many conditions a useful fertilizer, especially in mixture with potash, for permanent mowings where clover is desired. The experiment station plots have been several times referred to. The 9-acre field is divided into three nearly equal plots. Each of these is treated as follows: first year, barnyard manure at the rate of 16,000 pounds per acre, applied in the fall; second year, wood ashes at the rate of 1 ton per acre, applied in early spring; third year, fine-ground bone 400 pounds per acre and muriate of potash 200 pounds, mixed and applied in early spring. Each year all three systems of manuring are represented. Our average crops under this system have been heavy, having amounted, as has already been stated, to 6,600 pounds per acre.

Reseeding Permanent Mowings.

That it pays occasionally to reseed permanent mowings is made very evident by the results obtained in Amherst in the season of 1903. A portion of each of two plots in the station mowings was plowed and reseeded in the summer of 1902, as already described. One of these plots was the one top-dressed in 1903 with wood ashes. The yield on the portion not reseeded was at the rate of 6,243 pounds per acre; on the reseeded portion the yield was at the rate of 8,546 pounds. On the plot manured with barnyard manure the yield on the portion not reseeded was at the rate of 5,642 pounds per acre; on the reseeded portion it was at the rate of 10,002 pounds per acre. The manure used on the reseeded portion of this plot was harrowed in at the time the seed was sown; the balance of the plot was top-dressed late in the fall, as usual.

Top-dressing for Rowen.

Experiments extending over several years in Amherst indicate a probable profit from the application of a moderate top-dressing of nitrate of soda immediately after the removal of the first crop. This should of course be made only on mowings where the product is almost exclusively grasses. Top-dressing with nitrate of soda for clover would be a mistake, as this, as already stated, should get its nitrogen from the air. The quantity of nitrate likely to prove useful will usually vary between about 150 and 200 pounds per acre.

THE MANAGEMENT OF MOWINGS.[1]

BY PROF. WM. P. BROOKS, DIRECTOR, MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

The paper on "The hay crop in Massachusetts," prepared for the May Crop Report in 1904, treated the subject in a general but at the same time in a fairly comprehensive way. The writer is now asked to present a second paper on the same topic, and to go into greater detail concerning certain branches of the subject. Owing to the general nature of the first paper, there will almost of necessity be some repetitions of matter therein contained in this; but the writer trusts this will be pardoned, as such repetitions as will be made seem necessary in order to make this paper fairly complete in itself.

The Varieties of Grasses and Clovers.

There are but few of the species of grasses which have been recommended for cultivation which are well known to our farmers; and it shall be the first object of this paper to give in condensed form such information affecting the value for practical purposes of the different species as seems likely to prove most useful in the direction of enabling readers to select varieties suited to conditions.

All the different common varieties of grasses may be first divided into two great classes, which may be called respectively sod-formers and non-sod-formers. The sod-forming grasses are all capable of constant renewal by the formation of new plants between the plants first established. In the case of most of the sod-formers which will be spoken of, this multiplication of the plant is accomplished through the

[1] "Agriculture of Massachusetts," 1905.

agency of an underground stem, similar to the well-known pointed, white and jointed underground stem of witch grass, which is so frequently pictured as growing through a potato, for example, and which is generally so well known. These underground stems extend through and through the ground in the neighborhood of the plants from which they start. They are jointed, and provided with roots springing from near the joints. At each joint there is a bud from which a new stem pushes up into the air. From this centre a new plant is formed. This in turn produces underground stems, and the soil is gradually filled fuller and fuller of such stems, crowding through it in all directions and all sending up new stems from the joints. In the case of all the sod-forming grasses, then, the tendency is for the turf to become constantly thicker, closer and finer. The surface of the ground is completely covered, and a thick, tough sod of turf, firmly held together by the underground stems and by the roots, is formed. Grasses of this character are persistent, and they are not likely to die out under the action of natural causes nor to be crowded out by other species. Among such grasses meadow fescue and tall meadow fescue, Kentucky blue-grass, awnless brome grass and redtop are the more important.

There are a few grasses which spread and form a turf gradually thicker and thicker, by rooting at the lower joints of the stem. The stems of such grasses incline to bend near the base, so that the lowermost joint and perhaps the second joint also comes to rest on the surface of the ground. Under these circumstances, if the soil is moist, roots are sent out from the joints in contact with the ground, and thus the plant spreads and gradually forms a turf which becomes thicker and thicker with the lapse of time. The bent grasses are of this description. Grasses having this habit, like those having the underground stems which have been spoken of, are persistent.

The non-sod-forming grasses are not provided with either of these means of renewing themselves. Each plant comes from a seed. The plant, originally small, gradually increases in size, until from a single root a very considerable number of stems may be produced. In other words, these grasses stool freely. As a consequence of the stooling habit, many of them ultimately form tufts which make the surface quite uneven. Between the tufts formed by the individual plants there may be spaces which are relatively bare. Orchard grass and sheep's fescue are prominent representatives of grasses having this habit, while the common timothy, tall oat grass, yellow oat grass and the rye grasses are less likely to form tufts, but propagate themselves only by stooling or from seed. Most of the non-sod-forming grasses are rather likely to be crowded out of permanent mowings by the sod-formers, which have an advantage in the struggle for existence.

Some of the More Important Grasses described.

Timothy. — This variety is so well known that it seems almost unnecessary to describe it, but some of the principal reasons why it is a favorite and a statement of a few of its peculiarities may be of interest. Timothy is a large, moderately coarse grass, producing relatively little leaf and a large proportion of stem. The hay made from it is comparatively coarse and strawy, but the character of its growth is such that it may be readily cured. The hay is, therefore, perhaps more certain to be free from dust than that from most grasses. It is therefore looked upon as the standard of excellence, and usually sells for a higher price than any other hay in our markets.

Timothy requires a deep, retentive loam for its best growth. On such loams, with liberal top-dressing either with manures or fertilizers supplying abundance of nitrogen, it may prove quite persistent ; but on the lighter soils and under less generous treatment timothy is likely to give way to inferior species within a comparatively short time. Just at the surface of the ground on a timothy plant which is mature will be found a considerable number of pointed and rather small solid bulbs. If these be fed off, or if the mowings be too much trampled by heavy animals, which doubtless crushes and bruises the bulbs to a considerable extent, the timothy will be seriously weakened. It is not, therefore, well adapted to grazing, and great precaution should be used in pasturing mowings in which timothy is the principal species.

Redtop. — Redtop, next to timothy, is our best-known grass. It reaches its most luxuriant development on deep, rich soils, and the best redtop that the author has ever seen in any part of Massachusetts was produced on the reclaimed salt marshes in the town of Marshfield. Redtop is a sod-forming grass, but the vigor of its underground stems is considerably less than that of some other species. Close observation has shown that redtop is capable of doing better in soils containing free acid than most other species. Under ordinary conditions it is persistent. It will endure grazing much better than timothy. It starts slowly after having been cut, and usually produces very little rowen.

Rhode Island Bent and White Bent. — These species are very closely allied to redtop, and have the same general habit of growth. Indeed, it may be doubted whether there is a well-defined dividing line, based upon distinctions of practical importance, between these three species. There are doubtless differences which are sufficiently clear to the botanist; but it is at any rate true that the product from commercial samples of seed grown in plots side by side is so nearly alike in the case of these three species that so great an authority as Professor Lamson-Scribner, formerly agrostologist of the Department of Agriculture in Washington, has frankly admitted to the writer that he could distinguish no well-defined difference between them. It would seem, therefore, that, as the seed of redtop is more generally kept and better known, it must be unwise to purchase seeds of these other species which are less certain to be of good quality, and which are as a rule sold at higher prices.

Orchard Grass. — This is one of the best known among the less common grasses. It is a large, coarse species, and is one of the earliest to come into bloom. It has the very bad habit of growing in tufts, and is characterized by the production of a very heavy growth of foliage starting from the ground, and a relatively light production of stalk and seed. It is called orchard grass, not because it will grow better in the shade than when fully exposed to the sunshine, but because it will do better in the shade than most other grasses. If it can be established in light soils it will do better there than either the timothy or the redtop, and it is very persistent. In the writer's experience it has not seemed to yield to the pressure from any other competing species. It is often asserted that orchard grass is tough, woody or wiry; and, as this grass is frequently handled, this is undoubtedly true. This seems, however, to be due to the fact that it is not cut sufficiently early. It should not stand later than the period of very early bloom, and this stage is sometimes reached in this latitude as early as the 5th to the 10th of June. Few farmers are ready to begin haying at this time. Orchard grass deteriorates after blooming more rapidly than most species, and, as a consequence, orchard grass hay, often cut as late as the last of June, is of poor quality. Orchard grass starts quickly after being cut, but seldom comes into flower a second time during one season. Orchard grass rowen consists almost exclusively of very long, rather coarse leaves, springing from the ground; and, like the first crop, the rowen crop is not infrequently allowed to stand until these leaves have become in considerable measure brown or rusted, when it is somewhat inferior in quality.

Kentucky Blue-grass. — This species, known in some sections of the State as June grass, bears a general resemblance to redtop, although close inspection shows the two species to be in many respects quite different. Kentucky blue-grass produces a much larger proportion of leaves starting directly from the root than does redtop, and at the same time produces relatively far less stem and flower. It is also much earlier. Kentucky blue-grass has abundant underground stems, and in time forms a very close, velvety turf. It is one of the most valuable of pasture grasses, but is not a variety of the first importance for mowings, as there is little top. Kentucky blue-grass, further, has the very bad habit of producing relatively little second growth. In mowings it may be regarded as useful in filling in between larger and coarser species; but a mowing consisting largely of Kentucky blue-grass, while giving hay of excellent quality, is not likely to produce such quantity as to prove satisfactory to the best farmers. This species is best adapted to the strong, retentive soils, and reaches its highest development in the limestone regions of Kentucky and Ohio. On the stronger soils in many parts of Massachusetts it is one of the most aggressive of species, and often in time comes to predominate almost to the exclusion of more valuable kinds. It flowers about with orchard grass.

Meadow Fescue and Tall Meadow Fescue. — These two species resemble each other so closely that they may be spoken of together, though one, as indicated by the name, commonly attains a considerably greater height than the other. These fescues are intermediate in coarseness between redtop and timothy. They produce abundant and vigorous underground stems, and are therefore aggressive and persistent species. They are best suited in strong, retentive soils, retaining considerable moisture, and in such soils the meadow fescue at least often comes in spontaneously. These grasses have a bright, clean foliage, unusually free from rust or blight, and form a very close turf. They produce abundant stem and flower, as well as leaf growth. It is the belief of the writer that farmers having soils of the kind indicated, and desiring mowings which shall be fairly permanent, will do well to give these grasses a trial.

In the paper of last year the results of a comparison of a mixture of seeds in which these species were prominent with another mixture in which timothy was most prominent in the first year after seeding were presented. Somewhat later in this paper the results of the continued comparison of the two methods of sowing in the second year will be given.

The fescues start quite quickly after being cut, and on good soils produce a fair amount of rowen. It is often stated that meadow fescue is especially well adapted for use in pastures; but an experiment in lawn-mowing this species, which it was believed would throw light on the question of its suitability for grazing, indicates that it will not endure such treatment. The lawn-mowed portion of a plot of meadow fescue in one of our experiments died out completely within about a year of such treatment, while the half plot handled as a mowing was still in perfect condition.

Sheep's Fescue, Red Fescue, Hard Fescue and Slender Fescue. — These species of the fescue order are very much smaller and finer than the two fescues which have been spoken of. They are sometimes recommended in works on grasses; but the writer has not been convinced, as the result of considerable opportunities to observe these grasses under different conditions, that they are ever likely to prove of value in mowings. They will thrive in lighter soils than many grasses, and are very persistent. In dry hill pastures they are of possible value, because of their ability to thrive under the conditions existing there. Under no circumstances is it believed these grasses should be included in mixtures for mowings.

Tall Oat Grass. — This grass will do better on the moderately light soils than many others. In such soils it is persistent, and will make a large crop in seasons when some other species fail. The seed is large, the young plants growing from it especially vigorous; and, as a consequence, this species will take possession of the ground and make a crop within fewer weeks after sowing than almost any other. Unfortunately the seed in the markets often shows a low percentage of germination and the price at which it is held is high. Tall oat grass comes into bloom at about the same time as orchard grass, and is fairly suitable, therefore, for sowing with that grass. When the conditions as relating to farm work are such as to render it possible to secure a part of the hay crop exceptionally early, a mixture consisting largely of orchard grass and tall oat grass has much to recommend it for the lighter soils. It is asserted by some authorities that tall oat grass has a bitter flavor, which renders it unpalatable to animals; but the writer has observed no distaste for it on the part of any stock to which hay made from it has been fed. Tall oat grass starts quickly after cutting, and in favorable seasons will give three crops on rich soil.

Yellow Oat Grass. — This is a somewhat smaller and shorter species than the tall oat grass. It flowers at about the same season, and it is the belief of the writer that it is worth inclusion in mixtures made up chiefly of orchard grass. Unfortunately, as in the case of a number of the other less-known grasses, the seed often germinates poorly, and is held at a relatively high price.

Italian Rye Grass and Perennial Rye Grass. — These species of grass are said to be of the highest importance in Great Britain, and early writers upon the grass crop in America, copying to some extent from English books, frequently urged their cultivation. They seem to be less well suited to the drier climate of this country, with its more severe winters, than to Great Britain, and they are less hardy than most of our grasses. It is sometimes asserted that the perennial rye grass is much more hardy than the Italian; but, according to the writer's observation, there seems to be no great difference between the two species in respect to their ability to endure our winters. The seed of both varieties is relatively large. These species, therefore, make a quick start, and are capable of soon covering and occupying the ground. They are relatively early in coming into flower, and, while they are not sufficiently hardy to make it wise to depend upon them largely, it is the belief of the writer that a moderate amount of the seed of these grasses may wisely be included in mixtures composed chiefly of orchard grass, because of the contribution they will make, with a fairly favorable winter, to the product of the first one or two years, during which period they will help fill in between the larger and coarser orchard grass and other early species. If but one variety is to be tried for this purpose, the writer's preference would be for the Italian rye grass.

Awnless Brome Grass. — This species belongs to the same genus with some of the annual grasses which are regarded as troublesome weeds in some sections and which are known by the names of chess, cheat, etc. It has very vigorous underground stems, and it is sometimes suggested that it may be difficult to get rid of it when the land is plowed.

Experience on the Agricultural College grounds indicates this fear to be groundless. Awnless brome grass is an early-flowering species, and adapted, therefore, to sowing in mixture with orchard grass and other relatively early varieties. It inclines somewhat to the wiry habit of witch grass but if cut early makes fairly palatable hay. It is the writer's opinion that the species has been much over-praised, and yet that it is worth trial by farmers occupying the lighter and drier soils.

Sweet Vernal. — This grass, also known as June grass in some sections, is characterized by the most delightful fragrance (especially after wilting) of any of our common species of grass. Much poetical license in reference to its influence upon the quality of dairy products has been based upon this fact. In plain prose, it must be stated that this is one of the least valuable of the species commonly found in mowings. It does not appear to be especially palatable to cattle, nor is it known to exercise any especially favorable influence upon the flavor of dairy products. This species comes into mowings on the lighter soils or in dry seasons on heavier soils, and gradually displaces the more valuable timothy and redtop. There are two varieties, so-called perennial and the annual. The latter seems to have absolutely nothing to recommend it; while even the perennial sweet vernal should never, in the opinion of the writer, be included in mixtures of seeds for our mowings.

The Common Clovers described.

There are but four clovers of recognized value in our mowings and pastures, — common red, mammoth red, the alsike and the white.

Common Red Clover and Mammoth Red Clover. — These species, which are in general well known, closely resemble each other in general habit. Between typical specimens of the two there are well-defined differences; but the species seem to run together by insensible gradations, and the product of commercial samples of seed sold under the two names is often indistinguishable even by experts. The most important recognized differences between typical specimens are the following: the leaflet of the red clover is relatively broad, not very hairy, and has a whitish, approximately crescent-shaped mark on the upper surface. The leaflet of the mammoth clover is relatively narrow, elliptical, more hairy than in the common red, and is without the whitish mark. The mammoth clover is somewhat coarser and taller than the common red, and a little later in coming into flower. It is therefore looked upon as being somewhat better suited for use in mixture with timothy and redtop than is the common red, which is usually past the best stage of development for cutting before the timothy and redtop are ready. These clovers are rather short-lived perennials; but, as was pointed out in my first paper upon the hay crop, it is possible to produce hay in permanent mowings in which these clovers will be fairly prominent indefinitely, and that without reseeding; for a portion of the heads in the rowen crop are usually ripe before this crop is cut, and the seeds scattered from these heads constantly renew these clovers. As the older plants die, their place in the mowings is taken by the young plants from these accidentally scattered seeds. The persistence of these clovers in mowings, however, is dependent, as was pointed out in the earlier articles, upon a liberal supply of the mineral elements of plant food, especially lime, phosphates and potash.

Alsike Clover. — Alsike clover is intermediate in its characteristics between the common red clover and white clover, having the erect habit of growth of the red clover, but the heads shaped like those of the white are in color pink, — a blending of the red and white. Whether alsike clover was originally produced as a hybrid between the red and the white is not definitely known. Alsike clover is of much value in mowings, especially upon the stronger and moister soils, where it is better than the common red. It is considerably finer than the red, and therefore cures more easily. It is of great value as a honey plant. According to the writer's observation, however, it does not persist as long as the red, neither does it produce as heavy a second crop. It should, however, be included in mixtures of seeds for the stronger and moister soils, where hay including clover is desired.

White Clover. — This well-known plant is not often included in mixtures of seeds for mowings. Its creeping habit of growth renders it rather unsuited to this use. It is, however, of much value in all permanent mowings, into which it comes naturally if the soils are adapted to it, and if the mineral elements of plant food are abundantly supplied. In such mowings it contributes largely to the product both in quantity and in quality. It is, moreover, the most valuable of the clovers for bees.

Varying Mixtures of Seeds for Different Purposes.

In the first article on this subject three mixtures of seeds were given, and the conditions under which each should be used were briefly discussed. It was stated in that article that two of these seed mixtures were under careful comparison at the Experiment Station in Amherst.

The first of these mixtures, spoken of as the timothy mixture, was as follows : —

Per acre: —	Pounds.
Timothy,	18
Redtop,	8
Mammoth clover,	5
Alsike clover,	4

The second mixture, spoken of as the fescue mixture, was as follows : —

Per acre: —	Pounds.
Timothy,	6
Redtop,	8
Kentucky blue-grass,	4
Meadow fescue,	6
Tall fescue,	4
Red clover,	5
Alsike clover,	4

These mixtures are under comparison upon a strong, retentive loam, under liberal use of manure and fertilizers. The seeds were sown in August, 1902. The crops in 1904 were respectively as stated in the first paper: for the timothy mixture, a yield in two cuts at the rate of about 5 tons to the acre; for the fescue mixture, also in two cuts, a yield at the rate of about 4¼ tons per acre. Commenting on these results in the first article, I said: "The timothy mixture is in the first year plainly superior to the other, but it is expected that the fescue mixture will maintain its quality better." The yields during the last season seem so far to have justified this expectation. The average yield on the area sown to the timothy mixture in two cuts amounted during 1904 to 4 tons per acre. The average yield on the area sown to the fescue mixture is a very little greater than that amount. The first of the two mixtures of seed under comparison seems certain to prove most satisfactory where mowings are frequently broken up, but for more permanent mowings the second seems certain to prove superior on all the stronger and more retentive soils. A mixture adapted for permanent mowings on light soils was given in the first paper.

Other mixtures which may be valuable under the conditions indicated are the following: —

For two or three years' mowings on medium soils, per acre: —

	Pounds.
Orchard grass,	14
Tall oat grass,	6
Italian rye grass,	4
Meadow fescue,	6
Red clover,	6
Alsike clover,	2

For permanent mowings on medium soils, per acre: —

	Pounds.
Orchard grass,	8
Italian rye grass,	3
Yellow oat grass,	4
Meadow fescue,	5
Tall fescue,	5
Red clover,	5
Alsike clover,	4

Both of these seed mixtures will produce crops which should be harvested relatively early; and, unless the farmer is prepared to give them attention when the crop is in the best condition, he will do better to select a mixture made up chiefly of timothy and redtop.

The various methods of sowing grass seeds, the time of sowing and the use of manures and fertilizers in preparation for the hay crop were quite fully discussed in the first paper.[1]

The Use of Fertilizers on Grass Lands.

Top-dressing grass lands was discussed at some length in the first paper on this subject. The reasons were therein given why it is believed that on most farms manures should generally be used on the tilled fields. It was pointed out that in the decay of manures on the surface there is some risk of loss of their most valuable constituent, — nitrogen. It is equally true that in the decay of organic fertilizers, such as dried blood, dry ground fish or tankage on the surface there is danger of similar loss through the escape of ammonia into the air.

Nitrate of Soda for Mowings. — It seems to be the almost universal experience that nitrate of soda is the most valuable fertilizer which can be used for the purpose of increasing the growth of the grasses proper. Grasses make most of their growth in the early part of the season, and at a time when the conditions are not very favorable for the conversion of the relatively unavailable constituents of such fertilizers as sulfate of ammonia and the organic fertilizers which have just been mentioned into compounds suitable for plant food. Nitrate of soda, as is now generally known, is in condition to feed the crop just as soon as it is brought into solution, and relatively light rains will dissolve it and carry it into the soil. Nitrate of soda is, however, so soluble that there is quite a possibility that under some conditions it may be washed through the soil and lost before the crop can utilize it. This danger is undoubtedly less in the case of the grass crop than with most others, for the grass roots absolutely

[1] See page 13.

fill the soil, and the soil itself is in a relatively compact condition, — unfavorable to the rapid percolation of water. The writer has in a number of instances seen unmistakable evidence, in the second season following its application, of the beneficial effects of a heavy dressing of nitrate of soda. This observation, however, was made upon soils containing a large proportion of very fine particles, and therefore naturally compact and relatively impermeable. Even in the case of such soils, however, much care should be taken to apply nitrate of soda as near as possible at the time when the crop is ready to make use of it. It would be a mistake, especially in the case of the lighter soils, to apply nitrate of soda in early spring. It should be held until the weather is fairly settled and the grass is beginning to make considerable growth. In average seasons from about the 1st to the 10th of May will probably be found to give the largest increases in the crop. The quantity of nitrate of soda which may wisely be used in top-dressing mowings doubtless varies widely with soils. Wheeler finds that in Rhode Island applications running up to 300 or 350 pounds per acre prove profitable, and, indeed, that there is a larger profit from the use of such amounts than follows the use of smaller quantities. On some soils — and many of the fields of the college farm seem to have soils of this character — so heavy an application would usually prove inadvisable; it would render the crop likely to lodge. It has been found on the college farm that about 200 pounds per acre seem to be as large a quantity as it will pay to use. There must, of course, as will be at once understood, be a wide difference in the tendency to lodge under heavy nitrate manuring with the season, and no doubt also with the species of grass. In relatively dry seasons the heavy applications may prove useful, but in seasons characterized by frequent and sufficient rainfalls more moderate applications seem preferable. Wheeler has pointed out, as also have others, that the hay produced under heavy applications of nitrate of soda is richer in protein than that produced where less nitrate is used; but if the more liberal use of nitrate is followed by the lodging of the crop, the loss in quality due to the conditions existing must more than offset any gain due to the greater protein content.

Should Nitrate of Soda be used alone in Top-dressing Mowings? — In cases where a mowing is used in rotation for hoed crops, and where the hoed crops receive comparatively liberal applications either of manure or general fertilizers, which supply phosphates, potash and perhaps lime, and where the production of hay, which it is desired shall consist chiefly of grasses such as timothy and redtop, for market is the object, it sometimes may be wise to top-dress with nitrate of soda alone. For one or two years it is possible as large an increase may be produced by the use of nitrate alone as by the use of nitrate combined with materials supplying phosphates and potash; but even in such cases considerable practical difficulty will be experienced in attempting to apply the nitrate evenly, and it would seem to be wise to use in connection with it some material which will keep it dry, which will dilute it, and which will therefore make it easier to distribute the nitrate evenly. In selecting a substance for this purpose, some material which is relatively low in price, naturally dry and fine itself, and which may be expected to ultimately benefit the condition of the soil, should be selected; and among such substances basic slag meal seems to be one which meets the requirements admirably. Imported slag meal can be sold in Massachusetts at about $15 per ton. From 300 to 500 pounds in connection with nitrate in such quantity as will ordinarily be required, say 150 to 200 pounds, makes a mixture which will run through the fertilizer distributer evenly; while the slag meal, although not perhaps benefiting the immediate grass crop, will help correct a tendency to acidity in the soil, and will enrich it in phosphoric acid, which is fairly available.

With a view to maintaining the condition of the soil, it would seem to be expedient in most cases to combine with the slag and nitrate a moderate amount of some potash salt, for which purpose the high-grade sulfate will probably be found best adapted. On account of the expense connected with the use of slag and a potash salt in connection with nitrate, many are tempted, in view of the fact that the nitrate alone proves so largely beneficial to grasses, to depend exclusively upon this material. It should be clearly understood that nitrate supplies but one of the more important elements of plant food, and that continued dependence upon such one-sided manuring must therefore be unwise.

On the grounds of the Agricultural College is a plot of land containing about one-half acre, which for the last five or six years has been annually top-dressed with nitrate of soda alone. The mowing is one which has not been broken up for at least twenty years, and the prevailing species is Kentucky blue-grass. The product at the present time is exceedingly unsatisfactory. The grass during its growth shows a rather deep bluish-green color. Its growth is short, and it seems peculiarly liable to rust. Adjoining land of similar character, which six years ago was in the same condition as this half-acre, and which has been top-dressed with potash salts and slag meal in combination with nitrate, produces far heavier and more satisfactory crops. Nitrate alone, therefore, should be used for the grass crop only under exceptional conditions, and then not for many consecutive years. Two years will in most cases probably be the limit.

The Possibilities of the Hay Crop without Manures or Fertilizers supplying Nitrogen. — The fact that good crops of clover can be produced on land which for many successive years has received applications of materials furnishing of the different important plant food elements only phosphoric acid, potash and lime, was pointed out in the first paper upon this subject. In that paper the ability of clover to thrive on soils thus treated, due to the fact that it can take the needed nitrogen from the air, was especially emphasized. Attention is now called to the fact that good crops of mixed hay (clovers and grasses) can be produced under this system of manuring. A striking evidence of this fact is afforded by a number of plots on the grounds of the Massachusetts Agricultural College. It can readily be understood how good crops of clovers are possible under this system. It will not be equally clear, perhaps, to all how grasses which are known to take all the nitrogen which they require from the soil can thrive on soils to which for a long series of years neither manure nor fertilizer furnishing nitrogen has been applied. That the grasses can do this, however, has been shown both at Amherst and by the work of numerous experimenters in other parts of the United States and in Europe.

The limed portion of one plot upon the Experiment Station grounds last season, which had been annually manured with dissolved bone-black and muriate of potash for fifteen years, and the greater part of the time at the rates respectively, bone-black 320 and muriate of potash 160 pounds per acre, gave the following yields: hay, first cut, at the rate of 3,600 pounds per acre; rowen, second cut, at the rate of 2,575 pounds per acre.

Here was a total crop — and on soil, by the way, which is not typical grass land — at the rate of rather more than 3 tons per acre, at an annual fertilizer cost, covering the bone-black and muriate of potash, of about $5.50 per acre. The land, however, has been limed twice during the fifteen years, at a cost for each liming of about $6 or $7 per acre. We have, then, an annual cost for lime at the rate of about $1 per acre, making the total annual cost of the fertilizers used about $6.50. For this small expenditure we have a crop in the fifteenth year of rather over 3 tons. In the same field we have a similar plot, to which the same quantities of dissolved-bone-black, muriate of potash and lime are annually applied, and in addition nitrate of soda at the rate of 160 pounds per acre. Here the two crops last year amounted to 7,600 pounds of well-made hay. We have thus an increase of some 1,500 pounds of hay as the result of the employment of 160 pounds of nitrate of soda, which would cost about $4. The use of the nitrate in addition to the bone-black and potash, therefore, is clearly profitable. It will be asked, however, Whence comes the nitrogen required by the grasses, where the dissolved bone-black, muriate of potash and lime annually are used? The answer undoubtedly is, From decaying clover roots and stubble. Clover thrives under this system of manuring. It draws nitrogen freely from the air. The clovers, however, are not long-lived plants. On their death and decay the nitrogen which had become a part of their tissues becomes available to the grasses which follow. By liberal use of phosphates, potash and lime, then, we can, if we will, in the first place produce heavy crops of clover and later heavy mixed crops of grass and clover, the grass feeding upon the products of the decay of the earliest clover plants. That this will prove the most profitable system of manuring does not follow, for, as indicated by the comparison above made, yet greater profit was consequent in the experiment under consideration from a combination of nitrate of soda with the other materials.

The Necessity for Lime.— The fact that an application of lime is frequently necessary in order to bring soil into such condition that clovers will thrive was particularly emphasized in the first article upon the hay crop. The results in the field which has been referred to very strikingly illustrate the same point. In this field there are two plots, which for the last fifteen years have annually received equal quantities of dissolved bone-black and muriate of potash. One in addition has received during the fifteen years two applications of lime at the rate of 1 ton per acre — the first application, deeply disc-harrowed in, in 1899; the second application, put on as a top-dressing to the grass land, in the early spring of 1904. The product of the two plots was at the following rates per acre: —

	Pounds.
Unlimed plot: —	
First cut,	860
Second cut,	280

	Pounds.
Limed plot: —	
First cut,	3,600
Second cut,	2,575

The total product of the unlimed plot was at the rate of 1,140 pounds per acre. The total product of the limed plot was at the rate of 6,175 pounds per acre, or substantially five and one-half times the product of the unlimed plot. The grasses as well as the clovers made far more vigorous growth on the limed than on the unlimed plot.

Methods of applying Fertilizers. — In the relatively small amounts in which the concentrated fertilizer materials recommended are generally used, it is a matter of some difficulty, or rather one which requires an extreme degree of care, to apply evenly by hand sowing. There has been much inquiry for a machine which will apply fertilizers broadcast in a satisfactory manner. As a result of such experience as we have had here in the use of machines for this purpose, I conclude that our inventors have not as yet produced a machine which is altogether satisfactory. For the application of relatively small amounts of fertilizer we have for the last few years employed the Stevens' fertilizer distributer, and this, if kept in perfect order and all the working parts clean, is capable of doing fairly satisfactory work. The means whereby the amount of fertilizer applied can be gauged are not by any means perfect. It is difficult to set the machine for a definite amount, as the quantity of fertilizer feeding through it will vary widely with the condition of the material. A machine with a more certain and positive feed would be better. For the application of fertilizers such as lime or wood ashes, in amounts approximating a ton to the acre or more, we have used Kemp's manure spreader with the slow feed with fairly satisfactory results. It is relatively easy to apply definite amounts to given areas with this machine, but the fertilizer material is likely to drop in large masses occasionally, owing to not being reached and distributed by the beater; and to avoid killing the grass in the spots where this happens, it is necessary to go over the field and scatter such fertilizer by hand.

The Care of Mowings.

While great care is commonly taken in smoothing and leveling the surface when land is put into mowings, there is a tendency to unevenness, as the result of the action of frost and other agencies, and occasional rolling is likely to prove beneficial. In the case of the non-sod-forming grasses the condition of the mowing may be better maintained if some seed is occasionally sown. The reason why timothy in some cases proves much more persistent than in others is undoubtedly because the crop is harvested so late that some of the seed is mature before the crop is cut, and the seed thus accidentally scattered helps to thicken the mowing by producing plants which replace others as they die out. The best time for sowing such seed is either late summer or very early spring. The quantity of seed sown should be varied according as conditions seem to require. In case the stand of plants in a mowing is especially thin, and it is desired to reinforce it, it may be wise to go over the mowing either with a harrow or a weighted weeder after sowing the seed.

The Common Weeds of our Mowings.

A considerable proportion of the mowings of the State are infested with weeds of different kinds. Among the most common and troublesome are the common white and the yellow daisy, wild carrot, sorrel, dock, buttercups, the common plantain, dandelions, milkweed, ragged robin and horsetail. The methods which will prove most effective in eradicating these weeds or keeping them in subjection must be quite different in details for the different weeds; but in general it may be said that, if the soil is kept sweet by sufficient use of lime, and well enriched, the conditions will be made so favorable for the growth of the better grasses and the clovers that the weeds will have relatively little chance. The grasses and the clovers, in the struggle for existence which is always going on in the meadows, will prove victorious. There are localities, however, where certain weeds have gained such a foothold that special measures of eradicating them are called for. There is one general measure which may be expected to prove helpful in the case of almost any of them, which must be first considered. This is reseeding.

Reseeding Mowings.

The question is often asked, when mowings become highly infested with different weeds, how these weeds can be best subdued or eradicated. Reseeding in almost all such instances, if carried out under the right conditions, is likely to prove helpful. The question will at once arise whether it is better to plow and cultivate for one or more years and then reseed, or to plow or otherwise break up the ground and immediately reseed. Experience in reseeding mowings in a field having a rather strong, retentive soil, which had become much infested with white daisy, buttercups, ragged robin and a few other species, convinced me that the best results are likely to be obtained by breaking up the land in midsummer, harrowing it repeatedly and most thoroughly until early in August, — so frequently and so thoroughly as to keep the surface absolutely free from vegetation, — then enriching liberally and reseeding, sowing seed in very liberal amounts. The seeds of most weeds, if buried in the ground too deep for immediate germination, retain vitality almost indefinitely, and the number of seeds which has been so buried in many of our soils is very great. Cultivation must be very long continued in order to permit the destruction of all such seeds. Every time we plow we are likely to bring a fresh lot of seeds near enough to the surface to enable them to vegetate. Cultivation must therefore be persisted in for a good many years, or it will prove relatively unimportant in its influence on the number of weeds which will start when at length the field is seeded. Conditions are most unfavorable for the germination and establishment of weeds in mowings if they be seeded early in August, after thorough preparation of the soil. Moreover, during the interval between plowing, which should take place early in July, and seeding, early in August, most of the weed seeds which lie near enough to the surface to germinate will have started, and the repeated harrowings above advised will have resulted in the destruction of the young plants as they start. When, after this treatment and after the thorough enrichment advised above, grass and clover seeds are sown, they make a quick and vigorous start, and the weeds gain but little foothold.

On the grounds of the Experiment Station mowings reseeded in this way are far clearer from weeds to-day than other mowings which were broken up and cultivated for a couple of years and then reseeded. It would, of course, be possible to give fields which have been cultivated such treatment as has been recommended in the case of mowings broken and reseeded without cultivation; but this would involve a greater loss of time, and would not seem to have any special advantage. In the case of weeds starting from perennial roots only, such, for example, as witch grass, does a period of cultivation appear to be essential.

Use Care in purchasing Grass Seeds.

The seeds of several of the most troublesome of the weeds in our mowings are commonly found in commercial samples of grass and clover seeds, and a great deal of care should be used in the purchase of such seeds to avoid samples containing the seeds of troublesome weeds in any considerable number. Among the weed seeds which seem to be most commonly mixed with commercial samples of grass and clover seeds are those of dock and sorrel, the yellow daisy, buttercup and plantain. Farmers may send samples of seeds to the Experiment Station for examination; but it would be a relatively simple matter for any farmer to collect a few seeds of these commoner and more troublesome weeds, and keep them for comparison with any foreign seeds which may be found in grass or clover seeds purchased. In this way, by the use of a magnifying glass of moderate power, the seeds of any of the weeds mentioned can be identified. By the exercise of care in the purchase of grass and clover seeds much trouble and expense may be saved.

The white daisy (*Chrysanthemum Leucanthemum*) may be practically eradicated from mowings without reseeding, by persistent early cutting, usually from June 12 to 15, and such enrichment of the soil as favors the growth of grasses. This plant is a biennial, and it is only necessary to prevent the ripening of seed.

The yellow daisy (*Rudbeckia hirta*) is not ordinarily troublesome save on light soils. Pulling the plants soon after they come into blossom will prove efficacious.

The wild carrot (*Daucus Carota*) is one of the most troublesome weeds in mowings, and has been allowed in many localities to ripen a tremendous amount of seed, so that the soil is thoroughly infested with it, and replowing will not be likely to prove effective. Timely cutting to prevent the ripening of the seed is a better preventative, and if persisted in for a few years the carrot will be eradicated.

Sorrel (*Rumex Acetosella*) is often prominent in new seeded mowings, but commonly disappears after one or two years. Its presence is an indication that the soil would be benefited by a liberal application of lime.

It seems to be impossible to procure grass and clover seeds entirely free from dock (*Rumex crispus*). The plants should be pulled after the stems become tough, but before the seed matures, which is best done after a rain, when the soil is soft. Hand-pulling is the method generally preferred, but there is no doubt that cutting the roots a couple of inches below the ground will destroy almost all plants.

Buttercups, common plantain, dandelions and ragged robin frequently become quite numerous in mowings, but are not hard to keep in subjection. Liberal use of fertilizers will so strengthen the grasses and clovers that these weeds cannot become very prominent.

Horsetail (*Equisetum arvense*) sometimes becomes very abundant in mowings, usually in soils that are rather sandy in texture, but have at the same time a fair capacity for holding water. Mowings that are badly infested should be broken up and reseeded, with thorough cultivation before seeding, as its presence in mowings is sometimes a source of danger to horses fed with the hay, it exerting a distinctly injurious effect when consumed in quantity, and sometimes causing death.

CLOVERS: THEIR VALUE, CHARACTERISTICS OF VARIETIES AND METHODS OF PRODUCTION.[1]

BY PROF. WM. P. BROOKS, DIRECTOR MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

Most farmers who keep stock appreciate the fact that the clovers are among the most valuable of all the forage crops that can be produced in Massachusetts. The reasons why the clovers are so important are not always clearly understood. In this article the writer will attempt to make these reasons clear. Not infrequently, in personal interviews or by letter, the writer's attention is called to the fact that in some localities farmers are meeting with poor success in their efforts to produce this valuable class of forage crops. The reasons for comparative failure in efforts to produce clover doubtless vary in different localities, and it may not be possible for one unfamiliar with conditions to give directions which will always lead to success. Certain conditions, however, which are well established, must be provided, or failure will be the result. An effort will be made to make a clear statement as to what these conditions are, for it is in many cases at least true that comparative failure in the effort to produce clovers is due to a failure to observe some one or more of these conditions.

Reasons why Clovers are especially Valuable on the Farm.

It is the writer's opinion that on farms where stock is kept it will usually not be profitable to use clovers as green manures. They can be better utilized on such farms by cutting and feeding to stock, or by pasturing. On the other

[1] "Agriculture of Massachusetts," 1906.

hand, where but little stock is kept, and especially where the production of apples, peaches or other tree fruits is an important part of the farm business, the clovers are among the most valuable crops which can be used for cover, to supply humus, and to enrich the soils in nitrogen. It is now generally understood that under right conditions clovers are capable of taking the nitrogen which they need from the air. In this respect the clovers and the other plants of the clover family are superior to any other crops which can be used for similar purposes. It is, then, this single fact, that the clovers can take the nitrogen they need from the air, while crops of other families cannot do this, which renders them so much more valuable than most other crops for cover and green manuring. It is the purpose of this article to consider especially clovers as forage crops. A brief statement of the principal reasons for their great value as such may be useful.

1. The cost of manures and fertilizers needed to produce them is low. As has just been stated, the clovers under the right conditions take their nitrogen from the air. They draw upon the soil simply for the mineral constituents of plant food, such as lime, phosphoric acid, potash and magnesia. These mineral elements of plant food are relatively abundant, and can be purchased at comparatively low prices. Nitrogen, on the other hand, if purchased in the form of either manure or fertilizers, will usually cost from 16 to 18 cents per pound. Phosphoric acid and potash cost only 3 to 5 cents per pound, the price varying according to the material selected. Lime and magnesia cost still less. The latter, indeed, need seldom be purchased, for it, as well as the other mineral constituents found in plants, is almost invariably sufficiently abundant in all soils. Striking evidence that the manurial cost of producing clovers is low is afforded by the results in one of the fields of the Hatch Experiment Station. A plot in this field was manured annually for fifteen years at the following rates per acre: dissolved bone-black, 320 pounds; and muriate of potash, 160 pounds. The crops raised on this field, in the order of their production, were as follows: corn, corn, oats, hay, hay, corn, rye, soy beans, white mustard, corn, corn, hay, hay and corn. The hay crops have

consisted in all cases of mixed grass and clovers. During the fifteen years referred to, the entire field has received two applications of lime, at the rate in each case of 1 ton to the acre. The annual cost of the dissolved bone black and muriate of potash applied to this plot has been at the rate of about $5.50 per acre, while the cost of the two applications of lime has been sufficient, spread over the fifteen years, to amount to about $1 per acre annually. The total cost of manuring this land, then, has been at the rate of about $6.50 per acre annually. This plot has invariably produced good crops. Its fertility does not appear to have decreased. In 1902 it produced shelled corn at the rate of 56 bushels to the acre. Clover has always predominated in the hay crops. The yield of hay (two crops) in 1901 was at the rate of 3,400 pounds to the acre. That portion of this field which has not been manured during the fifteen years will at present yield corn at the rate of about 7 bushels of shelled corn per acre, and hay at the rate of about 600 pounds.

Some of the fields of the Massachusetts Agricultural College farm are kept permanently in mowing. A number of acres have not been broken up for about twenty-four years. In 1889, when the writer took charge of these fields, they were producing rather light crops of Kentucky blue grass, much mixed with the white daisy. For the last few years these fields have been subdivided into plots, and various combinations of fertilizers employed. To a considerable area, the annual application per acre is at the rate of basic slag meal 500 pounds, and a potash salt sufficient to furnish 75 pounds of actual potash per acre. The areas thus manured have steadily improved under the treatment received. At the start there was but little clover. Under the system of fertilizing followed, the proportion of clover has steadily increased. The daisies have almost entirely disappeared, while the grass as well as the clovers, though in less degree, has improved. The annual cost of the fertilizers used amounts to about $7 per acre. The soil of these fields is natural grass land, and is quite well adapted for clovers as well. The product under this system of manuring ranges from about 2 to 2½ tons per acre in two crops. During the present season these fields have given one of the best as well as one of the heaviest crops produced since 1889.

2. Clovers are of especial value upon the farm as stock feed, on account of their exceptional richness in protein. Protein, as is well understood, is the most valuable of the food constituents, being essential to the formation of flesh, and undoubtedly influencing milk production to a greater degree than any other food constituent. Hay made from grasses is likely to contain only 6 to 8 per cent of protein; hay made from clovers, on the other hand, is likely to contain from 12 to 14 per cent. Every farmer, however, who has had experience knows the superior results which can be obtained in feeding when good clover hay is available. This point, therefore, needs no further discussion.

3. The production of clovers under the right conditions enriches the soil. This is true even when the crops produced are cut and removed. Clover, as has been pointed out, is capable of taking its nitrogen from the air. Not only does it take from the air under the right conditions a large proportion of the nitrogen which becomes a part of its stems, leaves and flowers, but it takes also large amounts of nitrogen which become a part of its root. The 3 tons of clover hay which an acre of good clover land will produce in a year will contain about 120 pounds of nitrogen; and yet after the production of this crop the soil will contain more nitrogen than it did at the start, if conditions have been right, for the roots and the stubble of the clover are very rich in this element, and when these decay, the nitrogen they contain becomes a part of the capital of the soil, and this nitrogen has been taken from the air and thus brought within the reach of subsequent crops through the agency of the growing clover.

In one other direction the growth of clovers is likely to result in soil improvement. Most of them are very deep-rooted plants. They have long, thick tap roots, which run down into the soil. As a consequence, the sub-soil is opened up and mellowed. The availability of the stores of plant food in it, as well as in the surface soil, is increased. Crops which follow clovers are likely to send their roots deeper into the soil than when following grasses, which are more shallow rooted.

Under these conditions crops are less likely to suffer from drought. They gather food from a wider soil area, and are consequently more certain and less dependent upon applied fertility. The fact that other crops almost invariably do well when following a good crop of clover is generally understood among farmers of experience, and these points, therefore, do not appear to need further discussion.

4. The fact that when a clover sod is broken up the following crops do exceptionally well has just been pointed out and is generally understood. That the grasses growing in the field with clovers in permanent mowings will ultimately derive great benefit from the clovers which have grown with them is not so generally understood. That such is the case, however, cannot be doubted. European experience has demonstrated it, and many observations in America confirm the results of European experience. It will be of interest to consider how this effect is produced. As has been pointed out, a suitable selection of fertilizers will maintain a large proportion of clovers in permanent mowings. It must be remembered, however, that the individual clover plants are not long lived. Most of our clovers are short-lived perennials. The single plant will not, as a rule, live more than two or three years. Clover is permanent in the mowing simply because some of the seed almost invariably ripens previous to the cutting of the crop. Considerable numbers of individual plants undoubtedly die every year. It is the decay of the roots and stubble of these plants which accounts for the benefit to the grasses. Grasses thrive where nitrogen in available forms is abundant in the soil. The decay of the roots and stubble of clovers brings this element within the reach of the grasses, and thus the clovers, which first help themselves by drawing nitrogen from the air, in their death and decay help the grasses as well. Any permanent mowing which at the outset is brought into good condition to produce clovers in a few years will also be in a condition to produce a strong growth of grasses as well as clovers.

For four important reasons, then, the clovers are among the most valuable of forage plants: first, the manurial cost of their production is exceptionally low; second, they are richer in protein than most of the forage crops, — far richer than the grasses; third, they enrich the soil in nitrogen, as well as sub-soil it, so that the following crops are almost invariably good; fourth, in permanent mowings they ultimately so enrich the soil in nitrogen that the grasses as well as the clovers make vigorous growth.

The Kinds of Clover.

Crimson Clover (Trifolium Incarnatum).

Crimson clover is an annual or a winter annual.[1] Whenever crimson clover can be grown as a winter annual it is of much value, but the peculiarities of our winters and especially of our springs are such that crimson clover is not generally successful as a winter annual. In localities where it is hardy, its special value is due principally to the fact that it starts into growth the following season much earlier than the other clovers. Crimson clover may be grown in Massachusetts as a spring-sown crop, but if it must be sown in the spring it will not be earlier than the other clovers, and is not likely to yield so heavily as they. It does not appear likely, therefore, that crimson clover will prove of much value in our agriculture.

Medium or Common Red Clover, and Mammoth Red Clover.

These two kinds of clover are best described together, as the peculiarities of each are best brought out when studied in contrast with those of the other. These two kinds of clover resemble each other very closely. Typical specimens of the two show well-defined differences, but these two types of clover seem to run together, and there are many forms intermediate between the types. The product of commercial samples of seed sold under the two names is often indistinguishable, even by experts. Typical specimens show the following differences: the leaflet of the red clover is nearly round, comparatively smooth, with a whitish approximately

---

[1] Those plants are designated winter annuals which, when sown in late summer or fall, make a moderate growth, but do not blossom that season; but which will pass through the winter successfully, blossom and form seed the following spring, and then die. Winter rye is an example.

crescent-shaped mark on the upper surface; the mammoth clover has a leaflet relatively narrow, elliptical, more hairy than that of the common red clover and without the whitish mark. The more important practical differences are that the mammoth clover is somewhat coarser and taller than the common, and a little later. It is, therefore, somewhat better suited for sowing in mixture with timothy and redtop than the common red clover, for the latter is usually overripe before the timothy and redtop are sufficiently mature to cut. Both of these clovers are rather short-lived perennials; but it is nevertheless possible, as has been indicated, to produce hay for a long series of years in permanent mowings in which these clovers will be fairly prominent. This is possible even without sowing the seed, for when the rowen crop is usually harvested a portion of the heads are commonly ripe. The seeds are scattered from these heads, and from these seeds each year come new plants. Accordingly, though the older plants die, their place in the mowing is taken by the plants which grow from these accidentally scattered seeds.

Alsike Clover.

Alsike clover was once supposed to be a hybrid between common red clover and white clover. It is now known that this is not the case; it is a distinct species. In characteristics, however, it is intermediate between the common red and the white, showing a wonderful blending of the qualities of the two. It has the upright habit of growth of the red clover, though it is not so coarse. The head is shaped like the head of the white clover, while the color of the flowers is pink. Alsike clover is of much value in mowings, and seems to be especially adapted to the stronger and moister soils, where it does better than the common red. Being finer, it cures more easily than either the common red or the mammoth clover, producing hay of very superior quality. It is, moreover, of great value as a honey crop, for the honey bee can reach the nectar in its flowers, which it can seldom do in the case of the red and mammoth clovers. In a few respects alsike clover appears to be somewhat inferior to the red and mammoth varieties. In many cases it does not persist so long, nor does it appear to yield so heavy a second growth. The variety, however, is of such value that it should always be included in mixtures of seeds for the stronger and moister soils, where hay including clover is desired.

White Clover.

This plant is too well known to need description. Unlike the other clovers, it is perennial. Its ability to persist is due to the fact that its stems creep upon the ground, rooting at the joints wherever they come in contact with the soil. This clover is, therefore, constantly renewed, as a result of this habit of growth. This same habit renders this clover less valuable in mowings than the others which have been spoken of. In all permanent mowings, however, white clover will contribute greatly to the yield and to the nutritive value of the product. In such mowings it appears invariably to come in naturally if the soils are adapted to it, and if the necessary mineral elements of plant food are abundantly supplied. White clover is of great value in pastures. A turf in which white clover is abundant is most highly relished by all classes of stock, and the feed is highly nutritious. The white clover, moreover, is much the most valuable of all the clovers for bees. It secretes nectar abundantly, and the honey made from it stands highest in our markets, being, indeed, almost everywhere looked upon as the standard of excellence among the different grades of honey.

Varieties of the Different Species.

Critical examination of either grasses or clovers in the field will reveal the fact that the different plants exhibit considerable variation. In the United States, while we have countless varieties of vegetables, grains and fruits, we have thus far made little effort to produce select and more perfect varieties of our different species of forage crops. We have been satisfied to go on year after year sowing a mixed or average seed. The tendency to vary among the different species of clovers is apparently not less than it is in many other species of cultivated plants. It cannot be doubted that by intelligent effort greatly improved typ or types suited to widely different purposes, may be produced. Foreign countries are ahead of us in this direction; and on the experiment station farm at Amherst there is now a considerable collection of varieties of clovers, — of the red, alsike and white species respectively. The different varieties exhibit wide differences one from the other, and some of them have great apparent promise. These varieties of clovers have not been under trial sufficiently long to justify sending out any of them, but it is among the possibilities of the near future that we shall have highly improved types of the different leading species of clovers, — types which are suited to varying conditions or to different purposes. Meanwhile, in conclusion upon this topic, the intelligent clover grower is urged to keep his eyes open for promising plants, and, finding them, either to propagate from them himself, or to send them to the experiment station, where they will be given careful trial.

The Conditions Essential for the Most Successful and Profitable Growth of the Clovers.

1. *Soil Conditions.* — Successful clover growing is impossible unless the soil conditions are right. These plants will thrive upon a considerable variety of soils as regards texture and composition, but for the best results a deep, mellow and fairly retentive soil which is well drained is essential. Clovers will absolutely fail if there is any considerable proportion of free acid in the soil, or, in farmers' language, if the soil be "sour." If blue litmus paper in contact with moderately moist soil turns red as it absorbs the moisture, this is an indication that the soil is sour; but the farmer will be wise if, before incurring any considerable expense for the correction of acidity, he makes a careful test for himself. One of the best farmer's tests can be carried out as follows: take two small plots of land in a field supposed to possess "sour" soil, and plow them both. Plots containing about one square rod each will be sufficient. They should, of course, be located in a representative portion of the field. After plowing, spread about 20 pounds of builders' lime or R-R agricultural lime on one of the plots. Work this lime in deeply

with the wheel harrow, then manure or fertilize both plots alike and heavily, and plant table beets. If the soil is sour, these beets will grow much better on the plot to which the lime has been applied than on the other, and it is safe to conclude that a heavy application of lime will be essential before clovers will flourish. If the experiment indicates that lime is essential, it will probably be needed at about the rate of 1 ton to the acre; the weight referred to to be taken before slacking. If air-slacked lime is used, 1½ tons to the acre will not be too much. The best season for applying lime is autumn or early spring. As a rule, it should be spread upon the plowed land and deeply worked in with the disc harrow.

2. *The Use of Much Manure inexpedient.* — The writer is aware that splendid clover is often grown where the land is heavily dressed with manure. He is not disposed to deny the possibility of producing fine crops of clover on manure alone. He would, nevertheless, urge that manure alone be not depended upon as a means of enriching clover land. The leading and most valuable element of plant food in manures is nitrogen. The application of this for clovers in any considerable amounts is unnecessary. If clovers are grown on manures, they will feed upon the nitrogen in the manure; they will not draw from the air for that element. Growing clover upon manures, therefore, is not the best economy. Moreover, it is important to point out that the grasses with which clover is most generally grown are greatly invigorated by heavy dressings of manure. A strong, rank growth of the timothy and redtop will tend to crowd out the clover. Fine crops of hay may be produced, but it will not be clover hay, nor rich in clover. The writer would not be understood as urging that manure should never be used on land which is being prepared for clover, although he would strongly advise against top-dressing clover with manure. On soil which is naturally poor in nitrogen, manure may wisely be used in moderate amounts for crops preceding clover. Heavy dressings would be a mistake. It is far better to use the manure in only moderate or small amounts, and to use it in connection with materials which will supply lime, phosphates and potash.

3. *The Supply of the Mineral Elements of Plant Food should be Liberal.* — We should not forget, in considering the best means of growing clover, that the stock of nitrogen in the air from which it is capable of drawing is practically unlimited. The more of this nitrogen we can gather in the crop and in its roots and stubble, the better. In a certain sense, this trapped atmospheric nitrogen is so much clear gain. In considering this point, it must be remembered that the clover plant, like other plants, must take the different food elements in a certain balanced proportion. Though the nitrogen the clovers need is practically unlimited in amount, they cannot make a heavy growth unless provided with a great abundance of the elements which they must take from the soil. It is clearly unwise to lessen our chances for gathering the valuable element nitrogen from the air through failure to supply the soil elements in adequate amounts. The rule, then, in preparing for clover or in top-dressing for clover should be to supply the phosphates, potash salts, lime and possibly magnesia in great abundance. With these present in abundance, and with a soil of such a character that it will furnish suitable conditions and supply the needed moisture at critical times, enormous crops of clover may be produced.

4. *The Co-operation of Bacteria is essential.* — One of the most important discoveries of recent times is the now generally known fact that the presence of certain bacteria living in symbiotic relations with the clovers and other members of the clover family, and found in nodules on their roots, is essential in order that these plants may draw upon the air for nitrogen. The nodules which in the case of clovers indicate the presence of suitable bacteria are whitish, more or less elliptical bodies, of about the size of the head of a small pin. These grow singly or in small clusters, mainly on the smaller roots. They can be readily found by taking up clover plants grown under proper conditions, with care not to break off too many of the small roots. Bacteria, as is generally understood, are plants. They are very minute. The bacteria themselves are the veriest dust of the dust. As might be supposed, therefore, they appear to be very widely and freely disseminated, and prob-

ably through the air. The slightest currents of air must carry them. The dust from a freshly turned clover sod must contain countless millions of them. In certain quarters it has been urged that failures to produce good clover are frequently due to the absence of suitable bacteria, or to their presence in insufficient numbers. Certain experiments with sterilized soils in Amherst indicate to the writer that clover bacteria are everywhere; and it is not his belief that failures to produce satisfactory crops of clover in this State can often, if indeed they can ever, be attributed to the cause under consideration. The writer has never seen a case where, if a soil be brought into proper condition as to drainage and freedom from acidity, and well stocked with phosphates and potash, clovers have failed to grow; and he has never observed clover plants in any locality and failed to find abundance of nodules on their roots. It is, however, of course a possibility that there may be localities where it will pay to inoculate the soil designed for clover with suitable bacteria. This inoculation may be carried out in either of two ways. First, soil from a locality where clover thrives and where the nodules are known to be abundant may be scattered over the field where the clover is to be sown, and immediately harrowed in. Five or six hundred pounds of such soil per acre will be sufficient. Second, a culture of the proper species of bacteria may be used in accordance with directions which will be furnished with it. Such cultures may now be procured either from the United States Department of Agriculture in Washington, or from private dealers. These cultures are known by the name of nitro-cultures; but, as each species of the clover family must have its own species of bacteria, it is necessary in ordering to name the plant for which the nitro-culture is needed, as well as the area.

The United States Department of Agriculture first sent out cultures in dry form, in small packages containing dried cotton and chemicals, to be dissolved in the water in which the cultures were to be started. In very many cases the use of these cultures resulted in absolute failure. The desiccation to which the bacteria had been subjected appeared to have destroyed their vitality. So far as the writer knows, all private companies which are now offering commercial nitro-cultures prepare them in accordance with the system first used by the government, and the presumption is that in many cases these cultures will be found valueless, and for the reason above indicated. The United States government at the present time is preparing cultures in semi-fluid form. These are sent out in sealed glass vials. They have not been sufficiently tried to warrant an expression of opinion concerning their value, but the method, at least judged from a scientific point of view, appears better calculated to yield successful results than the earlier method.

It has been urged that the bacteria sent out in culture form are selected and especially vigorous forms, and that accordingly, even in cases where the soils contain the right species of bacteria, the clover crop may be increased, or may be enabled to draw nitrogen in larger quantity from the air through suitable inoculation with these improved cultures. It does not appear to the writer that this point has been as yet proved, and in conclusion he would go on record as most emphatically advising against the use of cultures for clover, unless, indeed, it is found on experiment that clovers do not develop in any given locality the characteristic nodules.

Fertilizers for Clovers.

In considering this topic, we shall do well to consider separately clovers grown in rotation with other crops and clovers in permanent mowing.

For Clovers in Rotation.

Where clovers are grown in rotation with other crops, they will occupy the land at most but two or three years. In such cases practically all manure or fertilizer used will be applied previous to seeding. On most farms where stock is kept, manure in larger or smaller quantity will be used for the crops which precede the clovers. It has been pointed out that it is a mistake to use manure too freely for the crops which precede the clover. Application at the rate of 4 to 5 cords to the acre only is desirable. In connection with such applications of manure, materials which supply phosphates, potash and perhaps also lime should be employed. During the past few years large quantities of phosphatic or basic slag meal have been employed on the college farm at Amherst, and with results which are eminently satisfactory. This slag meal should contain about 16 to 20 per cent of actual phosphoric acid. This acid is not in so highly available a form as in acid phosphate or dissolved bone black. On the other hand, it appears to be more available than the phosphoric acid in any of the phosphatic rocks, or even in most of the forms of bone. Besides phosphoric acid, the slag meal contains a large amount of lime, and this, while less effective in correcting the faults of a sour soil than quicklime, must prove valuable in helping to prevent soils which have once been brought into proper condition from becoming sour again. On such soils as those at Amherst the application of slag meal at the rate of some 500 or 600 pounds per acre in connection with such dressings of manure as have been indicated appears to be sufficient. In addition to the slag meal, there will be needed on most soils to bring them into suitable condition for producing clovers a fairly liberal application of potash in some form, for this element the 4 or 5 cords of manure will not supply in sufficiently large quantities for the best results with clover. Wood ashes furnish potash in very desirable form, but they are becoming increasingly scarce, and are held at prices which make them a relatively expensive source of that element. It is the practice on the college farm to depend mainly upon some of the German potash salts; and, as has been pointed out in earlier articles on the hay crop, sulfates of potash are found in the long run to give much better results with clover than muriate of potash or kainite. Experiments now in progress in Amherst are furnishing an interesting basis of comparison between the low-grade sulfate of potash and the high grade. The writer is not yet prepared to recommend the low grade as superior to the high grade; and, since the latter furnishes actual potash at the lower cost, it is his belief that it should usually be selected. Comparative observations, however, on crops grown on the two potash salts this year lead him to wonder whether the magnesia of the low-grade sulfate may not ultimately prove valuable. Certainly better clover is seldom seen than that produced on certain of the fields of the college farm during the past year, which have been during the past few seasons top-dressed with basic slag meal and low-grade sulfate of potash. If the high-grade sulfate of potash, however, is selected for use in connection with manure in preparing for clover, it is believed that an annual application at the rate of about 150 to 175 pounds per acre will supply the element potash in sufficient quantities for clovers on most soils. These materials (basic slag meal and sulfate of potash) should be mixed after the land has been plowed, spread broadcast and harrowed in.

Fertilizers without Manures.

In some cases the farmer will desire to bring his soil into suitable condition for clovers in rotation by application of fertilizers alone to preceding crops. In such cases the materials which have just been considered should constitute the main reliance, but they should be used in connection with materials which will furnish nitrogen in sufficient quantities for the preceding crops. Both the slag and potash, however, must be used in somewhat larger quantities; and the writer would suggest as suitable for most cases basic slag meal 800 pounds and high-grade sulfate of potash 200 pounds, though these amounts may, of course, wisely be varied to some extent according to the crop which precedes the clovers. What materials it will be best to use for the purpose of supplying the needed nitrogen for the preceding crop, and in what quantities, it is impossible to say without knowledge as to what that preceding crop is to be. If corn, only moderate quantities of nitrogen would be required, and this may wisely be furnished in materials furnishing this element in forms varying in availability. As a rule, the needed nitrogen may wisely be obtained by a combination of nitrate of soda, tankage and possibly raw bone meal; and for corn, in the proportion of about one part of nitrate to three of tankage and two or three of bone meal. The total quantities of these materials which it will be profitable to use for corn in connection with slag and potash must vary widely with the condition of the soil. Six hundred pounds of a mixture with the different materials in the proportions indicated will ordinarily be sufficient. All these materials, nitrate, tankage, bone meal, slag meal and potash, may be mixed after the land is plowed, spread broadcast and harrowed in.

Fertilizers for Clovers in Permanent Mowings.

To get permanent mowings to produce hay composed largely of clovers, it will be wise to depend chiefly upon the fertilizers which have been under consideration. Basic slag meal or bone meal should be mainly depended upon as sources of phosphoric acid, and lime and either the high-grade sulfate or low-grade sulfate of potash as the source of potash. Excellent crops can be produced by a combination in suitable amounts of these materials alone, and the clover will comprise a larger proportion of the product if they be used without materials which will supply nitrogen. On the college farm at Amherst crops of hay rich in clover have been produced year after year by an annual top-dressing composed of a mixture of basic slag meal 500 pounds, and either high-grade sulfate of potash 150 pounds or low-grade sulfate of potash 300 pounds per acre. The product under this annual system of top-dressing shows fairly good grass, with a bottom full of white clover which grows with remarkable luxuriance and attains unusual size. The fields thus top-dressed contain also many plants of the red clovers. These in the crop of the past year seem to be more abundant where the high-grade sulfate of potash was used than where the low grade had been applied. Basic slag meal is not yet common in our markets. If it be found difficult or impossible to obtain it, bone meal may be substituted for it; but it is not likely that it will permanently hold the land in a condition so favorable for clover as the slag meal, for it does not contain lime in so large proportion. The bone meal, however, furnishes a small amount of nitrogen, and this fact may render it somewhat more favorable for grass than is the slag meal.

It seems probable that in most cases somewhat more profitable crops of hay will be obtained if in connection with either the slag and bone meal or the potash salts a moderate amount of nitrate of soda is employed; and experiments in Amherst indicate that from 150 to 200 pounds per acre of this salt in connection with the other materials seem to be as large an amount as in seasons with abundant rainfall may profitably be used on strong and retentive soils. On the lighter soils the nitrate may without doubt be more largely employed with profit.

In top-dressing permanent mowings, whether with the slag meal or bone and potash alone or with these materials in connection with nitrate, it is the practice at Amherst to mix the materials and to apply the mixture about the first of May. There can be little doubt that the slag and the potash salt will do the crop of the succeeding season more good if applied in the autumn; but applying them at this time would mean going over the ground twice, — once with the mixture of slag and potash and once with the nitrate. It would, moreover, be found difficult to apply the small quantity of nitrate evenly by itself; and it seems doubtful, therefore, whether in the long run better results will not be secured by applying the mixture of all the materials in the spring.

Seeding to Clover.

As has been pointed out, it is almost invariably best in general farming to sow the clovers in mixture with grasses. Clovers growing alone are not likely to stand up well. If sown in mixture with a stout growing grass, such as timothy or orchard grass, the clovers retain their upright position much better than when growing alone. If, however, for any purpose it is considered desirable to sow clovers alone, the following quantities of seed per acre will usually be sufficient:[1] —

	Pounds.
Red clover,	15
Mammoth clover,	20
Alsike clover,	12
White clover,	8

[1] For seed mixtures for various purposes see article on "Hay crop in Massachusetts."

Spring Seeding.

The clovers are sown in spring in either one of two systems. First, it is common practice to scatter clover seed in very early spring on the surface of fields which have been seeded the previous fall either with grain or grasses. Under these conditions the soil cannot be freshly prepared, nor can the seed be covered. As might be expected, therefore, germination is less perfect than under more favorable conditions. When, however, the weather conditions are just right, a fair degree of success is attained by seeding in this way. It is usually best to defer sowing until the winter's frost is out of the ground. Results are most satisfactory when the seed can be sown on a lightly frozen surface which is somewhat honeycombed with the night's frost. If as this frost comes out of the ground, or soon after it comes out, there should chance to come a rain, the seed is much of it carried into the soil, and will usually germinate promptly and quite perfectly. Owing to the fact, however, that we are by no means certain to experience these ideal conditions, there is considerable risk in seeding with clover in accordance with this plan. It should be recognized, moreover, that, even if the seed germinates well, the clover sown in this way on land seeded to grass the previous fall makes but little showing in the crop of the succeeding season.

Second, the land may be plowed as early in spring as it can be worked, and the clover sown either alone or in connection with grass seeds, with or without grain as a nurse crop. Clovers sown in this way usually start well, but, whether they be sown with grain as a nurse crop or not, they are subject to peculiar risk and injury during the summer. If sown with grain as a nurse crop, this must be harvested usually during July. If sown alone, there will usually be a considerable growth of weeds, and these also, in order to prevent ripening of seed, must be cut at about the same time. The clover which has previously been shaded either by grain or weeds is in poor condition to stand full exposure to the hot sun of midsummer, and unless rains come within a short time after it is thus exposed, much of it is often killed. This method of seeding, then, leaves much to be desired.

Seeding in Summer or Early Autumn.

The best success in seeding to clovers can usually be counted upon when the work is done in late summer or very early autumn. Dog days furnish ideal conditions for germination and rapid growth. Clovers may be sown at this time either alone or with grasses. If the field can be cleared, plowed and thoroughly harrowed, it can be brought into the very best possible condition; but where clover is to follow corn, it is impossible to remove the corn in season to sow the clover. Under these circumstances, seeding in corn appears to be the best plan. The ensilage corn, since it is carried from the field as soon as cut, furnishes conditions on the whole more satisfactory than field corn, with which the young grass and clover will be killed where the stooks of corn stand while curing. In the seventeen years that the writer has had charge of the college farm in Amherst, a good many acres have been annually seeded in corn, and during this entire period there has never been a failure. The culture of the corn should be level. A spike-toothed cultivator should be used at the last cultivation, and the seed should be immediately sown. It will not need covering. The best time for sowing in this way is usually between July 20 and August 5. It is desirable to sow the seed before the corn is so tall as to make it difficult to swing the hand over it in sowing. Those who have not tried this method of seeding appear usually to fear that the stubble of the corn will be in the way in harvesting the hay crop; but if the field be rolled the spring following the seeding, no such difficulty will be experienced. Clover sown in this way in the corn becomes thoroughly established before winter, it is very unlikely to winter-kill, and it will give a full crop the following season.

Selection of the Seed.

The clover seeds upon our American markets appear usually to be of very good quality. European seed dealers have sometimes mixed specially prepared sand of approximately similar color and sizes with clover seeds; but, so far as the writer knows, this fraud has never been undertaken in this country. In purchasing clover seed, then, it seems necessary only to use care to obtain that which is free from admixture with weed seeds, and which shows good germination. Among the weed seeds most likely to be found mixed with clover seeds are dock and sorrel. These can easily be recognized. There is occasionally a sample of clover seed containing the seeds of dodder, — a thread-like parasite, which attaches itself to the stems of the clover plants. Where this is abundant the crop is practically ruined. The stems of the dodder straggling from stem to stem unite the different plants so that they cannot be separated; it therefore becomes almost impossible to handle and cure the hay. The presence of dodder, moreover, renders the hay very unpalatable. The seed of the dodder is excessively fine, and in cases where its presence is suspected a sample of the seed should be sent to the experiment station for identification.

Curing the Hay.

The first point to be considered in connection with this topic is the proper degree of maturity. Clover is often allowed to stand too late. If it be suffered to remain until a considerable proportion of the heads are brown and the seed ripe, there will be but little rowen, while there is much danger that the roots of the clover will die after the crop is cut. Relatively early cutting, then, — before many of the heads are brown, — is desirable, both because a better rowen crop will be secured and because the clover will persist in the mowing longer.

Good weather is essential for the satisfactory making of clover hay, as it is, indeed, for the satisfactory making of any hay; but it is far more important in the case of the clovers than for timothy, on account of the fact that the clovers need much more drying. The best hour in the day for cutting, as it appears to me, is late in the afternoon. Whatever the hour, it is essential to keep in mind the fact that in the curing of clover hay it should be handled but little after it begins to dry. It is generally well understood that too much handling as the crop dries results in the breaking off of the leaves and heads, which are the most valuable portion of the crop. Whatever the hour of cutting, then, the fact should be kept in mind that this crop should be tedded but little in curing. If cut late in the afternoon, the crop may be tedded once the following forenoon. If the weather is particularly fine, it will then be ready to rake and put into cocks late in the afternoon of the same day. If the clover is curing more slowly, it may be best to leave it in windrows over one night, and to turn these carefully with the fork the next forenoon, and to cock on the afternoon of the second day after cutting. The use of hay caps in curing clover hay should be more general. It is desirable to leave the clover in the cock for a number of days, sometimes as long as a week. The hay is coarse, and if exposed to rain it is badly damaged unless the cocks are protected by caps. When examination shows that the clover in the cock is apparently cured, it should be slightly opened and turned up from the bottom on the forenoon of a good day. It will then be ready to put in in the afternoon. Clover hay cured in this manner should hold substantially all its leaves and heads, and should cure of a bright green color. Such clover is one of the most valuable forage crops, whether for cattle, sheep or horses. Well-cured clover hay, popular opinion to the contrary notwithstanding, is a safe and valuable food for horses, which will need much less grain when fed such hay than when timothy hay is used.

BULLETIN No. 135. NOVEMBER 1910.

MASSACHUSETTS
AGRICULTURAL EXPERIMENT
STATION.

INSPECTION OF
COMMERCIAL FERTILIZERS

BY

H. D. HASKINS, L. S. WALKER and J. F. MERRILL.

This bulletin gives a detailed report of the fertilizer inspection for 1910. It summarizes the main points of the fertilizer law, states the number of fertilizers collected and analyzed, gives the trade values of fertilizer ingredients, discusses valuations, retail cash prices and percentages of difference. It makes clear the economy of buying only high grade fertilizers by showing the cost per pound of the several elements in the different grades. Mention is made of all brands showing a noticeable commercial shortage and the tables of analyses give the detailed composition of all fertilizers sold in Massachusetts.

Requests for bulletins should be addressed to the
Agricultural Experiment Station,
Amherst, Mass.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

AMHERST, MASS.

COMMITTEE ON EXPERIMENT STATION.

STATION STAFF.

William P. Brooks, Ph.D.,	*Director and Agriculturist.*
Joseph B. Lindsey, Ph.D.,	*Vice Director and Chemist.*
George E. Stone, Ph.D.,	*Botanist.*
Frank A. Waugh, M. Sc.,	*Horticulturist.*
J. E. Ostrander, C. E.,	*Meteorologist.*
James B. Paige, D. V. S.,	*Veterinarian.*
Henry T. Fernald, Ph.D.,	*Entomologist.*
Fred C. Sears, M. Sc.,	*Pomologist.*
Burton N. Gates, Ph.D.,	*Apiarist.*
Edward B. Holland, M. Sc.,	*Associate Chemist* (Research Sec.).
Fred W. Morse, M. Sc.,	*Research Chemist* (Research Sec.).
Henri D. Haskins, B. Sc.,	*Chemist in Charge* (Fertilizer Sec.).
Philip H. Smith, B. Sc.,	*Chemist in Charge* (Feed and Dairy Sec.).
Henry J. Franklin, Ph.D.,	*Assistant Entomologist* (Cranberry Investigations).
Erwin S. Fulton, B. Sc.,	*Assistant Agriculturist.*
Edwin F. Gaskill, B. Sc.,	*Assistant Agriculturist.*
George H. Chapman, B. Sc.	*Assistant Botanist.*
Sumner C. Brooks, B. Sc.,	*Assistant Botanist.*
Lewell S. Walker, B. Sc.,	*Assistant Chemist.*
James C. Reed, B. Sc.,	*Assistant Chemist.*
Joseph F. Merrill, B. Sc.,	*Assistant Chemist.*
Clement L. Perkins, B. Sc.,	*Assistant Chemist.*
J. K. Shaw, M. Sc.,	*Assistant Horticulturist.*
D. W. Anderson, B. Sc.,	*Assistant in Horticulture.*
Arthur I. Bourne, B. A.,	*Assistant in Entomology.*
James T. Howard,	*Inspector.*
James R. Alcock,	*Assistant in Animal Nutrition.*
C. M. Damon,	*Observer.*

Annual reports and bulletins on a variety of subjects are published. These are sent free on request to all interested in agriculture. Parties likely to find publications on special subjects only of interest will please indicate these subjects. Correspondence or consultation on all matters affecting any branch of our agriculture is welcomed. Communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

J. B. Lindsey, *Chemist.*

INSPECTION OF COMMERCIAL FERTILIZERS

FOR THE SEASON OF 1910.

By H. D. Haskins, *Chemist in Charge.*
Assisted by
L. S. Walker and J. F. Merrill.

Abstracts of Fertilizer Law.

The Massachusetts fertilizer law requires that all fertilizers or fertilizer materials sold, offered or exposed for sale within the Commonwealth shall (1) be properly branded; (2) contain the name and address of the manufacturer including location of factory; (3) bear a statement of the number of net pounds of fertilizer contained in each package; (4) and a chemical analysis stating—

(*a*) The guaranteed percentage of nitrogen,

(*b*) The guaranteed percentage of potash soluble in distilled water,

(*c*) The guaranteed percentage of phosphoric acid, soluble in water, reverted, as well as the available and total phosphoric acid.

The law also requires that before any fertilizer is sold, offered or exposed for sale, a certified copy of the above be filed with the director of this station. Furthermore, it is a misdemeanor to guarantee a *larger percentage* of any one or more of the fertilizer elements mentioned than is actually contained in the fertilizer; or to sell, offer or expose for sale any pulverized leather, hair or wool waste,—raw, steamed or roasted—as a fertilizer or as an ingredient of any fertilizer without the fact being stated in a conspicuous manner on every package, parcel or lot of the same.

In all cases where a fertilizer or fertilizer material does not contain soluble and available nitrogen, phosphoric acid and potash, but consists of other and cheaper materials, a printed label shall accompany every package of such fertilizer and shall give a correct general statement of the composition and ingredients of said fertilizer. (This refers in particular to ground rocks and lava). Offenders against any of the above regulations are subject to prosecution.

Suitable provisions are made for the collection and analyses of all brands of fertilizer sold in the state of Massachusetts, and the publication of the results from time to time, together with such additional information as circumstances render advisable. The Acts of 1907, Chapter 289 require that in connection with the analyses, the fertilizer bulletins shall state the dealers' cash price per ton and the monetary value of the ingredients; also the percentage of difference between the said price and the said value. The full text of the fertilizer law will be furnished upon application.

Manufacturers and Brands.

During the season of 1910, 465 distinct brands of fertilizer, including agricultural chemicals and by-products, have been licensed in Massachusetts by eighty-three manufacturers, importers and dealers, including the various branches of the American Agricultural Chemical Company. Five more licenses have been issued including thirty-four more brands than during 1909. They are classified as follows:

Complete fertilizers	316
Fertilizers furnishing phosphoric acid and potash	14
Ground bone, tankage and dry ground fish	53
Chemicals and organic compounds furnishing nitrogen	82
Total	465

List of Licensees and Brands.

Following will be found a list of those who have secured licenses for the sale of fertilizer in Massachusetts for the season of 1910, accompanied by a list of brands.

W. H. Abbott, Holyoke, Mass.

Abbott's Eagle Brand,
Abbott's Animal Fertilizer,
Abbott's Tobacco Fertilizer,
Abbott's Onion Fertilizer.

The American Agricultural Chemical Co., 92 State St., Boston, Mass.

North Western Empire Special,
Tobacco Starter and Grower,
High Grade Fertilizer with 10% Potash,
Grass and Lawn Top Dressing,
Special Grass and Garden Mixture,
Nitrate of Soda,
Muriate of Potash,
High Grade Sulfate of Potash,
Plain Superphosphate,
Kainit,
Fine Ground Tankage,
Fine Ground Bone,

Dissolved Bone Black,
Dry Ground Fish,
High Grade Tobacco Manure,
Basic Slag Phosphate,
Sulfate of Ammonia,
Church's Fish and Potash "D,"
East India A.A. Ammoniated Superphosphate,
Bradley's XL Superphosphate of Lime,
Bradley's Potato Manure,
Bradley's Corn Phosphate,
Bradley's Eclipse Phosphate for All Crops,
Bradley's Potato Fertilizer,
Bradley's Complete Manure for Potatoes and Vegetables,
Bradley's Complete Manure for Corn and Grain,
Bradley's Complete Manure with 10% Potash,
Bradley's Complete Manure for Top Dressing Grass and Grain,
Bradley's Seeding Down Manure,
Bradley's Niagara Phosphate,
Bradley's English Lawn Fertilizer,
Bradley's Columbia Fish and Potash,
Clark's Cove Bay State Fertilizer,
Clark's Cove Bay State Fertilizer, G. G.,
Clark's Cove Potato Manure,
Clark's Cove Potato Fertilizer,
Clark's Cove Great Planet Manure for Potatoes, Onions, Cabbage and Market Garden Truck, A. A.
Crocker's Ammoniated Corn Phosphate,
Crocker's Potato, Hop and Tobacco Phosphate,
Cumberland Potato Fertilizer,
Cumberland Superphosphate,
Darling's Farm Favorite,
Darling's Potato Manure,
Darling's General Fertilizer,
Darling's Blood, Bone and Potash,
Darling's Potato and Root Crop Manure,
Darling's Complete 10% Manure,
Farquhar's Lawn and Garden Dressing,
Farquhar's Vegetable and Potato Fertilizer,
Farquhar's Pure Ground Bone,
Great Eastern Northern Corn Special,
Great Eastern Vegetable, Vine and Tobacco,
Great Eastern Garden Special,
Great Eastern General,
Pacific Potato Special,
Pacific High Grade General Fertilizer,
Soluble Pacific Guano,
Packers' Union Animal Corn Fertilizer,
Packers' Union Potato Manure,
Packers' Union Gardeners' Complete Manure,
Packers' Union Universal Fertilizer,
Quinnipiac Corn Manure,
Quinnipiac Phosphate,
Quinnipiac Potato Manure,
Quinnipiac Market Garden Manure,
Quinnipiac Potato Phosphate,
Read's Farmers' Friend Superphosphate,
Read's Practical Potato Special,
Read's Standard Superphosphate,
Read's Vegetable and Vine Fertilizer,
Read's High Grade Farmers' Friend Superphosphate,
Standard Fertilizer,
Standard Guano for All Crops,
Standard Complete Manure,
Standard Special for Potatoes,
Tucker's Original Bay State Bone Superphosphate,
Tucker's Special Potato Fertilizer,
Wheeler's Corn Fertilizer,
Wheeler's Potato Manure,
Wheeler's Havana Tobacco Grower,
Wheeler's Bermuda Onion Grower,
A. A. C. Co.'s Grass and Oats,
Williams & Clark's Americus Ammoniated Bone Superphosphate,
Williams & Clark's Prolific Crop Producer,
Williams & Clark's Royal Bone Phosphate for All Crops,
Williams & Clark's Americus Corn Phosphate,
Williams & Clark's Americus Potato Manure,
Williams & Clark's Potato Phosphate,
Williams & Clark's Americus High Grade Special for Potatoes and Vegetables.

American Cotton Oil Co., 27 Beaver St., New York City.

Choice Cottonseed Meal,
Prime Cottonseed Meal.

Armour Fertilizer Works, 861 Calvert Bldg., Baltimore, Md.

Grain Grower,
All Soluble,
Market Garden,
Complete Potato,
Fish and Potash,
Ammoniated Bone with Potash,
High Grade Potato,
Fruit and Root Crop Special,

Bone, Blood and Potash,
Onion Special,
Special Value,
Bone Meal.

H. J. Baker & Bro., 100 William St., New York City.

Baker's Pure Castor Pomace.

Baltimore Pulverizing Co., Baltimore, Md.

Corn and Grain Fertilizer,
Special Potato Mixture,
Market Garden,
Perfect Potato.

Beach Soap Co., Lawrence, Mass.

Beach's Top Dressing Fertilizer,
Beach's Market Garden Fertilizer,
Beach's Advance Fertilizer,
Beach's Reliance Fertilizer,
Beach's Lawn Dressing Fertilizer,
Beach's Fertilizer Bone.

Berkshire Fertilizer Co., Bridgeport, Conn.

Berkshire Long Island Special,
Berkshire Grass Special,
Berkshire Complete Fertilizer,
Berkshire Complete Tobacco Fertilizer,
Berkshire Potato and Vegetable Phosphate,
Berkshire Ammoniated Bone,
Berkshire Tobacco Special,
Berkshire Fish and Potash,
Berkshire Dry Ground Fish.

Bonora Chemical Co., 488 Broadway, New York City.

Bonora.

Bowker Fert. Co., 43 Chatham St., Boston, Mass.

Bowker's Highly Nitrogenized Mixture,
Bowker's Blood, Bone and Potash,
Bowker's Early Potato Manure,
Bowker's Lawn and Garden Dressing,
Bowker's Onion Fertilizer,
Bowker's Market Garden Fertilizer,
Bowker's Potato and Vegetable Fertilizer,
Bowker's Soluble Animal Fertilizer,
Bowker's High Grade Fertilizer,
Bowker's Complete Alkaline Tobacco Grower,
Bowker's Cranberry Phosphate,
Bowker's Corn, Grain and Grass Fertilizer,
Bowker's Fish and Potash, Square Brand.
Bowker's Hill and Drill Phosphate,
Bowker's Potato and Vegetable Phosphate,
Bowker's Farm and Garden Phosphate,
Bowker's Corn Phosphate,
Bowker's Bone and Wood Ash Fertilizer.
Bowker's Bristol Fish and Potash,
Bowker's Ammoniated Food for Flowers,
Bowker's 10% Manure,
Bowker's Sure Crop Phosphate,
Bowker's Potash Bone,
Bowker's Gloucester Fish and Potash,
Bowker's Tobacco Ash Elements,
Bowker's Fresh Ground Bone,
Bowker's Acid Phosphate,
Bowker's Nitrate of Soda,
Bowker's Sulfate of Ammonia,
Bowker's Dried Blood,
Bowker's Fine Ground Tankage,
Bowker's Muriate of Potash,
Bowker's High Grade Sulfate of Potash,
Bowker's Kainit,
Bowker's Canadian Hardwood Ashes,
Bowker's Dry Ground Fish,
Bowker's Basic Slag,
Bowker's Tobacco Starter,
Bowker's Sheep Manure,
Stockbridge's Tobacco Manure,
Stockbridge's Special Complete Manure for Top Dressing and Forcing,
Stockbridge's Special Complete Manure for Potatoes and Vegetables,
Stockbridge's Special Complete Manure for Corn and All Grain Crops,
Stockbridge's Special Complete Manure for Seeding Down, Permanent Dressing and Legumes.

Jos. Breck & Sons Corporation, 51-52 N. Market St., Boston, Mass.

Ram's Head Brand Sheep Manure,
Breck's Market Garden Manure,
Breck's Lawn and Garden Dressing.

F. W. Brodé & Co., 40 So. Front St., Memphis, Tenn.

Owl Brand Cottonseed Meal.

Buffalo Fertilizer Co., William St., Buffalo, N. Y.

Fish Guano,
Farmers' Choice,

New England Special,
Celery and Potato Special,
Vegetable and Potato,
High Grade Manure,
Buffalo Tobacco Producer,
Top Dresser,
Bone Meal,
Nitrate of Soda.

The Coe-Mortimer Co., 24-26 Stone St., New York City.

E. Frank Coe's Celebrated Special Potato Fertilizer,
E. Frank Coe's Columbian Corn and Potato Fertilizer,
E. Frank Coe's Complete Manure with 10% Potash,
E. Frank Coe's Excelsior Potato Fertilizer,
E. Frank Coe's Famous Prize Brand Grain and Grass Fertilizer,
E. Frank Coe's Gold Brand Excelsior Guano,
E. Frank Coe's H. G. Ammoniated Bone Superphosphate,
E. Frank Coe's New Englander Corn and Potato,
E. Frank Coe's Red Brand Excelsior Guano,
E. Frank Coe's Special Grass Top Dressing,
E. Frank Coe's XXV Ammoniated Bone Phosphate,
E. Frank Coe's Double Strength Potato Manure,
Peruvian Vegetable Grower (Peruvian Guano Base),
Genuine Peruvian Guano, Lobos Grade,
Thomas Phosphate Powder,
Nitrate of Soda,
Muriate of Potash,
Sulfate of Potash,
Peruvian Market Gardeners' Fertilizer,
Chincha Grade Peruvian Guano.

John C. Dow Co., 13-14 Chatham St., Boston, Mass.

Dow's Pure Ground Bone.

Eastern Chemical Co., 37 Pittsburg St., Boston, Mass.

IMP Plant Food.

Essex Fertilizer Co., 39 N. Market St., Boston, Mass.

Essex XXX Fish and Potash,
Essex Complete Manure for Potatoes, Roots and Vegetables,
Essex Market Garden and Potato Manure,
Essex Special Tobacco Manure,
Essex Complete Manure for Corn, Grain and Grass,
Essex Special Potato Phosphate,
Essex A1 Superphosphate,
Essex Lawn Dressing,
Essex Potato Grower,
Essex Grain and Grass Fertilizer,
Essex Grass and Top Dressing,
Essex Tobacco Starter and Grower,
Essex Dry Ground Fish,
Essex Ground Bone,
Essex Nitrate of Soda.

The Farmhood Corporation, 226 Newbury St., Boston, Mass.

Farmfood.

R. J. Farquhar & Co., 6-7 So. Market St., Boston, Mass.

Clay's London Fertilizer,
Thomson's Grape, Vine, Plant and Vegetable Manure,
Thomson's Special Chrysanthemum Manure.

Finch, Pruyn & Co., Glens Falls, New York.

Lime Ashes.

German Kali Works, Continental Bldg., Baltimore, Md.

Muriate of Potash,
Sulfate of Potash,
Kainit.

Green Mountain Plant Food Co., Edw. W. Gardner, 152 Perkins St., Somerville, Mass.

Green Mountain Plant Food.

W. R. Grace & Co., Hanover St., New York City.

Nitrate of Soda.

H. C. Green Co., London, Ontario, Canada.

Wood Ashes.

Chas. W. Hastings, 76 Center St., Dorchester, Mass.

Ferti-Flora.

Thomas Hersom & Co., New Bedford, Mass.

Pure Bone Meal,
Meat and Bone.

Home Soap Co., 103 Webster St., Worcester, Mass.

Pure Ground Bone.

Humphreys, Godwin & Co., Memphis, Tenn.

"Dixie Brand" Cottonseed Meal.

John Joynt, Lucknow, Ontario, Canada.

Canada Hardwood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.

Lister's Special Potato Fertilizer,
Lister's Special Corn Fertilizer,
Lister's Success Fertilizer,
Lister's 10% Potato Grower,
Lister's Potato Manure,
Lister's Special Tobacco Fertilizer,
Lister's H. G. Special for Spring Crops,
Lister's Standard Grass Fertilizer,
Lister's Grain and Grass Fertilizer,
Lister's H. G. Dry Blood,
Lister's H. G. Sulfate of Potash,
Lister's Nitrate of Soda,
Lister's Buyers' Choice Acid Phosphate.

The McCaw Manufacturing Co., Cincinnati, Ohio.

Prime Cottonseed Meal.

Jas. E. McGovern, Andover, Mass.

Andover Animal Fertilizer.

Mapes' Formula and Peruvian Guano Co., 143 Liberty St., N. Y. City.

Mapes' Potato Manure,
Mapes' Tobacco Starter, Improved,
Mapes' Tobacco Manure, Wrapper Brand,
Mapes' Economical Potato Manure,
Mapes' Vegetable or Complete Manure for Light Soils,
Mapes' Average Soil Complete Manure,
Mapes' Cauliflower and Cabbage Manure,
Mapes' Corn Manure,
Mapes' Grass and Grain Spring Top Dressing,
Mapes' Lawn Top Dressing,
Mapes' Complete Manure, "A" Brand,
Mapes' Cereal Brand,
Mapes' Complete Manure 10% Potash,
Mapes' Fruit and Vine Manure,
Mapes' Top Dresser, Imp. Half Strength,
Mapes' Tobacco Ash Constituents,
Mapes' Complete Manure for General Use,
Mapes' Dissolved Bone,
Mapes' Complete Manure for Heavy Soils,
Mapes' Nitrate of Soda,
Mapes' Double Manure Salt.

The Geo. E. Marsh Co., Lynn, Mass.

Ground Tankage,
Pure Bone Meal.

W. L. Mitchell, New Haven, Conn.

Lime Kiln Ashes.

D. M. Moulton, Monson, Mass.

Ground Bone.

Geo. L. Munroe & Sons, Oswego, N. Y.

Pure Unleached Wood Ashes.

National Fertilizer Co., 92 State St., Boston, Mass.

Chittenden's Complete Corn and Grain Fertilizer,
Chittenden's Fine Ground Bone,
Chittenden's Fish and Potash,
Chittenden's XXX Fish and Potash,
Chittenden's Market Garden Fertilizer,
Chittenden's Ammoniated Bone Phosphate,
Chittenden's H. G. Special Tobacco Fertilizer,
Chittenden's Potato Phosphate,
Chittenden's Complete Root Fertilizer,
Chittenden's Complete Tobacco Fertilizer,

Chittenden's Connecticut Valley Tobacco Grower,
Chittenden's Connecticut Valley Tobacco Starter,
Chittenden's Tobacco Special with Carbonate of Potash,
Chittenden's Dry Ground Fish,
Chittenden's Complete Grass Fertilizer,
Chittenden's Eureka Potato Fertilizer,
Chittenden's H. G. Top Dressing,
Chittenden's Plain Superphosphate,
Double Manure Salt,
H. G. Sulfate of Potash,
Muriate of Potash,
Dissolved Bone Black,
Nitrate of Soda.

Natural Guano Co., Aurora, Ill.

Pulverized Sheep Manure.

New England Fertilizer Co., 40A North Market St., Boston, Mass.

New England Corn Phosphate,
New England Potato Fertilizer,
New England H. G. Potato Fertilizer,
New England Corn and Grain Fertilizer,
New England Potato Grower,
New England Superphosphate.

New England Mineral Fertilizer Co., 19 Exchange Place, Boston, Mass.

New England Mineral Fertilizer.

Nitrate Agencies Co., 64 Stone St., New York City.

Nitrate of Soda,
Muriate of Potash,
Sulfate of Potash,
Acid Phosphate.

Olds & Whipple, Hartford, Conn.

Olds & Whipple's Complete Onion Fert.
Olds & Whipple's Complete Tobacco Fert.
Olds & Whipple's Complete Grass Fert.
Olds & Whipple's Complete Corn and Potato,
Olds & Whipple's Dry Ground Fish,
Olds & Whipple's H. G. Potato Fert.
Olds & Whipple's Fish and Potash,
Olds & Whipple's Castor Pomace,
Olds & Whipple's Tankage,
Olds & Whipple's Acid Phosphate.
Olds & Whipple's Sulfate of Potash,
Olds & Whipple's Muriate of Potash,
Olds & Whipple's Nitrate of Soda,
Olds & Whipple's Cottonseed Meal,
Bone Meal,
Carbonate of Potash.

Parmenter & Polsey Fert. Co., Boston, Mass.

Parmenter & Polsey Plymouth Rock Brand,
Parmenter & Polsey Special Potato Fert.
Parmenter & Polsey "A.A." Brand,
Parmenter & Polsey Potato Fertilizer,
Parmenter & Polsey Potato Grower,
Parmenter & Polsey Star Brand Superphosphate,
Parmenter & Polsey Aroostook Special,
Parmenter & Polsey Grain Grower.

Patrons' Co-operative Association, 19 Exchange Place, Boston, Mass.

Tankage,
Thomas Phosphate Powder,
Ground Bone,
Sulfate of Potash,
Muriate of Potash,
Acid Phosphate,
Nitrate of Soda,
Fertilizer 4-7-10.
Dry Ground Fish.

R. T. Prentiss, Granby, Mass.

R. T. Prentiss' Top Dressing,
R. T. Prentiss' for Potatoes and Roots,
R. T. Prentiss' for Corn and Grain.

The Pulverized Manure Co., 28 Exchange St., Chicago, Ill.

Wizard Brand Pulverized Manure.

W. W. Rawson & Co., Boston, Mass.

Rawson's Ground Bone,
Rawson's Lawn and Garden Dressing.

The Rogers Manufacturing Co., Rockfall, Conn.

All Round Fertilizer,
Complete Potato and Vegetable,
Complete Corn and Onion,
Fish and Potash,
H. G. Oats and Top Dressing,
Pure Fine Ground Bone,
Pure Knuckle Bone Flour,
H. G. Tobacco and Potato,
H. G. Grass and Grain,

H. G. Tobacco Grower,
H. G. Soluble Tobacco Manure,
Dry Ground Fish,
Acid Phosphate,
Muriate of Potash,
H. G. Sulfate of Potash,
Nitrate of Soda.

The Rogers & Hubbard Co., Middletown, Conn.

Hubbard's Bone Base Oats and Top Dressing,
Hubbard's Bone Base Grass & Grain Fert. and Fruit,
Hubbard's Bone Base Soluble Tobacco Manure,
Hubbard's Bone Base Soluble Potato Manure,
Hubbard's Bone Base Soluble Corn and General Crops,
Hubbard's Bone Base New Market Garden Phosphate,
Hubbard's Bone Base Potato Phosphate,
Hubbard's Bone Base Complete Phosphate,
Hubbard's Bone Base Pure Raw Knuckle Bone Flour,
Hubbard's Bone Base Strictly Pure Fine Bone.

Ross Bros. Co., 88 Front St., Worcester, Mass.

H. G. Potato and Vegetable Fertilizer,
Corn, Grass and Grain,
Potato and Vegetable Fertilizer,
Odorless Lawn Dressing.

N. Roy & Son, South Attleboro, Mass.

Roy's Complete Animal Fertilizer.

Salisbury Cutlery Handle Co., Salisbury, Conn.

Bone Dust.

Sanderson Fertilizer & Chemical Co., New Haven, Conn.

Sanderson's Formula "A,"
Sanderson's Formula "B,"
Sanderson's Top Dressing for Grass and Grain,
Sanderson's Potato Manure,
Sanderson's Special with 10% Potash,
Sanderson's Corn Superphosphate,
Sanderson's Atlantic Coast Bone, Fish and Potash,
Sanderson's Fine Ground Fish,
Sanderson's Blood, Bone and Meat,
Sanderson's Plain Superphosphate,
Nitrate of Soda,
Muriate of Potash,
Double Sulfate of Potash,
Sulfate of Potash,
Castor Meal.

M. L. Shoemaker & Co., Ltd., Philadelphia, Penn.

"Swift-Sure" Superphosphate,
"Swift-Sure" Bone Meal,
"Swift-Sure" Truck, Corn and Onions.

J. E. Soper Co., Chamber of Commerce, Boston, Mass.

Choice Cottonseed Meal.

Springfield Rendering Co., Springfield, Mass.

Ground Tankage,
Ground Steamed Bone,
Ground Raw Bone.

Thos. L. Stetson, Randolph, Mass.

Pure Ground Bone.

A. T. Story & Co., Taunton, Mass.

Chas. Stevens' Canada Wood Ashes.

E. P. Swan Co., South Deerfield, Mass.

Lime Ashes.

Swift's Lowell Fertilizer Co., 40 N. Market St., Boston, Mass.

Swift's Lowell Lawn Dressing,
Swift's Lowell Special Grass Mixture,
Swift's Lowell Dissolved Bone and Potash,
Swift's Lowell Potato Manure,
Swift's Lowell Empress Brand,
Swift's Lowell Sterling Phosphate,
Swift's Lowell Perfect Tobacco Grower,
Swift's Lowell Seeding Down Fertilizer,
Swift's Lowell Special Potato Fertilizer,
Swift's Lowell Potato Phosphate,
Swift's Lowell Bone Fertilizer,
Swift's Lowell Animal Brand,
Swift's Lowell Ground Bone,
Swift's Lowell Tobacco Manure,
Swift's Lowell Superior Fertilizer with 10% Potash,

Swift's Potato Grower,
Swift's Market Garden Manure,
Swift's Special Corn and Vegetable Manure,
Nitrate of Soda,
Acid Phosphate,
Muriate of Potash,
Ground Tankage,
H. G. Sulfate of Potash.

W. G. Todd, East Bridgewater, Mass.

Ground Pigeon Manure.

A. L. Warren, Northboro, Mass.

Warren's Pure Ground Bone.

Whitman & Pratt Rendering Co., Lowell, Mass.

Whitman & Pratt's Corn Success,
Whitman & Pratt's All Crop,
Whitman & Pratt's Potato Manure,
Whitman & Pratt's Potato Plowman,
Whitman & Pratt's Vegetable Grower,
Whitman & Pratt's Potash Special,
Whitman & Pratt's Ground Bone,
Nitrate of Soda,
Acid Phosphate,
Sulfate of Potash,
Dried Blood,
Dissolved Bone Black.

Wilcox Fertilizer Co., Mystic, Conn.

Wilcox Potato, Onion and Vegetable Phosphate,
Wilcox Grass Fertilizer,
Wilcox H. G. Tobacco Special,
Wilcox Complete Bone Superphosphate,
Wilcox Potato Fertilizer,
Wilcox Fish and Potash,
Wilcox Nitrate of Soda,
Wilcox Dry Ground Fish,
Wilcox Muriate of Potash,
Wilcox Dry Ground Acidulated Fish.

Sanford Winter Estate, Brockton, Mass.

Pure Ground Bone.

A. H. Wood & Co., Framingham, Mass.

Wood's B. B. Fertilizer,
Wood's S. P. Fertilizer,
Wood's 7 7 7 Fertilizer.

J. M. Woodard, Greenfield, Mass.

Unground Tankage.

Worcester Rendering Co., Auburn, Mass.

Ground Tankage.

Fertilizers Collected. With but few exceptions, representative samples of every brand of fertilizer sold in the state have been secured. The fertilizers listed in the tables of analyses as "manufacturer's samples" were certified samples sent by the manufacturers at our request because our inspectors had failed to find representative samples of the same in the general markets. All other samples were taken by an authorized agent from the experiment station. As comprehensive a collection as possible has been made in the limited time at our disposal, and with the means available for the work. A smaller number of samples was collected this year than during the previous season, as it seemed desirable to have the results of analyses published earlier in order that these results might be in the hands of the farmer sufficiently early for him to use as a reference in selecting his goods for the succeeding year.

The collection work was in charge of Mr. James T. Howard, the regular assistant, who has had years of experience in collecting samples of both fertilizers and feeds in the Massachusetts markets, assisted by Mr. A. B. Harris. As a general rule an effort has been made to collect representative samples of the various brands in different parts of the state and to make one analysis of a composite sample, made up of equal weights of the various samples. It is believed that this will prove more representative than an analysis of a single sample. In all cases, at least 10 per cent of the number of bags found present were sampled; in cases where only a small amount of any particular brand was found in stock, a larger percentage of the bags was sampled (often 50 to 100 per cent), and in no case were less than five bags sampled without the fact being stated on the guaranty slip which is sent to the station laboratory with every brand of fertilizer sampled.

One hundred and fourteen towns were visited during the season and samples of fertilizer taken from 291 different agents. Eight hundred and ninety samples have been drawn, representing 487 distinct brands. This includes a larger number of brands than was actually licensed. Some of the brands represent private formulas which the farmers have had manufactured for their own use, and which do not require the payment of an analysis fee. The analyses of such brands will be found in the bulletin in a table by themselves, immediately following the table of analyses of fertilizers which furnish only phosphoric acid and potash.

Fertilizers Analyzed. A total of 612 analyses has been made in connection with the inspection of 1910. They may be grouped as follows:

Complete fertilizers	418
Fertilizers furnishing phosphoric acid and potash, such as ashes, etc.	21
Ground bones, tankage and fish	71
Nitrogen compounds including blood, castor pomace, cottonseed meal, etc., also the mineral sources of nitrogen	50
Potash compounds	32
Phosphoric acid compounds	20
Total	612

These analyses have been made very carefully and in accordance with methods adopted by the Association of Official Agricultural Chemists.

The analysis of a composite sample has been made whenever possible and in instances where such an analysis has shown a brand to be seriously deficient in one or more plant food elements, a new portion has been drawn from each original sample collected and a separate analysis made. This was done to determine whether the shortage was confined to one sample or whether all of the samples participated in the deficiency. Twelve such analyses have been made on five composites.

On the last page of the bulletin will be found the results of the analyses of 12 samples of "lava" so-called; they are interpreted on a subsequent page.

Trade Values of Fertilizing Ingredients. The following table of trade values of fertilizer ingredients has been used in this state for the season of 1910. It was adopted by the experiment stations of New England, New Jersey and New York, at a meeting held in March, 1910. For purposes of comparison the 1909 schedule is also given.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1909 AND 1910.

	Cents per pound. 1909	1910
Nitrogen.		
In ammonia salts	.17	16
In nitrates	.16½	16
Organic nitrogen in dry and fine ground fish, meat, blood and in high grade mixed fertilizers	.19	20
Organic nitrogen in fine* bone and tankage	.19	20
Organic nitrogen in coarse* bone and tankage	.14	15
Phosphoric Acid.		
Soluble in water	4	4½
Soluble in neutral ammonium citrate solution (reverted phosphoric acid)†	3½	4
In fine* ground bone and tankage	3½	4
In coarse* bone and tankage	3	3½
In cottonseed meal, linseed meal, castor pomace and ashes	3	3½
Insoluble (in neutral ammonium citrate solution) in mixed fertilizers	2	2
Potash.		
As sulfate, free from chlorides	5	5
As muriate (chloride)	4¼	4¼
As carbonate	8	8

* Fine and medium bone and tankage are separated by a sieve having circular openings 1/50 of an inch in diameter. Valuations of these materials are based upon degree of fineness as well as upon composition.

† Dissolved by a neutral solution of ammonium citrate, sp. gr. 1.09, in accordance with method adopted by Association of Official Agricultural Chemists.

These trade values represent the average pound cost for cash at retail, of the various ingredients as furnished by unmixed raw materials and chemicals, in large markets in New England and New York for the six months preceding March 1st, 1910. They will also be found to correspond fairly with the average wholesale quotations of raw materials and chemicals as found in trade publications for the six months preceding March 1st, plus about 20 per cent. As may be seen from the tables, the values for the mineral forms of nitrogen (nitrate of soda and sulfate of ammonia) have been somewhat lower than for the previous year; consequently this has led to a more general use of these forms of nitrogen than ever before. Nitrogen from organic sources has been higher than for the season of 1909. The values for phosphoric acid are ½ cent higher than for the previous season. There was no material change in the values of the various forms of potash.

Valuations and Retail Cash Prices.

In determining the valuations which appear in the tables of analyses, the water soluble nitrogen has been valued as coming from nitrate of soda and sulfate of ammonia at 16 cents per pound. The organic nitrogen has been valued at 20 cents per pound. The soluble, reverted and insoluble phosphoric acid have been valued respectively at 4½, 4 and 2 cents per pound. The potash, when present as sulfate, has been valued at 5 cents and wherever sufficient chlorine has been found present to unite with all of the potash, the latter has been valued at 4¼ cents. Some brands of tobacco fertilizer have had carbonate of potash as a potash source. In such cases, if no soluble chlorides or sulfates were found present, the potash has been valued at 8 cents per pound. If soluble chlorides or sulfates have been found, the potash has been proportioned and valued as chlorides, sulfate or carbonate, as the case might be.

In the valuations published, it must be assumed that the various elements of plant food are derived from high grade products. This may not always be the case as the methods employed do not indicate the availability of the organic portion of the nitrogen; methods, however, are being perfected so that this may be done. The valuations published do not show the agricultural value of a given brand but rather the *cash cost at centers of distribution of amounts of nitrogen, phosphoric acid and potash* as supplied in unmixed standard chemicals and raw materials, equivalent to the *amounts* of said elements found in a ton of the fertilizer or brand in question. To illustrate:

A purchase is made of different materials to mix a ton of fertilizer analyzing 4% nitrogen, 8% available phosphoric acid, and 10% potash. These materials may be approximately:

210 lbs.	sulfate of potash (high grade),
1150 "	acid phosphate,
200 "	nitrate of soda,
440 "	dried blood.
2000 lbs.	

The cost of these materials at retail, unmixed, in Boston may have been $32.00 which would represent about the so-called "commercial valuation" of a brand of similar composition found in the tables of analyses. This sum, however, does not represent the entire cost to the purchaser for to it must be added the cost of transportation, possible regrinding, mixing and bagging. In case the above article was factory mixed and placed on sale in the general markets, it would be necessary to add the additional item of local agent's commission, long credits, depreciation of factory plants, interest and profits. The entire sum approximates the agent's retail cash price. Great care and pains are taken to procure the agents' cash prices published and in most instances they have been verified over the agent's signature through correspondence.

Percentage of Difference. The percentage excess of the average retail cash price per ton over the computed or commercial value of each fertilizer; i. e., *the percentage of difference*, is published to conform to our state law.. As has been repeatedly pointed out, this percentage of difference should not be interpreted as representing the profit which the manufacturer makes on his fertilizer. It must include not only the profit but all other expenses connected with the manufacture and delivery of the goods such as grinding, mixing, bagging, transportation, agents' profits, long credits, interest and depreciation of factory plants. The "percentage of difference" column, as published, becomes a convenient method of comparing the commercial worth of fertilizers of the *same grade and cost*, and usually indicates fairly the most economical fertilizer to purchase.

Comparison of Grades of Fertilizer. For the convenience of study and comparison the complete licensed fertilizers may be divided into three grades: (*a*) those having a commercial value of $18 or less per ton classed as low grade of which 67 brands occur; (*b*) those having a commercial value between $18 and $24 classed as medium grade, representing 120 brands; (*c*) those having a commercial value of over $24 per ton classed as high grade, representing 151 brands. The following table shows the average comparative commercial values, the average cash prices, the *money difference* between the valuation and selling price, and the average percentage excess of the selling price over the valuation or *percentage of difference.*

	High Grade		Medium Grade		Low Grade	
	1909	1910	1909	1910	1909	1910
Average ton valuation	$27.63	$28.81	$20.69	$21.04	$15.32	$15.61
Average cash price per ton	$39.05	$38.40	$33.85	$33.51	$29.51	$27.80
Average money difference	$11.42	$ 9.59	$13.16	$12.47	$14.19	$12.19
Percentage difference	41.33	33.28	63.61	59.26	92.62	78.08

The following table shows the average composition of the complete commercial fertilizers, according to grade, as sold in the Massachusetts markets during 1910.

GRADE	Number of Brands	Per Cent of Whole Number	Per Cent of Nitrogen	Per Cent of Phosphoric Acid			Per Cent of Potash	Lbs. of Available Plant Food in 100 Lbs. of Fertilizer
				Soluble	Reverted	Available		
High	151	44.67	4.22	3.88	3.26	7.14	7.63	18.99
Medium	120	35.50	2.65	4.86	2.81	7.67	5.06	15.38
Low	67	19.83	1.77	4.55	2.46	7.01	3.06	11.84

A study of the above tables shows:

(1). That the percentage difference or percentage excess of the selling price over the valuation in the low grade fertilizer is over twice what it is in the high grade goods.

(2). That with a 38 per cent advance in price over the low grade fertilizer, the high grade furnishes *over* 84 per cent increase in commercial value.

(3). The average high grade fertilizer with a 14.6 per cent advance in price over the medium grade goods, furnishes about 23 per cent more plant food and about 37 per cent increase in commercial value.

(4). That with a 38 per cent advance in price over the low grade fertilizer, the high grade furnishes more than 78 per cent increase in available plant food.

(5). The medium grade goods cost about 20 per cent more than the low grade goods and furnish over 34 per cent greater commercial value.

(6). That the per cent of nitrogen and potash is very much higher in the high grade goods than in the low or medium grade.

(7). A ton of the average high grade fertilizer furnishes about 49 lbs. more nitrogen, 2½ more available phosphoric acid and 91 more of actual potash than does a ton of the low grade goods.

(8). A ton of the average high grade fertilizer furnishes about 31 lbs. more nitrogen and about 51 lbs. more potash than does a ton of the medium grade goods.

Table showing the comparative pound cost of nitrogen, potash and phosphoric acid in its various forms in the three grades of fertilizer.

ELEMENT	Low Grade Fertilizer	Medium Grade Fertilizer	High Grade Fertilizer
Nitrogen	35.62	31.85	26.66
Potash (as muriate)	7.57	6.77	5.67
Soluble phosphoric acid	8.01	7.17	6.00
Reverted phosphoric acid	7.12	6.37	5.33
Insoluble phosphoric acid	3.56	3.19	2.67

This table emphasizes the marked increase in the cost of plant food wherever the low and medium grade fertilizers are purchased. It shows that nitrogen has cost 8.96 cents, available phosphoric acid about 2 cents, and potash 1.9 cents per pound *more* in the average low grade fertilizer than in the average high grade goods. It shows that nitrogen has cost 5.19 cents, the available phosphoric acid 1.11 cents and the potash 1.10 cents *more* per pound in the average medium grade goods than in the average high grade fertilizer. A comparison with the previous year shows that more high grade brands have been sold this season than for 1909. There is, however, altogether too large a proportion of low and medium grade brands sold at present (55.33% of the whole). It is evident that too many purchasers select a fertilizer for its low cost and without much regard to the plant food which they are getting. The object in buying a fertilizer should be to get the largest amount of plant food in the proper form and proportion for the least money. The high grade goods approach as near this ideal as is possible in case of factory mixed fertilizers. It costs just as much to *freight*, *cart* and *handle* the low grade fertilizers as it does the high grade. Nitrogen and potash in low grade fertilizers cost from a third to a half more than if obtained from high grade goods. *The farmer cannot afford to buy low grade fertilizers.*

The general summary of results of analyses of the complete fertilizers in comparison with the manufacturers' guarantees is set forth in the following table:

MANUFACTURER	No. of brands analyzed	No. with all three elements equal to guarantee	No. equal to guarantee in commercial value	No. with one element below guarantee	No. with two elements below guarantee	No. with three elements below guarantee
W. H. Abbott	3	1	3	1	1	
American Agr'l. Chem. Co.	78	55	75	19	3	1
Armour Fert. Works	11	11	11	–		
Baltimore Pulverizing Co.	4		2	4		
Beach Soap Co.	5	3	5	2		
Berkshire Fert. Co.	8	6	8	2		
Bonora Chemical Co.	1		1	1		
Bowker Fert. Co.	30	21	27	7	2	
Joseph Breck & Sons, Corp.	3	1	3	2		–
Buffalo Fert. Co.	8	1	6	6	1	
Coe-Mortimer Co.	13	6	10	3	3	1
Eastern Chemical Co.	1	1	1			
Essex Fert. Co.	12	4	10	5	3	
R. & J. Farquhar	3	1	3	2		
The Green Mt. Plant Food Co.	1	1	1			
C. W. Hastings	1		1	1		
Lister's Agr'l. Chem. Works	6	3	6	3		
James E. McGovern	1		1	1		
Mapes' Form. & Peru. Guano Co.	17	6	17	9	2	
National Fert. Co.	14	8	12	3	3	
New England Fert. Co.	6	3	5	2		1
Olds & Whipple	6	4	6	1	1	
Parmenter & Polsey Fert. Co.	8	1	7	4	3	
R. T. Prentiss	1		1	2	1	1
Pulverized Manure Co.	2	1	2		1	
W. W. Rawson & Co.	1	1	1			
Rogers Mfg. Co.	9	3	9	5	1	
Rogers & Hubbard Co.	8	6	8	2		
Ross Bros. Co.	3	2	3	1		
N. Roy & Son	1	1	1			
Sanderson Fert. & Chem. Co.	6	5	6		1	
M. L. Shoemaker & Co., Ltd.	1	1	1			
Swift's Lowell Fert. Co.	17	1	15	9	2	2
W. G. Todd	1	1	1			–
Whitman & Pratt Rend. Co.	5		5	1	1	
Wilcox Fert. Works	6	5	6	1		
A. H. Wood & Co.	3	–	3	2	1	–

The above table shows that 306 distinct brands of licensed complete fertilizers have been collected and analyzed.

1. That 140 brands (45.75 per cent of the whole number analyzed) fell below the manufacturer's guarantee in one or more elements.

2. That 104 brands were deficient in one element.
3. That 30 brands were deficient in two elements.
4. That 6 brands were deficient in all three elements.
5. That 24 out of the 306 brands (7.85 per cent of the whole number) showed a commercial shortage; that is, they did not show the amount and value of the plant food as expressed by the lower guarantee, although the values of any overruns were used to offset shortages.

The deficiencies were divided as follows:

60 brands were found deficient in nitrogen,
80 " " " " " available phosphoric acid.
71 " " " " " potash.

When the data furnished by the above summary are compared with those of previous years, it is clear that greater care has been exercised on the part of the manufacturers, the guarantees being more generally maintained. More brands were deficient in potash than during the previous year which fact may be due to the shortage in the supply of potash salts, occasioned by a disagreement among the companies forming the potash syndicate and to a subsequent interference by the German government. The brands having a commercial shortage were much fewer in number than for 1909 and the amount or value of the shortages was much less as may be seen from the following table:

COMMERCIAL SHORTAGES IN MIXED COMPLETE FERTILIZERS FOR 1910 AS COMPARED WITH THE PREVIOUS YEAR.

Commercial Shortages.	Number of Brands. 1910.	1909.
Over $4.00 per ton	none	4
Between $3.00 and $4.00 per ton	none	2
" $2.00 and $3.00 " "	none	5
" $1.00 and $2.00 " "	6	11
Under $1.00 not less than 25 cts. per ton	18	35

There were a few brands showing rather serious deficiencies in some element of plant food, but which did not suffer a commercial shortage on account of an overrun of some other ingredient. Such brands, of course, may be seriously out of balance and while not excusable, the manufacturer evidently had no intention to defraud.

Quality of Plant Food.

As a general rule the potash and phosphoric acid were furnished in the forms guaranteed.

It is hoped that methods of analysis may soon be perfected so that it will be possible to indicate the relative availability of the organic nitrogen in mixed fertilizers. The importance of this may, in a measure, be realized when it is remembered that nearly 45 per cent of the nitrogen used in the complete fertilizers this year was derived from organic sources. It may be remarked, however, that more mineral nitrogen has been used during the year than in the past. The relatively low cost of nitrate of soda and sulfate of ammonia will probably account for this fact. Nitrogen derived from nitrate of soda is quickly available and is more easily lost by leaching so that it would hardly be advisable nor economical to use it as the only source of nitrogen.

Brands Showing a Commercial Shortage of Over 50 Cents Per Ton.

American Agricultural Chemical Co., Boston, Mass.—Standard Complete Manure, No. 867. Nitrogen found 3.12%, guaranteed 3.29%; available phosphoric acid found 7.81%, guaranteed 8%; potash found 6.86%, guaranteed 7%.

Williams & Clark's Americus High Grade Special, No. 876. Nitrogen found 3.10%, guaranteed 3.29%; available phosphoric acid found 7.58%, guaranteed 8%; potash found 7.03%, guaranteed 7%.

Read's High Grade Farmers' Friend Superphosphate, No. 806. Nitrogen found 2.78%, guaranteed 3.29%; available phosphoric acid found 6.91%, guaranteed 6%; potash found 8.96%, guaranteed 10%.

Bowker Fertilizer Co., Boston, Mass.—Stockbridge's Special Complete Tobacco, No. 219. Nitrogen found 5.10%, guaranteed 5.76%; available phosphoric acid found 4.95%, guaranteed 4.00%; potash found 9.98%, guaranteed 10%.

Stockbridge's Special Complete Tobacco, No. 864. Nitrogen found 5.52%, guaranteed 5.76%; available phosphoric acid found 5.10%, guaranteed 4%; potash found 8.49%, guaranteed 10%.

Stockbridge's Special Complete Tobacco, No. 143. Nitrogen found 5.75%, guaranteed 5.76%; available phosphoric acid found 4.34%, guaranteed 4%; potash found 9.48%, guaranteed 10%.

Buffalo Fertilizer Co., Buffalo, N. Y.—Buffalo Celery and Potato Special, No. 667. Nitrogen found 1.66%, guaranteed 1.60%; available phosphoric acid found 8.55%, guaranteed 8%; potash found 8.16%, guaranteed 10%.

Essex Fertilizer Co., Boston, Mass.—Essex Tobacco Starter and Grower, No. 242. Nitrogen found 3.86%, guaranteed 4%; available phosphoric acid found 4.13%, guaranteed 4%; potash found 5.12%, guaranteed 6%.

Essex Lawn Dressing, No. 701. Nitrogen found 3.96%, guaranteed 4%; available phosphoric acid found 5.86%, guaranteed 7%; potash found 6.90%, guaranteed 6%.

National Fertilizer Co., Boston, Mass.—Chittenden's High Grade Special Tobacco, No. 251. Nitrogen found 5.21%, guaranteed 5.76%; available phosphoric acid found 6.38%, guaranteed 5%; potash found 9.36%, guaranteed 10%.

Parmenter & Polsey Fertilizer Co., Boston, Mass.—Parmenter & Polsey A. A. Brand, No. 766. Nitrogen found 3.89%, guaranteed 4.10%; available phosphoric acid found 7.07%, guaranteed 7%; potash found 8%, guaranteed 8%.

R. T. Prentiss, Holyoke, Mass.—Prentiss' Top Dressing, Nos. 600–603–705. Nitrogen found 5.34%, guaranteed 5.76%; available phosphoric acid found 6.03%, guaranteed 6.00%; potash found 8.35%, guaranteed 8.00%.

Prentiss' Complete for Potatoes, Nos. 599–604. Nitrogen found 3.28%, guaranteed 3.30%; available phosphoric acid found 7.51%, guaranteed 8%; potash found 9.36%, guaranteed 10%.

Swift's Lowell Fertilizer Co., Boston, Mass.—Swift's Lowell Corn and Vegetable, No. 584. Nitrogen found 3.12%, guaranteed 3.29%; available phosphoric acid found 7.65%, guaranteed 8%; potash found 6.72%, guaranteed 7%.

Phosphate and Potash. Two samples of phosphate and potash have shown a commercial shortage of over 50 cents per ton. They are as follows:

Bowker's Tobacco Ash Elements, No. 772. Available phosphoric acid found 7.58%, guaranteed 6%; potash found 10.52%, guaranteed 15.00%.

E. Frank Coe's Prize Brand Grass and Grain, No. 823. Available phosphoric acid found 9.03%, guaranteed 10%; potash found 2.07%, guaranteed 2%.

Wood Ashes. Thirteen samples of wood ashes have been analyzed, of which one was found deficient in potash and two in phosphoric acid, although none of the samples showed a commercial shortage. The three samples listed under H. C. Green & Co., Importers, and represented by Nos. 889, 891 and 892, were simply guaranteed "Pure wood ashes." The agent for three cars of these ashes, Ross Bros. Co., Worcester, Mass., stated that the ashes were of such poor quality that no charge would be made for them. Under present conditions of price and quality, the purchase of wood ashes is of questionable economy. They should never be bought without a guarantee of potash, phosphoric acid and lime.

Ground Rock. The Farmhood Corporation of Boston, Mass., has offered a product called "Farmfood," which is unquestionably a ground mineral. It was guaranteed 2% phosphoric acid and 5% potash, both "in bond" meaning presumably associated with silica and not soluble. An analysis reveals the presence of 2.55% phosphoric acid, of which only .38% was available (dissolved by neutral citrate of ammonia). Only .56% of potash was found soluble in boiling water and only .66% was found soluble in dilute hydrochloric acid. The commercial value of the product was $1.65 per ton, which would hardly pay cartage.

The New England Mineral Fertilizer Co.* of Boston, Mass., has put out a product called "New England Mineral Fertilizer," which is apparently largely ground rock. The material was guaranteed .23% phosphoric acid and 1.50% potash. Our analysis showed .18% of phosphoric acid, .10% water soluble potash and

* The New England Mineral Fert. Co. of 19 Exchange Place, Boston, should not be confused with the New England Fert. Co., of 40 North Market St., Boston. The latter is an old, reliable company which has done business in Massachusetts for many years and disclaims any connection with the New England Mineral Fert. Co.

.35% of potash soluble in dilute hydrochloric acid. The plant food in a ton of this material values at 24 cents although $17.00 is the advertised price in ton lots. Aside from the guarantee of potash and phosphoric acid the firm makes a claim for a given percentage of soda, lime, magnesia, iron, sulfur, silica, chlorine and alumina. Although some of these elements are essential to the growth of plants, yet they are found in most soils in sufficient quantities to meet the needs of growing vegetation so that they have no particular significance in this connection. The extravagant claims made by the company for this "New England Mineral Fertilizer" are overdrawn and bordering somewhat upon the ridiculous.

Unmixed Fertilizers.

Ground Bone. Thirty-nine samples of ground bone have been inspected and analyzed. Nine were found deficient in phosphoric acid and five in nitrogen. None of the brands, however, showed a commercial shortage of 50 cents per ton. The average retail cash price for ground bone has been $31.13 per ton, the average valuation $29.75, and the percentage difference 4.64.

Ground Tankage. Twelve samples of tankage have been analyzed. Four were found deficient in nitrogen and four in phosphoric acid. The average retail cash price per ton was $31.82, the average valuation per ton $31.28, and the percentage of difference 1.73. Nitrogen in fine tankage has cost on the average 20.34 cents, while nitrogen in coarse tankage has cost 15.25 cents per pound. Two samples have shown a commercial shortage of over 50 cents per ton. They are as follows:

Geo. E. Marsh & Co., Lynn, Mass.—Ground Tankage, No. 392. Nitrogen found 5.22%, guaranteed 6.99%; phosphoric acid found 12.86%, guaranteed 11.44%.

Ground Tankage, No. 517. Nitrogen found 5.55%, guaranteed 6.58%; phosphoric acid found 13.67%, guaranteed 14.00%.

Dissolved Bone. Two samples of dissolved bone have been analyzed and both were up to the guarantee placed upon them. The average retail cash price per ton has been $29.67, the average valuation $26.17, and the percentage difference 13.37.

Dry Ground Fish. Twenty-three samples of dry ground fish have been examined, of which five were found deficient in nitrogen and four in phosphoric acid. The average retail cash price per ton was $39.65, the average valuation $38.89, and the percentage difference 1.95. Nitrogen from dry ground fish has cost on the average 20.39 cents per pound. Two brands have been analyzed which show a commercial shortage of over 50 cents per ton. They are as follows:

Chittenden's Dry Ground Fish, No. 6. Nitrogen found 7.80%, guaranteed 8.23%; phosphoric acid found 7.70%, guaranteed 6%.

Rogers Mfg. Co.'s Dry Ground Fish, No. 223-256. Nitrogen found 7.87%, guaranteed 8.20%; phosphoric acid found 5.59%, guaranteed 5%.

Sulfate of Ammonia. Two samples of sulfate of ammonia have been analyzed and found well up to the guarantee. The average cost of the pound of nitrogen in this form has been 15.65 cents.

Nitrate of Soda. Sixteen samples of nitrate of soda have been analyzed and only one was found deficient in nitrogen. The average cost of nitrogen per pound in this form has been 16.56 cents.

Whitman & Pratt's Nitrate of Soda, No. 233, showed a commercial shortage of over 50 cents per ton. It was guaranteed 15.63% nitrogen and only 15.27% was found.

Dried Blood. Three samples of this material were examined, two of the brands showing a considerable overrun and one a slight deficiency in nitrogen, the latter containing, however, considerable phosphoric acid. The average cost of nitrogen from blood has been 20.16 cents per pound.

Castor Pomace. Six samples of castor pomace have been inspected and the guarantee was maintained in each instance. The average cost of nitrogen in this form has been 22.29 cents per pound.

Cottonseed Meal. Nineteen samples of cottonseed meal used for fertilizer have been examined. These were licensed by six companies doing business in Massachusetts. Nitrogen from cottonseed meal has cost on the average 28.47 cents per pound. Seven out of the nineteen samples analyzed showed a commercial shortage amounting to over 50 cents per ton. They are as follows:

American Cotton Oil Co.'s Cottonseed Meal, No. 17. Nitrogen found 6.31%, guaranteed 6.50%.

Cottonseed Meal, No. 19. Nitrogen found 6.29%, guaranteed 6.50%.

Cottonseed Meal, No. 21. Nitrogen found 6.25%, guaranteed 6.50%.

Cottonseed Meal, No. 523. Nitrogen found 6.34%, guaranteed 6.50%.

Cottonseed Meal, No. 524. Nitrogen found 6.04%, guaranteed 6.50%.

F. W. Brode & Co.'s Cottonseed Meal, No. 20. Nitrogen found 6.22%, guaranteed 6.50%.

Humphreys, Godwin & Co.'s Cottonseed Meal, No. 529. Nitrogen found 5.92%, guaranteed 6.16%.

Carbonate of Potash. Only one sample of carbonate of potash was analyzed during the season. It sold so that the pound cost of actual potash was 7.54 cents.

High Grade Sulfate of Potash. Nine samples of high grade sulfate of potash have been examined and the potash guarantee was maintained in every instance. The pound of actual potash in this form has cost, on the average, 4.64 cents.

Potash-Magnesia Sulfate. Seven samples of double sulfate of potash and magnesia have been examined and all have been found well up to the guarantee. The pound cost of actual potash in this form has been 5.46 cents.

Muriate of Potash. Eleven samples of muriate of potash have been examined and only one deficiency was found. The pound of actual potash as muriate or chloride has cost on the average 4.06 cents.

Kainit. Two samples of kainit have been analyzed and found well up to the guarantee. The pound of actual potash from kainit has cost 4.21 cents.

Dissolved Bone Black. Three samples of dissolved bone black have been examined. Two of these were found somewhat low in available phosphoric acid, although only one showed a commercial shortage of over 50 cents per ton. The pound of available phosphoric acid from this source has cost, on the average, 5.91 cents.

The brand showing a commercial shortage was put out by the *American Agricultural Chemical Co.* and represented by No. 868. Available phosphoric acid found 14.54%, guaranteed 15%.

Acid Phosphate. Ten samples of acid phosphate have been examined, all but three being found well up to the minimum guarantee. No commercial shortages of over 50 cents per ton were noticed. The pound of available phosphoric acid from acid phosphate has cost 5.76 cents.

Basic Slag Phosphate. Five samples have been analyzed and the phosphoric acid ran low in two instances. There were no commercial shortages of over 50 cents per ton. The pound of available phosphoric acid (by Wagner's method) from basic slag has cost, on the average, 5.01 cents.

Lava Fertilizers.

On the last page of the bulletin will be found the analyses of various brands of "Lava" so-called. Although these materials have not been offered for sale in the Massachusetts markets, to our knowledge, yet in view of the fact that literature has been distributed by the Lava Company of America, located at Passaic, N. J., it has been thought best to have samples of these various products examined and the results published in order to avoid correspondence with parties in regard to their value.

The samples which have served for the analyses, were forwarded by the company who were anxious that they might be tested both in the field and laboratory. Many extravagant claims are made by the company concerning the value of the products. The analyses speak for themselves. The large amount of insoluble matter and lime would indicate some of them to be ground limestone, marl or similar natural products to which have been added various amounts of nitrate of soda and some form of organic nitrogen. The organic portion of the nitrogen shows a low availability by the alkaline-permanganate method, indicating inferior materials. Several of the samples contained sufficient nitrogen from nitrate of soda to give them considerable value. They contain very little or no phosphoric acid and with one exception (The Coba Brand), little water soluble potash. They cannot, therefore, be called complete fertilizers. Several of the samples showed the presence of free sulfur.

In calculating the relative values of the various brands it has been assumed that the organic nitrogen was derived from only high grade sources; potash was counted as derived from muriate, and the phosphoric acid was valued at the same price as when found in wood ashes (3 cents). The lime was valued the same as agricultural lime. The valuations must, therefore, be favorable to the brands in question; in other words, are somewhat higher than conditions would warrant.

Explanation of Tables of Analyses.

In the first column will be found the name and address of the fertilizer manufacturer and the names of the brands analyzed.

The second column designates the town where each sample was drawn. Where the words "manufacturer's sample" occur, a certified sample was sent on by the manufacturer at our request.

The column giving "dealer's cash price per ton" shows the cash price that was charged the consumer for one ton of fertilizer at the place where the brand was collected. There are in some instances very wide differences between the prices which were charged by various agents for the same brand. These variations have, however, been verified by the agents in writing and so are published for what they are worth.

The "valuation" column shows the retail cash cost in our large markets or centers of distribution of amounts of nitrogen, phosphoric acid and potash, equivalent to those found in one ton of the fertilizer.

The "percentage of difference" column shows the percentage excess of the retail cash price over the valuation, another manner of expressing the difference between the cash cost and the commercial valuation of the fertilizer.

The "laboratory number" is simply a reference number used in the collection and analyses of the various brands.

In the nitrogen column the water soluble nitrogen includes nitrogen as nitrates and as ammoniates, with more or less amido compounds, in case of acidulated goods, which rank with the ammonia compounds in availability. The organic nitrogen, as expressed in the tables, is that part of the total nitrogen insoluble in water. The total nitrogen includes all forms of nitrogen present.

In the phosphoric acid column the insoluble phosphoric acid is that part of the total phosphoric acid insoluble in water or a neutral solution of citrate of ammonia. The reverted phosphoric acid is that portion dissolved by a neutral solution of citrate of ammonia (specific gravity 1.09) by treating two grams of the fertilizer, previously washed with water, with 100 c.c. of the citrate solution one-half hour at 65° C. It is supposed to represent that part of the phosphoric acid insoluble in water but soluble in soil and root acids—it represents the difference between the total and the sum of the soluble and insoluble phosphoric acids. The available phosphoric acid column represents the sum of the soluble and reverted phosphoric acid.

The potash column shows the per cent of potash soluble in water; results published without an asterisk (*) indicate that the potash is present as chloride or that sufficient chlorine is present in the fertilizer to unite with all of the potash. Foot-notes indicate the amount of potash present as sulfate and carbonate.

The guarantee columns show the minimum percentage of nitrogen, total and available phosphoric acid, and potash guaranteed by the manufacturer to be present.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
W. H. Abbott, Holyoke, Mass.				
Abbott's Tobacco Fertilizer	Sunderland	$42.00	$36.99	10.89
" " "	North Hatfield	40.00		
Abbott's Onion Fertilizer	Sunderland	38.00	28.19	34.80
" Eagle Brand Fertilizer	Man'f't'r's Sample	38.00	30.07	26.37
American Agric. Chem. Co., 92 State St., Boston.				
Tobacco Starter and Grower	Sunderland	37.00	24.78	49.31
" " "	Worcester	37.50	24.31	54.26
High Grade Fertilizer with 10% Potash	Sunderland	37.50	25.27	47.41
" " " " " "	Southboro	37.00		
High Grade Fertilizer with 10% Potash	Amesbury	36.00	23.34	58.52
" " " " " "	Montague	36.00		
" " " " " "	Williamstown	39.00		
Grass and Lawn Top Dressing	Seekonk	34.00	20.32	83.71
" " " " "	Worcester	38.00		
" " " " "	Marlboro	40.00		
Special Grass and Garden Mixture	Concord	52.00	43.79	18.75
Church's Fish and Potash "	So. Deerfield	30.50	18.05	57.89
" " " " "	New Bedford	28.00		
" " " " "	Westport	30.00		
North Western Empire Special Manure	Seekonk	34.00	26.67	24.97
" " " " "	Seekonk	32.00		
" " " " "	New Bedford	34.00		
East India A. A. Ammoniated Superphosphate	New Bedford	35.00	20.42	71.40
Sheep Manure	Amesbury	40.00	10.36	286.10
Bradley's X L Superphosphate of Lime	Sunderland	32.00	19.37	65.20
Bradley's X L Superphosphate of Lime	New Bedford	33.00	20.15	63.77
" " " " "	Norton	32.00		
" " " " "	Marblehead	34.00		
Bradley's Potato Manure	New Bedford	33.00	21.16	49.67
" " "	Norton	32.00		
" " "	West Berlin	30.00		
Bradley's Corn Phosphate	Bradstreet	32.00	18.07	77.09
Bradley's Corn Phosphate	Amesbury	29.00	18.91	63.93
" " "	Milford	32.00		
" " "	Uxbridge	32.00		
Bradley's Eclipse Phosphate	Amesbury	28.00	14.70	90.48
" " "	Marblehead	28.00		
Bradley's Potato Fertilizer	Amherst	32.00	19.23	61.20
" " "	Westport	33.00		
" " "	Amesbury	29.00		
" " "	Norton	30.00		
Bradley's Comp. Man. for Potatoes and Vegetables	Bradstreet	40.00	25.33	57.92
Bradley's Comp. Man. for Potatoes and Vegetables	Millbury	40.00	26.70	49.81
Bradley's Comp. Man. for Corn and Grain	Bradstreet	40.00	24.84	61.03
Bradley's Comp. Man. for Corn and Grain	Sunderland	40.00	25.22	58.61
Bradley's Comp. Man. with 10% Potash	Bradstreet	41.00	25.81	58.85
Bradley's Comp. Man. with 10% Potash	Norton	40.00	25.75	55.34
Bradley's Comp. Man. Top Dress. Grass and Grain	Bradstreet	40.00	24.15	65.63
Bradley's Comp. Man. Top Dress. Grass and Grain	Amesbury	38.00	23.57	61.22

*No. 171–183 Chlorine 1.86%, equivalent to 2.46% potash, 7.87% potash as sulfate
" 157 " 1.39% " 1.84% " 5.58% " "
" 68 " .66% " .88% " 4.28% " "
" 632 " .74% " .97% " 3.94% " "
" 884 " .22% " .30% " 9.29% " "

†Total potash, associated with organic matter. Valued at 5 cts. per pound

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
174, 183	10.47	2.65	1.56	4.21	4.00	.57	6.88	4.21	11.66	10.00	7.45	8.00	10.33*	10.00
157	11.81	2.02	1.56	3.58	3.50	none	8.16	4.54	12.70	10.00	8.16	8.00	7.42*	7.00
884	10.47	1.23	1.92	3.15	2.50	1.44	6.93	5.15	13.52	12.00	8.37	9.00	9.59*	10.00
68	12.78	2.41	1.00	3.41	3.29	6.89	1.73	1.15	9.77	9.00	8.62	8.00	5.16*	4.00
632	14.94	2.40	1.08	3.48	3.29	6.42	1.60	1.22	9.24	9.00	8.02	8.00	4.91*	4.00
165, 456	12.09	1.47	1.30	2.77	2.47	5.80	1.52	1.25	8.57	7.00	7.32	6.00	9.92	10.00
387, 793, 808	12.27	1.40	1.10	2.50	2.47	4.78	1.96	1.25	7.99	7.00	6.74	6.00	9.52	10.00
346, 626, 746	9.06	3.79	.18	3.97	3.91	1.06	4.78	.84	6.68	6.00	5.34	5.00	2.78	2.00
518	5.25	7.25	.25	7.50	8.43	7.27	4.95	.28	12.50	7.25	12.22	6.25	10.56	8.25
249, 269, 303	14.89	1.41	.74	2.15	2.06	6.86	1.38	1.61	9.85	7.00	8.24	6.00	3.14	2.00
262, 287, 350	13.23	1.90	1.73	3.63	3.29	6.00	1.65	1.43	9.08	9.00	7.65	7.00	7.50	7.00
286	16.75	1.88	.91	2.79	2.47	7.33	2.34	1.38	11.05	10.00	9.67	9.00	2.05	2.00
406	26.10	—	—	1.81	3.11	—	—	—	1.30	2.07	—	—	2.21†	1.73
83	17.91	1.69	.84	2.53	2.47	7.44	1.59	1.33	10.36	10.00	9.03	9.00	2.47	2.00
280, 509, 567	15.84	1.61	1.06	2.67	2.47	6.76	2.55	1.79	11.10	10.00	9.31	9.00	2.26	2.00
283, 463, 710	13.58	1.62	.98	2.60	2.47	5.71	1.89	1.48	9.08	7.00	7.60	6.00	5.67	5.00
50	13.55	1.04	1.29	2.33	2.05	6.51	2.04	1.48	10.03	9.00	8.55	8.00	1.76	1.50
386, 645, 675	15.46	1.48	.86	2.34	2.06	7.02	2.22	1.35	10.59	9.00	9.24	8.00	2.46	1.50
404, 588	15.27	.55	.67	1.22	1.03	6.42	2.36	1.35	10.13	9.00	8.73	8.00	2.41	2.00
134, 266, 422, 470	15.00	1.27	.90	2.17	2.06	7.37	1.89	1.51	10.77	9.00	9.26	8.00	3.33	3.00
45	13.07	2.42	.98	3.40	3.29	6.22	1.95	1.17	9.34	9.00	8.17	8.00	7.10	7.00
677	14.14	2.34	1.36	3.70	3.29	5.87	2.17	1.12	9.16	9.00	8.04	8.00	7.41	7.00
47	12.98	3.11	.40	3.51	3.20	5.73	5.37	.43	11.63	13.00	11.15	12.00	4.24	3.00
86	11.93	3.20	.36	3.56	3.29	10.52	1.67	.41	12.60	13.00	12.19	12.00	3.02	3.00
44	11.51	2.77	.73	3.50	3.20	3.76	2.08	.87	6.71	7.00	5.84	6.00	10.17	10.00
513	10.72	1.90	1.31	3.21	3.29	4.46	2.15	1.25	7.86	7.00	6.61	6.00	9.65	10.00
40	10.45	4.25	.19	4.44	4.94	3.80	3.04	.69	7.53	6.00	6.34	5.00	4.30	2.50
398	11.19	4.33	.14	4.47	4.94	4.38	2.25	.87	7.50	6.00	6.63	5.00	3.60	2.50

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chem. Co. (Continued.)				
Bradley's Seeding Down Manure	Boston	$34.00	$21.26	59.92
Bradley's Niagara Phosphate	Webster	27.00	15.56	72.52
Bradley's English Lawn Fertilizer	Amesbury	55.00	24.54	101.71
" " " "	Williamstown	44.00		
Bradley's Columbia Fish and Potash	Westfield	28.00	17.55	59.54
Bradley's Columbia Fish and Potash	Man'f't'r's sample	27.50	17.44	57.68
Bradley's High Grade Tobacco Manure	Bradstreet	50.00	34.67	44.22
Clark's Cove Bay State Fertilizer	Man'f't'r's sample	32.00	23.03	38.95
Clark's Cove Bay State Fertilizer, G.G.	" "	29.50	18.59	58.69
Clark's Cove Potato Manure	" "	32.00	19.63	63.02
Clark's Cove Potato Fertilizer	Spencer	32.00	19.06	67.89
Clark's Cove Great Planet Manure A.A. Brand	Spencer	40.00	26.43	51.06
Crocker's Ammoniated Corn Phosphate	Worcester	30.00	18.75	60.00
Crocker's Potato, Hop and Tobacco Phosphate	Whitman		13.33	56.66
" " " " " "	Worcester	30.00		
" " " " " "	Princeton	29.00		
Cumberland Potato Fertilizer	N. Leominster	32.00	18.33	74.58
Cumberland Superphosphate	N. Leominster	32.00	18.42	70.09
" "	N. Wilbraham	31.00		
" "	Monson	31.00		
Darling's Potato Manure	Sunderland	33.00	22.24	48.38
Darling's Farm Favorite	Billerica	30.00	22.79	36.02
" " "	Worcester	32.00		
Darling's Complete 10% Manure	Barre Plains	39.00	26.17	49.03
Darling's General Fertilizer	Pepperell	32.00	17.25	79.71
" " "	"	30.00		
Darling's Blood, Bone and Potash	Pepperell	42.00	27.73	43.99
" " " " "	Worcester	40.00		
" " " " "	Palmer	38.00		
Darling's Potato and Root Crop Manure	Barre Plains	37.00	24.26	52.51
Farquhar's Lawn and Garden Dressing	Boston	50.00	27.83	79.66
Farquhar's Potato and Vegetable Fertilizer	Boston	45.00	24.85	31.09
Great Eastern Northern Corn Special	Chelmsford	32.00	20.67	53.17
" " " " "	Pratt's Junction	31.00		
" " " " "	Agawam	32.00		
Great Eastern Vegetable, Vine and Tobacco	Swansea	35.00	20.91	53.08
" " " " " "	Chelmsford	32.00		
" " " " " "	Billerica	30.00		
" " " " " "	Pratt's Junction	31.00		
Great Eastern General Fertilizer	Swansea	31.00	15.64	98.21
Pacific Potato Special	Newburyport	32.00	19.14	67.19
Pacific High Grade General	Montague	38.00	26.30	44.49
Pacific High Grade General	Man'f't'r's sample	38.50	26.68	44.30
Soluble Pacific Guano	Newburyport	30.00	17.22	74.22
Packer's Union Animal Corn Fertilizer	Amherst	34.00	20.87	58.12
" " " " "	Upton	32.00		
Packer's Union Potato Manure	Amherst	34.00	22.42	48.31
" " " "	Upton	32.50		
Packer's Union Gardeners' Complete Manure	Concord	37.00	24.83	49.01

No. 411 Chlorine 1.92%, equivalent to 2.55% potash, .27% potash as sulfate
" 42 " .52%, " .69% " 9.56% " "
" 754 " 2.25%, " 3.00% " 4.01% " "
" 393 " .43%, " .57% " 9.10% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
441	15.93	1.70	1.17	2.87	2.47	6.76	2.52	1.51	10.79	10.00	9.28	9.00	2.82*	2.00
725	16.09	1.08	.45	1.53	.82	6.67	1.87	2.02	10.56	8.00	8.54	7.00	2.34	1.00
405, 314	10.87	4.56	.22	4.78	4.94	3.89	2.77	.82	7.48	6.00	6.66	5.00	3.55	2.50
330	15.73	1.43	.74	2.17	1.65	6.10	1.83	1.71	9.64	6.00	7.93	5.00	2.30	2.00
369	9.14	.80	1.49	2.29	1.65	4.85	1.71	2.68	9.24	6.00	6.56	5.00	2.48	2.00
42	4.93	5.40	.31	5.71	5.76	5.33	1.20	.61	7.14	6.00	6.53	5.00	10.25*	10.00
372	12.32	.77	2.05	2.82	2.47	9.35	1.51	1.18	12.04	10.00	10.86	9.00	2.67	2.00
371	12.68	.91	1.43	2.34	2.06	6.44	2.06	2.58	11.08	9.00	8.50	8.00	1.74	1.50
373	13.72	1.26	1.21	2.47	2.47	4.91	1.53	1.88	8.32	7.00	6.44	6.00	5.14	5.00
762	15.15	1.15	1.03	2.18	2.06	7.72	1.39	1.68	10.79	9.00	9.11	8.00	2.98	3.00
754	12.72	2.39	1.08	3.47	3.29	7.02	1.32	1.35	9.69	9.00	8.34	8.00	7.04*	7.00
631	15.45	1.58	.85	2.43	2.06	7.27	1.76	1.31	10.34	9.00	9.03	8.00	1.91	1.50
539, 708, 733	16.38	1.28	.89	2.17	2.06	7.33	1.54	1.56	10.43	9.00	8.87	8.00	3.20	3.00
702	15.64	1.16	.93	2.09	2.06	7.65	.90	1.45	10.00	9.00	8.55	8.00	3.19	3.00
696, 723, 737	16.41	1.40	.88	2.28	2.06	7.56	1.60	1.81	10.97	9.00	9.16	8.00	1.90	1.50
158	20.58	1.86	1.02	2.88	2.47	6.10	1.40	1.05	8.55	7.00	7.50	6.00	6.09	5.00
570, 625	15.43	2.37	.90	2.27	2.06	6.86	1.76	1.58	10.20	9.00	8.62	8.00	4.00	3.00
666	11.04	1.81	1.54	3.35	3.29	5.36	.97	1.07	7.40	7.00	6.33	6.00	9.63	10.00
613, 624	13.33	.65	.92	1.57	1.25	6.10	2.04	1.71	9.85	7.00	8.14	6.00	4.34	3.00
605, 634, 770	12.86	2.47	1.67	4.14	4.11	6.13	1.32	1.91	9.26	8.00	7.35	7.00	7.00	7.00
658	12.26	2.68	.70	3.38	3.29	5.68	2.25	1.84	9.77	9.00	7.93	8.00	7.38	7.00
443	11.27	1.94	1.58	3.52	3.30	2.68	5.82	4.77	13.27	14.00	8.50	4.00	7.44	7.00
448	13.62	1.58	1.78	3.36	3.00	6.10	1.56	1.60	9.26	7.00	7.76	7.00	6.22	7.00
465, 679, 730	15.75	1.57	1.17	2.74	2.47	7.02	2.14	1.68	10.84	10.00	9.16	9.00	2.67	2.00
300, 507, 596, 687	15.53	1.29	.95	2.24	2.06	6.48	1.63	1.66	9.77	9.00	8.11	8.00	6.10	6.00
341	13.88	.81	.44	1.25	.82	6.03	2.16	.89	9.08	9.00	8.19	8.00	4.44	4.00
407	15.45	1.55	.71	2.26	2.06	7.37	1.68	1.79	10.84	9.00	9.05	8.00	3.12	3.00
301	12.23	2.41	1.10	3.51	3.29	6.95	1.60	1.76	10.31	9.00	8.55	8.00	7.00	7.00
370	12.78	2.06	1.29	3.35	3.29	5.61	3.33	1.70	10.64	9.00	8.94	8.00	7.69	7.00
421	16.03	1.40	.67	2.07	2.06	7.21	1.72	1.81	10.74	9.00	8.93	8.00	1.73	1.50
130, 622	15.49	1.93	.97	2.90	2.47	6.99	2.43	1.63	11.05	10.00	9.42	9.00	2.27	2.00
124, 641	14.12	1.55	.93	2.48	2.06	6.25	1.83	1.61	9.69	9.00	8.08	8.00	7.07	6.00
393	9.22	2.11	.57	2.68	2.47	4.69	1.64	.97	7.30	7.00	6.33	6.00	9.97	10.00

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agric. Chemical Co. (Continued.)				
Packer's Union Universal Fertilizer	Concord	$27.00	$16.56	66.06
" " " "	Upton	—		
" " " "	Van Deusenville	28.00		
Quinnipiac Phosphate	Seekonk	30 00	20.81	48.97
" "	Billerica	32.00		
Quinnipiac Potato Manure	Seekonk	30.00	22 19	42.68
" " "	Billerica	32.00		
" " "	N. Amherst	33 00		
Quinnipiac Market Garden Manure	Seekonk	33.50	25.73	35.05
" " " "	Seekonk	36.00		
Quinnipiac Corn Manure	N. Amherst	29.00	18.43	60.06
" " "	Springfield	30.00		
Quinnipiac Corn Manure	Man'f't'r's sample	29.50	19.78	49.14
Quinnipiac Potato Phosphate	Fall River	30.00	19.24	55.92
Read's Farmers' Friend Superphosphate	So. Deerfield	31 00	18.63	66.40
" " " "	Marlboro	—		
Read's Practical Potato Special	So. Deerfield	29 50	19.91	48.17
" " " "	Webster	29.50		
Read's Standard Superphosphate	Man'f't'r's sample	28.50	17.13	65.89
Read's Vegetable and Vine Fertilizer	South Barre	32.00	21.12	51.51
Read's Potato Manure	Marlboro	—	23.16	—
Read's H.G. Farmers' Friend Superphosphate	Greenfield	38.00	24 20	57.03
Read's H.G. Farmers' Friend Superphosphate	Man'f't'r's sample	39.50	26.39	49.68
Standard Fertilizer	Whitman	32.00	17.61	73.20
" "	Conway	29.00		
Standard Guano for all Crops	Spencer	23.00	14 83	38.17
Standard Guano for all Crops	Man'f't'r's sample	—	15 93	—
Standard Complete Manure	Man'f't'r's sample	—	23.49	—
Standard Special for Potatoes	Whitman	32.00	18.74	68.09
" " " "	Conway	31.00		
Tucker's Original Bay State Superphosphate	Concord	28.00	18 47	51.60
Tucker's Special Potato Fertilizer	Concord	30.00	18 26	64 29
Wheeler's Potato Manure	Concord	32 00	19.38	65.12
Wheeler's Havana Tobacco Grower	Agawam	36 00	24.41	47.48
" " " "	Danvers	36.00		
Wheeler's Bermuda Onion Grower	Concord	30.00	15.70	91.08
Williams & Clark's Amer. Ammo. Bone Superphos.	Southboro	32 00	20.33	57.40
Williams & Clark's Potato Phosphate	Southboro	32.00	20 36	57.17
Williams & Clark's H. G. Special	Sheffield	40.00	25.73	55.46
Williams & Clark's Americus H. G. Special	Man'f't'r's sample	—	23.51	—
Williams & Clark's Americus Potato Manure	Brockton	34.00	18 40	65 82
" " " " "	Southboro	29.00		
" " " " "	Webster	29.00		
Williams & Clark's Americus Corn Phosphate	Brockton	34.00	18.02	75.69
" " " " "	Monson	31.00		
" " " " "	Sheffield	30.00		
Williams & Clark's Royal Bone Phosphate	Brockton	29 00	18 97	104.00
" " " " "	Newburyport	28.00		
Williams & Clark's Prolific Crop Producer	Brockton	28.00	14 30	95.80
" " " " "	Worcester	28.00		

*776–847 Chlorine .66%, equivalent to .87% potash, 8.65% potash as sulfate

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid Reverted.	Phosphoric Acid Insoluble.	Phosphoric Acid Total. Found.	Phosphoric Acid Total. Guaranteed.	Phosphoric Acid Available. Found.	Phosphoric Acid Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash Guaranteed.
360, 636, 822	13.92	.81	.57	1.38	.82	5.84	2.04	1.38	9.26	9.00	7.88	8.00	5.00	4.00
299, 531	15.82	1.80	1.06	2.86	2.47	7.08	2.00	1.58	10.66	10.00	9.08	9.00	2.60	2.00
294, 569, 741	13.28	1.67	1.17	2.84	2.47	5.93	1.62	1.28	8.83	7.00	7.55	6.00	5.91	5.00
284, 289	14.17	2.35	1.13	3.48	3.29	5.91	2.25	1.10	9.26	9.00	8.16	8.00	7.21	7.00
730, 781	13.70	1.13	1.11	2.24	2.06	7.40	1.76	1.76	10.92	9.00	9.16	8.00	1.88	1.50
879	15.47	1.86	.70	2.56	2.06	5.49	2.81	1.48	9.78	9.00	8.30	8.00	3.82	1.50
400	16.64	1.33	.82	2.15	2.06	6.99	2.45	1.71	11.15	9.00	9.44	8.00	3.26	3.00
250, 734	14.05	1.39	.71	2.10	2.06	6.42	2.00	1.89	10.31	9.00	8.42	8.00	3.76	3.00
245, 726	13.94	1.02	.76	1.78	.82	5.91	1.43	1.10	8.44	5.00	7.34	4.00	7.89	8.00
874	10.63	.56	.55	1.11	.82	8.04	1.82	.96	10.82	9.00	9.86	8.00	4.83	4.00
659	13.14	1.82	.53	2.35	2.06	6.19	2.00	1.10	9.29	9.00	8.19	8.00	6.55	6.00
722	9.70	1.20	1.02	2.22	2.40	2.23	3.79	3.04	9.06	7.00	6.02	6.00	10.57	10.00
806	11.20	1.73	1.00	2.73	3.29	5.23	1.68	2.07	8.98	7.00	6.91	6.00	8.96	10.00
880	11.99	1.85	1.41	3.26	3.29	3.95	2.07	1.54	7.56	7.00	6.02	6.00	10.58	10.00
554, 802	15.17	1.42	.89	2.31	2.06	6.51	1.86	1.45	9.82	9.00	8.37	8.00	1.86	1.00
764	14.90	.81	.56	1.37	1.03	6.70	1.59	1.76	10.05	9.00	8.29	8.00	2.41	2.00
866	8.02	.83	.72	1.55	1.03	5.17	4.0	1.64	10.90	9.00	9.26	8.00	2.19	2.00
867	12.59	2.61	.51	3.12	3.29	4.34	3.47	1.45	9.26	9.00	7.81	8.00	6.86	7.00
555, 738	14.54	1.26	.84	2.10	2.06	7.21	1.98	1.45	10.64	9.00	9.19	8.00	3.18	3.00
500	15.32	1.42	.81	2.23	2.06	7.27	2.35	1.76	11.38	9.00	9.62	8.00	1.85	1.50
510	15.78	1.01	1.05	2.06	2.06	7.40	1.38	1.45	10.23	9.00	8.78	8.00	2.93	3.00
359	13.55	1.16	1.17	2.33	2.06	6.70	2.21	1.91	10.82	9.00	8.91	8.00	2.86	3.00
776, 847	8.41	2.15	.50	2.65	2.47	4.82	1.76	.97	7.55	7.00	6.58	6.00	9.52*	10.00
358	11.61	.84	.47	1.31	.82	5.93	2.19	1.40	9.52	9.00	8.12	8.00	4.09	4.00
445	15.99	1.73	1.08	2.81	2.47	6.70	2.30	2.17	11.17	10.00	9.00	9.00	2.04	2.00
454	13.79	1.48	.92	2.40	2.47	6.42	1.64	1.53	9.59	7.00	8.06	6.00	4.99	5.00
812	12.03	2.18	1.12	3.30	3.29	6.19	2.46	1.94	10.59	9.00	8.65	8.00	7.00	7.00
876	12.27	2.48	.62	3.10	3.29	3.76	3.82	1.68	9.26	9.00	7.58	8.00	7.03	7.00
374, 432, 740	14.98	1.06	1.06	2.12	2.06	7.37	1.38	1.53	10.28	9.00	8.75	8.00	2.96	3.00
385, 718, 813	12.94	1.33	1.00	2.33	2.06	6.54	2.08	1.58	10.20	9.00	8.62	8.00	1.86	1.50
384, 418	14.30	.80	.43	1.23	1.03	6.03	2.24	1.68	9.95	9.00	8.27	8.00	2.12	2.00
371, 682	14.19	.83	.44	1.27	.82	6.16	2.59	1.15	9.90	8.00	8.75	7.00	2.13	1.00

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works, Baltimore, Md.				
Armour's Grain Grower	Ipswich	$26 00	$16 55	57 10
" " "	Salem	26.00		
Armour's All Soluble	Taunton	34.00	21 53	55 60
" " "	Salem	33.00		
" " "	Marblehead	—		
Armour's Market Garden	Seekonk	33.00	26 11	34 70
" " "	Concord	35.00		
" " "	Ipswich	37.50		
Armour's Complete Potato	Fall River	26.00	19.37	57 46
" " "	So. Framingham	35.00		
Armour's Fish and Potash	Taunton	25.00	16 52	51 33
Armour's Ammoniated Bone with Potash	Fall River	24 00	17.30	60.40
" " " " "	Ipswich	28.00		
" " " " "	Salem	29.00		
" " " " "	Milford	30.00		
Armour's High Grade Potato Fertilizer	Taunton	34.00	22.33	48 92
" " " " "	Salem	34.00		
Armour's Bone, Blood and Potash	Swansea	34.00	29.60	23 31
" " " " "	Marlboro	39.00		
Armour's Fruit and Root Crop Manure	Billerica	29.00	19.65	47.53
" " " " " "	Franklin	29 00		
Armour's Onion Special	Hadley	34.00	31.03	9 57
Armour's Special Value Fertilizer	Man'f'r's sample	—	25 35	
Baltimore Pulverizing Co., Baltimore, Md.				
Market Garden Fertilizer	Mansfield	35 00	20.92	67 30
Perfect Potato Grower	Mansfield	40.00	23.42	70.79
Corn and Grain Fertilizer	Mansfield	32 00	16.02	99.75
Special Potato Mixture	Mansfield	32 00	16 21	97 41
Beach Soap Co., Lawrence, Mass.				
Beach's "Advance" Fertilizer	Lawrence	33.00	27 29	22 75
" " "	Boston	34 00		
Beach's "Reliance" Fertilizer	Lawrence	23.00	20 83	36 32
" " "	Boston	29.00		
Beach's "Market Garden" Fertilizer	Lawrence	40.00	32 90	24 62
" " " "	Boston	42 00		
Beach's "Top Dressing" Fertilizer	Lawrence	46 00	38 23	20 32
" " " "	Danvers	46.00		
Beach's "Lawn Dressing" Fertilizer	Lawrence	43 00	25 24	90 17
Berkshire Fertilizer Co., Bridgeport, Conn.				
Berkshire Complete Fertilizer	N. Hadley	30.00	24.00	25.00
Berkshire Complete Fertilizer	Sunderland	32.00		
" " "	N. Hadley	30 00	23 73	30 36
" " "	Sunderland			
Berkshire Complete Fertilizer	Somerset	33 00	24 49	34 75
Berkshire Complete Tobacco Fertilizer	N Hadley	30 00	24 35	23 20

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
	Moisture.	Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
403, 586	9.30	.68	1.16	1.84	1.65	5.91	2.67	.66	9.24	10.00	8.58	8.00	2.36	2.00
312, 579, 537	12.87	1.58	1.29	2.87	2.08	6.86	1.69	.66	9.21	9.50	8.55	8.00	4.15	4.00
273, 372, 402	11.29	2.16	1.40	3.56	3.30	6.44	1.83	.94	9.21	8.50	8.27	8.00	7.01	7.00
409	11.58	.79	1.13	1.92	1.65	4.63	2.37	1.10	8.60	10.00	7.50	7.00	6.36	6.00
430, 313	11.41	.93	1.31	2.23	2.06	4.38	1.82	2.30	8.50	7.00	6.20	6.00	2.33	2.00
410, 411, 585, 668	10.21	1.32	1.20	2.52	2.47	4.78	1.90	.59	7.27	6.50	6.68	6.00	2.61	2.00
304, 591	9.87	1.02	.77	1.79	1.65	7.03	1.64	.87	9.54	8.50	8.67	8.00	10.00	10.00
340, 686	10.01	2.37	1.85	4.22	4.11	7.02	1.50	.69	9.21	8.50	8.52	8.00	7.73*	7.00
576, 720	10.77	.70	1.24	1.94	1.65	5.49	2.77	1.43	9.69	10.50	8.26	8.00	5.55	5.00
449	10.24	2.53	.29	2.82	2.47	9.63	2.74	1.05	13.42	12.50	12.37	12.00	10.62*	10.00
850	10.21	1.77	1.50	3.27	2.88	7.88	1.10	.48	9.46	8.50	8.93	8.00	6.71*	6.00
447	6.98	2.50	.57	3.07	3.00	8.51	3.33	.43	7.27	9.00	6.84	8.00	5.47	4.00
476	10.23	2.06	.64	2.70	3.29	4.76	3.37	.77	8.90	9.00	8.13	8.00	8.21	7.00
469	11.83	1.05	.55	1.60	2.00	6.06	2.64	.51	9.21	9.00	8.70	8.00	3.18	3.00
472	8.83	1.24	.61	1.85	2.00	2.21	3.60	1.10	6.91	6.50	5.81	5.50	5.28	4.00
491, 534	9.41	2.34	1.09	3.43	2.50	8.83	4.47	3.95	12.25	10.00	8.30	8.00	7.11*	6.00
437, 527	10.43	1.64	.89	2.53	1.65	2.65	5.92	4.34	12.91	10.00	8.57	8.00	3.70	3.00
515, 552	7.77	3.94	.92	4.86	4.74	3.13	3.37	2.30	8.80	8.00	6.50	7.00	10.37*	9.75
499, 574	4.25	5.14	.77	5.91	5.76	none	4.21	4.77	8.98	7.00	4.21	4.00	15.79	15.00
504	9.02	3.77	.23	4.00	4.00	3.35	2.72	4.57	10.64	9.50	6.07	7.50	6.15	5.25
61, 93	11.25	1.32	1.71	3.03	2.50	5.10	3.19	.13	8.42	9.00	8.29	8.00	5.90*	6.00
102, 166	11.63	1.06	1.98	3.04	2.50	5.08	2.34	1.38	8.80	9.00	7.42	8.00	6.45	6.00
301	12.34	.99	1.70	2.75	2.50	5.42	3.23	1.02	9.72	9.00	8.70	8.00	7.36*	6.00
52	10.93	.91	1.80	2.71	2.50	6.06	3.56	.46	10.08	9.00	9.62	8.00	5.85*	6.00

No. 340-686 Chlorine 4.55%, equivalent to 6.04% potash, 1.69% potash as sulfate
" 449 " .65%, " .86% " 9.76% " "
" 850 " 3.44%, " 4.55% " 2.16% " "
" 491-534 " 1.43%, " 1.89% " 5.22% " "
" 515-552 " .99%, " 1.31% " 9.06% " "
" 61 " .76%, " 1.01% " 4.89% " "
" 301 " 5.00%, " 6.63% " .73% " "
" 52 " .45%, " .61% " 5.24% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Berkshire Fertilizer Co. (Concluded.)				
Berkshire Complete Tobacco Fertilizer	Sunderland	—	$25.43	25.84
" " " "	Hadley	$32.00		
Berkshire Complete Tobacco Fertilizer	N. Hadley	30.00	24.20	23.97
Berkshire Potato and Vegetable Phosphate	Whately	30.00		
" " " " "	Somerset	31.00	16.95	78.94
" " " " "	Northbridge	30.00		
Berkshire Grass Special	N. Hadley	32.00	24.30	31.69
Berkshire Grass Special	N. Hadley	36.00	25.22	42.74
Berkshire Long Island Special	Dighton	34.00	26.90	26.39
Berkshire Ammoniated Bone Phosphate	W. Bridgewater	30.00	16.40	82.93
Berkshire Fish and Potash	Hadley	27.00	18.74	44.08
Berkshire Tobacco Special	Hadley	33.00	26.65	23.83
" " "	Hadley	33.00		
Bonora Chemical Co., 584 Broadway, N. Y. City.				
Bonora	Boston	—	58.02	—
Bowker Fert. Co., 43 Chatham St., Boston, Mass.				
Stockbridge's Spec. Comp. Man. Tobacco	Sunderland	44.00	32.53	35.26
Stockbridge's Spec. Comp. Man. Tobacco	Hadley	38.00	31.70	19.87
Stockbridge's Spec. Comp. Man. Tobacco	Northampton	44.00	31.93	37.80
Stockbridge's Sp. Com. Man. Top Dress. & Forcing	Northampton	37.50		
" " " " " " " "	Taunton	39.00	27.53	39.77
" " " " " " " "	Dighton	33.95		
" " " " " " " "	Middleboro	40.00		
Stockbridge's Sp. Com. Man. Potatoes and Veg.	Northampton	37.50		
" " " " " " "	Middleboro	40.00	26.66	45.79
" " " " " " "	Bridgewater	38.00		
" " " " " " "	N. Grafton	40.00		
Stockbridge's Sp.Com.Man.Corn & all Grain Crops	Sunderland	37.50	27.44	35.75
" " " " " " " "	Sunderland	37.00		
Stockbridge's Sp.Com.Man.Corn & all Grain Crops	N. Grafton	40.00	25.62	56.13
Stockbridge's Sp.Com.Man. Per.Dress.Seed. Down	Taunton	39.00		
" " " " " " " "	Dighton	37.05	23.68	67.39
" " " " " " " "	Mansfield	38.50		
" " " " " " " "	Littleton	44.00		
Bowker's Blood, Bone and Potash	W. Peabody	41.00	29.16	40.60
Bowker's Comp. Alkaline Tobacco Grower	Sunderland	34.00	27.35	24.31
Bowker's Comp. Alkaline Tobacco Grower	Sunderland	34.00	27.65	22.97
Bowker's Early Potato Manure	Dighton	38.00	26.54	46.95
" " " "	Beverly	40.00		
Bowker's Lawn and Garden Dressing	Fall River	60.00		
" " " " "	Newburyport	60.00	23.44	155.97
" " " " "	Lawrence	—		
Bowker's Market Garden Fertilizer	Northampton	35.00	23.52	43.81
" " " "	Concord	35.00		
Bowker's Cranberry Phosphate	Man'f't'r's sample	—	20.13	—
Bowker's Soluble Animal Fertilizer	Dighton	33.25	21.78	52.66

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
	Moisture.	Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
176, 482	8.51	1.33	1.57	2.90	2.50	4.82	2.63	.99	8.44	9.00	7.45	8.00	8.43*	6.00
833	6.41	1.51	1.47	2.98	2.50	4.31	3.57	.92	8.80	9.00	7.88	8.00	6.45*	6.00
192, 308, 673	12.37	.71	1.38	2.09	1.70	2.53	3.29	1.20	7.02	7.00	5.82	6.00	4.44	4.00
51	10.75	2.80	1.94	4.74	5.00	3.44	2.10	.97	6.51	5.00	5.54	4.00	3.09	2.00
92	9.55	2.85	2.12	4.97	5.00	3.19	1.71	1.40	6.30	5.00	4.90	4.00	3.32	2.00
490	10.41	1.50	2.29	3.79	3.30	2.23	3.84	1.89	7.96	7.00	6.07	6.00	8.35	7.00
553	11.00	.20	1.41	1.61	.80	3.19	5.05	1.28	9.52	9.00	8.24	8.00	3.18	2.00
195	13.57	.65	2.01	2.66	2.46	3.93	1.41	2.14	7.48	6.00	5.34	—	3.64	3.00
200, 202	10.97	2.46	2.12	4.58	4.10	3.35	.71	1.30	5.36	4.00	4.06	3.00	6.32*	5.00
429	4.14	15.52	.15	15.67	15.00	3.93	.02	—	3.95	5.00	3.95	5.00	4.94	3.00
143	11.31	4.62	1.13	5.75	5.76	3.00	1.34	.43	4.77	5.00	4.34	4.00	9.48*	10.00
864	11.39	4.23	1.29	5.52	5.76	3.13	1.97	.56	5.66	5.00	5.10	4.00	8.49*	10.00
219	9.68	4.24	.92	5.16	5.76	3.04	2.14	1.20	6.38	5.00	5.18	4.00	9.98*	10.00
222, 310, 354, 464	12.80	3.24	1.72	4.96	4.94	2.04	3.47	1.38	6.89	6.00	5.51	4.00	6.01	6.00
217, 479, 525, 642	12.65	1.84	1.41	3.25	3.29	4.21	2.96	1.12	8.29	7.00	7.17	6.00	10.02	10.00
78, 97	10.26	2.54	.93	3.47	3.29	7.63	2.55	1.76	11.94	11.00	10.18	10.00	7.04	7.00
656	14.04	2.26	.82	3.08	3.29	6.25	4.08	.87	11.20	11.00	10.33	10.00	6.90	7.00
333, 342, 471, 623	12.91	1.38	1.13	2.51	2.47	4.34	2.60	1.66	8.60	9.00	6.94	6.00	9.52	10.00
598	13.53	1.67	2.44	4.11	4.11	5.80	2.08	1.79	9.67	8.00	7.88	7.00	7.60	7.00
64	10.18	2.12	2.19	4.31	4.11	trace	5.97	3.72	9.69	5.00	5.97	4.00	5.64*	5.00
80	9.39	2.01	2.15	4.16	4.11	1.02	4.98	4.72	10.72	5.00	6.00	4.00	5.91*	5.00
336, 597	13.06	1.78	1.41	3.19	3.29	6.83	2.08	1.68	10.59	9.00	8.91	8.00	7.91	7.00
399, 417, 451	10.97	3.57	.20	3.77	3.29	3.51	3.02	.77	7.30	8.00	6.53	4.00	6.53	5.00
223, 355	12.29	1.28	1.17	2.45	2.47	2.68	3.57	2.25	8.50	7.00	6.25	6.00	10.08	10.00
378	12.06	1.83	.87	2.70	2.47	4.95	4.19	2.40	11.54	10.00	9.14	9.00	2.38	2.00
328	16.88	1.43	1.23	2.66	2.47	6.06	3.28	1.81	11.15	9.00	9.34	8.00	4.11	4.00

*No. 176–482 Chlorine 1.90%, equivalent to 2.51% potash, 5.92% potash as sulfate
" 833 " .35%, " .45% " 6.00% " "
" 200–202 " .63%, " .84% " 5.48% " "
" 143 " .96%, " 1.28% " 8.20% " "
" 187 " .54%, " .72% " 6.76% " "
" 864 " .89%, " 1.18% " 7.31% " "
" 219 " 1.14%, " 1.52% " 8.46% " "
" 64 " .53%, " .70% " 4.94% " "
" 80 " .46%, " .51% " 5.40% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Bowker Fertilizer Co. (Continued.)				
Bowker's Potato and Vegetable Fertilizer	Northampton	$37.50		
" " " " "	Dighton	33.25		
" " " " "	Middleboro	35.00	$22.06	53.85
" " " " "	Bridgewater	30.00		
Bowker's High Grade Fertilizer	Sunderland	30.00		
" " " "	Mansfield	36.00	20 72	60.86
" " " "	Beverly	34.00		
Bowker's Corn, Grain and Grass Fertilizer	Sunderland	30.00	21.45	39.86
Bowker's Corn, Grain and Grass Fertilizer	Leominster	34.00	22 33	52.26
Bowker's Square Brand Fish and Potash	Northampton	28.00	17.38	61.10
Bowker's Tobacco Starter	Conway	33 50	21.60	55.10
Bowker's Hill and Drill Phosphate	Northampton	32 00		
" " " " "	Plymouth	34.00	20.19	63.45
Bowker's Potato and Vegetable Phosphate	Taunton	31 00		
" " " " "	Mansfield	30 00	17.60	79.94
" " " " "	Plymouth	34.00		
Bowker's Farm and Garden Phosphate	Brockton	31.00		
" " " " "	Mansfield	30 00	17.22	76.13
" " " " "	Wrentham	30.00		
Bowker's Corn Phosphate	Taunton	31.00		
" " "	Dighton	31.35	16.96	85.43
" " "	N. Grafton	32 00		
Bowker's Onion Fertilizer	Sunderland	33.00	27.49	20.04
Bowker's Onion Fertilizer	N. Amherst	33.00		
" " "	Sunderland	33.00	27.77	18.83
Bowker's Pure Sheep Manure	Northampton	25 00	15 67	59.53
Bowker's Bristol Fish and Potash	Dighton	27.55	17.26	59.62
Bowker's Gloucester Fish and Potash	Dighton	23.75		
" " " " "	Taunton	26.00	15.05	69.96
" " " " "	Wrentham	27.00		
Bowker's Bone and Wood Ash Fertilizer	Fall River	35 00		
" " " " " "	W. Newton	35 00	16.93	90.01
" " " " " "	Mansfield	26 50		
Bowker's 10% Manure	Hudson	34 00	16.61	104.70
Bowker's 10% Manure	Leominster	32 00	18.59	72.14
Bowker's Sure Crop Bone Phosphate	Lawrence	26 50		
" " " " "	Grafton	28 00	14.55	87.30
Bowker's Potash and Bone	Plymouth	27.00	15.18	77.87
Bowker's Ammoniated Food for Flowers	Boston	-	18.77	- -
Jos. Breck & Sons Corp., Boston, Mass.				
Breck's Market Garden Manure	Boston	34.00	21.07	61.37
Breck's Lawn and Garden Dressing	Boston	50.00	26.88	86.01
Ram's Head Brand Sheep Manure	Boston	35.00	12 67	176.24
Buffalo Fertilizer Co., Buffalo, N. Y.				
Buffalo Fish Guano	Webster	23.50	18.28	28.56
Farmer's Choice	Danvers	30 00		
" "	Sterling	29.00	17.45	61.43
" "	Webster	25 50		
Celery and Potato Special	Jefferson	35.00	20.34	72.08
Celery and Potato Special	Pepperell	35.00	22.54	55.28

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
	Moisture.	Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
212, 337, 487, 560	15.40	1.46	1.42	2.88	2.47	5.36	2.88	2.17	10.41	9.00	8.24	8.00	4.38	4.00
170, 474, 563	14.39	1.50	1.06	2.56	2.47	6.38	2.76	1.68	10.82	9.00	9.14	8.00	3.60	4.00
66	11.34	1.33	1.26	2.59	2.47	5.80	3.38	2.68	11.86	9.00	9.18	8.00	3.72	4.00
703	15.48	1.28	1.30	2.58	2.47	6.19	2.41	1.73	10.33	9.00	8.60	8.00	5.69	4.00
213	10.88	1.64	1.15	2.79	2.47	2.30	3.19	1.40	6.89	5.00	5.49	4.00	3.34	4.00
795	9.97	1.74	1.12	2.86	2.47	6.29	2.56	1.94	10.79	9.00	8.85	8.00	3.08*	3.00
207, 553	11.71	1.89	.77	2.66	2.47	6.83	2.74	1.71	11.28	10.00	9.57	9.00	2.40	2.00
339, 475, 540	14.45	1.44	.67	2.11	1.65	6.70	2.18	1.61	10.49	9.00	8.88	8.00	2.23	2.00
362, 483, 611	14.24	1.31	.71	2.02	1.65	6.38	2.45	1.63	10.46	9.00	8.83	8.00	2.17	2.00
329, 331, 657	13.47	1.30	.61	1.91	1.65	6.19	2.59	1.63	10.41	9.00	8.78	8.00	2.43	2.00
65	9.90	2.39	.21	2.60	2.47	6.80	6.11	1.45	14.36	13.00	12.91	12.00	7.41**	3.00
98, 150	9.21	2.41	.29	2.70	2.47	6.89	5.64	1.76	14.29	13.00	12.53	12.00	7.52*	3.00
208	10.70	-	3.11	3.11	3.11	—	—	—	2.07	2.07	—	—	1.78†	1.78
305	13.55	1.16	.75	1.91	1.65	6.44	2.80	1.51	9.75	7.00	9.24	6.00	2.25	2.00
334, 349, 638	15.17	.90	.60	1.50	.82	5.97	2.12	1.84	9.93	9.00	8.09	8.00	2.31	1.00
383, 403, 434	11.93	1.31	.76	2.07	1.65	2.40	4.90	2.88	10.18	7.00	7.30	6.00	2.91	2.00
639	12.27	1.04	.38	1.42	.82	4.46	2.56	1.30	8.32	6.00	7.02	5.00	6.09	10.00
699	14.33	1.15	.58	1.73	.82	5.36	2.52	1.15	9.03	7.00	7.88	5.00	6.22	10.00
433, 621	14.70	.73	.53	1.26	.82	5.74	2.73	1.96	10.43	9.00	8.47	8.00	2.31	2.00
559	14.21	.44	.85	1.29	.82	6.63	1.84	1.66	10.13	7.00	8.47	6.00	2.67	2.00
428	5.10	2.74	.37	3.11	2.47	.80	5.50	1.10	7.40	-	6.30	6.00	3.41*	2.00
440	15.18	1.50	1.36	2.86	2.47	6.76	1.92	1.86	10.54	10.00	8.68	9.00	2.91	2.00
461	8.37	4.73	.39	5.12	4.11	3.74	2.30	.59	6.63	6.00	6.04	5.00	5.56	5.00
460	5.78	none	2.39	2.39	2.67		—	—	1.51	1.50			2.05†	1.75
712	9.00	1.08	.69	1.77	.80	5.55	2.80	.94	9.29	10.00	8.35	9.00	5.22	2.00
580, 698, 739	9.75	.74	.82	1.56	.80	4.69	3.29	1.51	9.49	9.00	7.98	8.00	5.01*	5.00
667	13.34	.97	.69	1.66	1.60	4.82	3.73	.56	9.11	9.00	8.55	8.00	8.16	10.00
858	6.94	1.48	.54	2.02	1.60	3.95	3.48	1.17	8.60	9.00	7.43	8.00	9.01*	10.00

*No. 795 Chlorine .12%, equivalent to .16% potash, 2.92% potash as sulfate
** " 65 Potash as sulfate
* " 98-150 Chlorine .15%, equivalent to .20% potash, 7.32% potash as sulfate
" 428 " 2.25%, " 2.99% " .42% " "
" 580-698-739 " 3.29%, " 4.37% " .64% " "
" 858 " .92%, " 1.23% " 7.78% " "
†No. 208 Total potash, associated with organic matter. Valued at 5 cts. per pound

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Buffalo Fertilizer Co. (Continued.)				
Buffalo New England Special	Westport	$31.00		
" " " "	Carlisle	31 00		
" " " "	Danvers	30 00	$19 88	49.90
" " " "	Jefferson	30 00		
" " " "	Sheffield	27 00		
Buffalo Vegetable and Potato	Sheffield	32 00	22 94	39.49
" " " "	Westfield	32 00		
Buffalo High Grade Manure	Jefferson	33 00		
" " " "	Webster	38 00	28 44	34.77
" " " "	Pepperell	39 00		
Buffalo Tobacco Producer	Westfield	40.00	26 33	51.92
Buffalo Top Dresser	Peverly	40 00	31.72	29.25
" " "	Pepperell	42 00		
Coe-Mortimer Co., 24-26 Stone St., N. Y. City.				
E. Frank Coe's Celebrated Special Potato Fert.	Westfield	34.00	17 71	91.98
E. Frank Coe's Columbian Corn and Potato Fert.	New Pedford	30.00		
" " " " " " " "	Warren	28 00	17 37	72.71
" " " " " " " "	Baldwinsville	30 00		
" " " " " " " "	Westfield	32 00		
E. Frank Coe's Excelsior Potato Fert.	Dighton	38.00	21 50	76.74
E. Frank Coe's Excelsior Potato Fert.	Agawam	37 00	23 03	60.31
E. Frank Coe's H.G. Ammo. Bone Superphosphate	Grafton	31 00	18 73	73.52
" " " " " " "	Westfield	34.00		
E. Frank Coe's New Englander Corn and Potato	S. Williamstown	30 00	13 60	120.59
E. Frank Coe's Complete Manure with 10% Potash	New Pedford	35 00	21 54	62.49
" " " " " " "	Concord	—		
E. Frank Coe's Gold Brand Excelsior Guano	Dighton	36.00	20.61	74 67
" " " " " " "	Baldwinsville	36 00		
E. Frank Coe's Double Strength Potato Manure	So. Williamstown	39 50	30 65	28.87
Red Brand Excelsior Guano for Market Gardening	Concord	33 00	26 75	23.36
Genuine Peru'n Guano, Chincha Grade, Standard'd	Concord	47 00	33.25	41.35
Genuine Peruvian Guano, Lobos Grade	Concord	40.00	25 99	53 91
Peruvian Veg. Grower (Peruvian Guano Base)	Grafton	40 00	31 26	27.96
Peruvian Market Gardener's Fert. (Per. Guano Base)	Hadley	50 00	38 50	29.87
Eastern Chemical Co., 37 Pittsburg St., Boston.				
I M P Plant Food	Boston	**	90 66	—
Essex Fertilizer Co., 39 N. Market St., Boston.				
Essex XXX Fish and Potash	Easthampton	28 00		
" " " " "	Taunton	30 00	18 53	58.28
" " " " "	Warren	30 00		
Essex Complete Manure, Potatoes, Roots and Veg.	Westport	41 00		
" " " " " " "	Taunton	40.00	25 89	57 09
" " " " " " "	Leominster	41 00		
Essex Market Garden Potato Manure	So. Framingham	35 00		
" " " " "	Billerica	34.00	20 21	71 55
" " " " "	Leominster	35 00		
Essex Special Tobacco Manure	Easthampton	40 00	30 60	30.72
Essex Complete Corn, Grain and Grass	Leominster	41 00		
" " " " " "	Spencer	40 00	26 30	52.74
" " " " " "	Warren	39 50		
Essex Special Potato Phosphate	Warren	34 00	21 64	57.12
Essex AI Superphosphate	So. Framingham	30 00	12.33	119.33
" " "	Warren	26 50		

**Sold in small packages, 11 oz. for 25 cts.

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
	Moisture.	Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
276 583 592 692	14.00	1.44	.72	2.16	1.64	5.93	2.88	.99	9.30	10.00	8.81	9.00	5.12	5.00
810 821 855	10.82	1.43	1.34	2.77	2.40	3.51	3.20	1.10	7.81	9.00	6.71	8.00	7.60*	7.00
660 716 859	8.64	2.98	.98	3.91	3.30	4.59	2.56	.61	7.76	8.00	7.15	7.00	10.04*	10.00
854	8.10	1.46	2.43	3.89	4.51	2.49	2.59	1.20	6.28	6.00	5.03	5.00	7.24*	5.50
413 862	11.57	3.16	1.91	5.07	5.74	4.85	1.94	.43	7.22	7.00	6.79	6.00	8.53*	5.00
865	9.46	.56	1.18	1.74	1.65	5.87	2.49	1.48	9.84	9.00	8.36	8.00	3.93	4.00
295 750 805	8.72	.50	1.08	1.58	1.23	5.14	5.01	1.51	11.66	9.50	10.15	8.50	2.60	2.50
837 344	9.08	1.41	.97	2.38	2.47	5.17	2.18	1.43	8.78	8.00	7.35	7.00	7.24	8.00
890	8.55	1.83	.81	2.64	2.47	3.81	3.05	1.79	8.65	8.00	6.86	7.00	8.69	8.00
619 831	8.83	.74	1.41	2.15	1.85	4.46	4.04	1.45	9.95	9.00	8.50	8.00	3.41	3.00
816	11.35	.66	.60	1.26	.80	3.99	3.00	1.94	8.93	8.50	6.99	7.50	2.73	3.00
292 332	6.63	1.59	.96	2.55	2.47	3.83	1.71	.94	6.48	7.00	5.54	6.00	8.72	9.00
343 807	7.74	1.48	.98	2.46	2.47	5.27	2.59	1.12	8.98	9.00	7.86	8.00	5.52	6.00
826	11.24	.99	3.46	4.45	3.70	4.63	2.05	2.35	9.03	8.00	6.68	7.00	8.10	10.00
367	9.57	2.02	1.53	3.55	3.30	5.46	2.66	1.73	9.85	9.00	8.12	8.00	7.53	7.00
383	9.96	3.09	3.42	6.51	7.06	2.31	3.77	2.78	9.36	8.50	6.58	6.50	3.13*	2.00
390	8.70	1.20	1.90	3.10	2.90	2.21	7.18	4.95	14.34	14.00	9.39	8.00	4.94*	4.75
637	8.60	1.74	1.97	3.71	3.30	4.40	3.33	3.55	11.28	10.00	7.73	8.00	9.33*	9.00
505	10.30	4.50	1.28	5.78	5.74	3.57	5.18	1.35	10.10	9.00	8.75	8.00	11.26*	10.00
427	.41	13.00	none	13.00	13.00	25.55	.42	none	25.97	25.30	25.97	25.30	25.78†	24.60
244 320 735	8.33	.98	1.28	2.26	2.00	5.08	2.98	1.30	9.36	9.00	8.06	8.00	3.29	3.00
282 296 694	7.66	1.71	1.55	3.26	3.25	4.34	1.60	1.33	7.27	7.00	5.94	6.00	10.00	10.00
514 582 605	9.17	1.23	1.09	2.32	2.00	5.52	2.71	1.08	9.31	9.00	8.23	8.00	5.11	5.00
243	6.16	1.16	2.55	3.71	4.00	2.34	2.78	2.12	7.74	7.00	5.62	6.00	11.18*	10.00
707 753 761	8.12	1.32	1.55	3.37	3.28	4.02	2.19	1.32	7.53	7.00	6.21	6.00	9.36	10.00
747	8.85	1.19	1.29	2.48	2.46	4.80	3.11	1.46	9.46	9.00	8.00	8.00	6.12	6.00
436 749	7.54	.60	.81	1.41	1.23	3.61	2.73	1.32	7.66	8.00	6.34	7.00	2.07	2.00

*No. 821–855 Chlorine 3.82%, equivalent to 5.07% potash, 2.53% potash as sulfate
" 660–716–859 " 6.60%, " 8.77% " 1.27% " "
" 854 " .45%, " .59% " 6.65% " "
" 413–862 " 3.50%, " 4.65% " 3.93% " "
" 383 " .80%, " 1.06% " 2.12% " "
" 390 " .49%, " .66% " 4.28% " "
" 637 " .32%, " .42% " 9.41% " "
" 505 " .85%, " 1.13% " 10.13% " "
† " 427 Potash as nitrate. Valued at 5 cts. per pound. No chlorides present
* " 243 Chlorine .60%, equivalent to .80% potash, 10.38% potash as sulfate

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Essex Fertilizer Co. (Continued.)				
Essex Lawn Dressing	Leominster	$43.00	$23.94	79.58
Essex Potato Grower	Spencer	33.00	23.30	63.09
Essex Grain and Grass	So. Framingham	34.00	15.12	101.70
" " " "	Warren	27.00		
Essex Grass and Top Dressing	Sterling	44.00	27.72	55.12
" " " "	Warren	42.00		
Essex Tobacco Starter and Grower	Easthampton	35.00	23.44	49.32
R. & J. Farquhar & Co., Boston, Mass.				
Clay's London Fertilizer	Boston	90.00	20.50	339.02
Thomson's Improved Vine, Plant & Veg. Manure	Boston	**	29.40	—
Thomson's Special Chrysanthemum Manure	Boston	**	27.93	—
The Green Mount'n Plant Food Co., Somerville, Mass.				
Green Mountain Plant Food	Man'f't'r's sample	-	6.82	—
C. W. Hastings, Dorchester, Mass.				
Ferti-Flora	Boston	*	16.89	
Lister's Agricultural Chemical Works, Newark, N. J.				
Lister's High Grade Special for Spring Crops	Hadley	36.00	23.53	57.25
" " " " " " "	Amherst	38.00		
Lister's Success Fertilizer	N. Hanover	29.00	17.72	121.95
" " "	Pepperell	30.00		
" " "	Webster	29.00		
Lister's Special Corn Fertilizer	Fall River	31.50	17.42	78.93
" " " "	N. Hanover	30.00		
" " " "	Williamstown	32.00		
Lister's Special Potato Fertilizer	Fall River	31.50	17.77	75.41
" " " "	N. Hanover	30.00		
" " " "	N. Leominster	32.00		
" " " "	Amherst	31.00		
" " " "	Williamstown	32.00		
Lister's Special Tobacco Fertilizer	Amherst	31.00	20.34	52.41
Lister's Standard Grass Fertilizer	Fall River	34.00	21.25	60.00
James E. McGovern, Andover, Mass.				
Andover Animal Fertilizer	Andover	35.00	25.30	38.34
Andover Animal Fertilizer	So. Lawrence	35.00	23.37	49.76
Mapes Formula & Peruvian Guano Co., N. Y. City.				
Mapes' Potato Manure	Northampton	40.00	27.11	51.23
" " "	Taunton	42.00		
Mapes' Tobacco Starter, Improved	Northampton	39.00	24.31	58.37
" " " "	Conway	38.00		
Mapes' Fruit and Vine Manure	Taunton	43.00	23.64	77.66
" " " "	Lawrence	41.00		
Mapes' Economical Potato Manure	Boston	41.00	24.70	61.94
" " " "	Fitchburg	39.00		
Mapes' Vegetable or Complete Man. for Light Soils	Taunton	45.00	30.02	49.90
Mapes' Complete Manure for Heavy Soils	Boston	43.00	26.49	62.33
Mapes' Grass and Grain Spring Top Dressing	Northampton	42.00	27.33	58.54
" " " " " " "	Taunton	44.00		
" " " " " " "	Fitchburg	44.00		

**No. 431 Sold only in small quantities, 112 lb. bag for $7.00
* " 158 Sold only in small packages, 56 lbs. for $7.00
" 767 Sold only in small bottles

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
701	4.29	3.72	.24	3.96	4.00	4.25	1.61	.22	6.08	8.00	5.86	7.00	6.90	6.00
768	7.53	1.22	1.27	2.49	2.46	3.38	2.62	1.07	7.07	7.00	6.00	6.00	10.29	10.00
363, 731	9.25	.33	.78	1.11	.82	5.04	3.42	1.14	9.60	9.00	8.46	8.00	3.76	4.00
688, 738	9.56	1.98	1.86	3.84	4.00	4.40	2.82	1.17	8.39	8.00	7.22	7.00	8.53	8.00
242	6.01	1.10	2.76	3.86	4.00	1.34	2.79	1.25	5.38	5.00	4.13	4.00	5.12*	6.00
442	16.51	2.43	2.17	4.60	4.50	trace	2.19	5.16	7.35	8.00	2.19	.75	.25*	.25
434	10.88	1.71	2.46	4.17	3.50	4.50	3.51	3.57	11.58	12.00	8.01	8.00	6.82	7.00
458	4.01	4.08	.60	4.68	4.00	5.93	2.87	2.27	11.07	12.00	8.80	6.50	4.26*	4.50
857	19.61	.12	1.15	1.27	.70	trace	.76	.08	.84	.50	.76		1.20†	.50
767	82.98	3.30	—	3.30	3.25	3.27	—	—	3.27	3.67	3.27	3.67	3.39‡	3.30
135, 728	13.06	.35	1.00	1.35	1.65	6.44	2.67	1.43	10.54	9.00	9.11	8.00	9.77	10.00
528, 610, 727	11.67	1.11	.86	1.97	1.23	6.12	3.04	1.96	11.12	10.00	9.16	9.00	2.36	2.00
379, 572, 817	12.77	.71	1.04	1.75	1.23	5.33	2.83	2.20	10.36	10.00	8.16	9.00	3.59	2.00
419, 565, 693, 717, 825	13.29	.37	.95	1.32	1.65	5.78	3.02	1.28	10.08	9.00	8.80	8.00	3.60	3.00
729	10.30	.93	1.40	2.33	2.06	6.86	2.20	1.22	10.28	9.00	9.06	8.00	3.20*	3.00
415	15.94	1.34	1.47	2.81	2.47	6.89	2.05	2.38	11.32	10.00	8.94	9.00	2.69	2.00
122	7.92	.78	3.96	4.74	3.00	trace	3.75	3.39	7.14	6.00	3.75	5.00	3.06	3.00
503	9.30	1.25	2.49	3.74	3.00	trace	5.72	5.36	11.08	6.00	5.72	5.00	3.16	3.00
235, 318	9.06	2.99	.59	3.58	3.71	1.70	7.48	2.14	11.32	8.00	9.18	8.00	6.90*	6.00
236, 786	10.66	3.68	1.04	4.72	4.12	trace	7.18	2.80	9.98	8.00	7.18	6.00	1.57*	1.00
321, 516	14.41	1.52	.61	2.13	1.65	.77	4.87	1.38	7.02	7.00	5.64	5.00	11.30*	10.00
526, 671	8.99	2.73	.80	3.53	3.29	.51	2.81	2.73	6.05	6.00	3.32	4.00	9.11*	8.00
324	9.95	4.41	.63	5.04	4.94	.87	5.21	1.70	7.78	8.00	6.08	6.00	7.89*	6.00
535	11.59	4.30	.67	4.97	4.94	1.25	5.54	2.81	9.60	10.00	6.79	8.00	3.37‡	3.00
237, 319, 663	10.06	4.31	.67	4.98	4.94	.61	3.93	2.96	7.50	6.00	4.54	5.00	7.05	7.00

*No. 242 Chlorine .88%, equivalent to 1.17% potash, 3.95% potash as sulfate
" 442 " .09%, " .12% " .13% " "
" 458 " 1.72%, " 2.28% " 1.98% " "
†No. 857 Potash present in combination with organic matter; valued at 5 cts. per pound
‡No. 767 Potash as sulfate
* " 729 Chlorine .10%, equivalent to .13% potash, 3.07 potash as sulfate
*No. 235–318 Chlorine .44%, equivalent to .58% potash, 6.32% potash as sulfate
" 236–786 " .25%, " .39% " 1.18% " "
" 321–516 " .49%, " .66% " 10.64% " "
" 526–671 " .74%, " .99% " 8.12% " "
" 324 " .63%, " .84% " 7.05% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Mapes Formula & Peruvian Guano Co. (Continued.)				
Mapes' Complete Manure for Average Soil	Fitchburg	$39.00	$25.68	51.87
Mapes' Cauliflower and Cabbage Manure	Boston	43.00	24 32	72.70
" " " " "	Fitchburg	41.00		
Mapes' Corn Manure	Northampton	37.00		
" " "	Taunton	38.00	22 57	63.93
" " "	Lawrence	36.00		
Mapes' Lawn and Top Dressing	Taunton	34.00	13 30	146.38
Mapes' Complete Manure A Brand	Springfield	38.00	21.40	77.57
Mapes' Cereal Brand	Taunton	32.00	15 04	112.77
Mapes' Complete Manure with 10% Potash	Enfield	33.00	21.92	50.55
Mapes' Top Dressing Improved—Half Strength	Southwick	36.00	20.40	76.47
Mapes' Wrapper Brand Tobacco Manure	Conway	50 00	33 91	28.50
Mapes' Complete Manure for General Use	Taunton	40 00		
" " " " " "	Lawrence	38.00	22 13	80.75
" " " " " "	Boston	40 00		
" " " " " "	Sturbridge	42.00		
National Fertilizer Co., 92 State St., Boston, Mass.				
Chittenden's Complete Corn and Grain Fertilizer	Millis	39.50		
" " " " " "	Saundersville	38.00	26.60	45.98
" " " " " "	Warren	39.00		
Chittenden's Fish and Potash	N. Hadley	29.00	21 12	37.31
Chittenden's Fish and Potash	W. Springfield	32.00	22.92	41.80
" " " "	Hopedale	33.00		
Chittenden's XXX Fish and Potash	N. Hadley	30.00	18.93	58.06
Chittenden's XXX Fish and Potash	Sunderland	29.00	18.61	53.14
" " " " "	N. Hadley	28.00		
Chittenden's Market Garden Fertilizer	Sunderland	32.00	22 76	50.48
" " " "	Millis	36.50		
Chittenden's Ammoniated Bone Phosphate	Sunderland	27.50	16 73	64.38
Chittenden's Ammoniated Bone Phosphate	Saundersville	31.00	17 75	74 65
Chittenden's H. G. Special Tobacco Fertilizer	So. Deerfield	45 00	32 46	38.63
Chittenden's Potato Phosphate	Sunderland	30.00	21.16	41.78
Chittenden's Potato Phosphate	Millis	33.00	23.09	42.92
" " "	Warren	33.00		
Chittenden's Complete Root Fertilizer	Bradstreet	—	24.86	—
Chittenden's Complete Root Fertilizer	N. Amherst	32.00	25.67	24.66
Chittenden's Complete Root Fertilizer	N. Amherst	32.00	24.19	32 29
Chittenden's Complete Root Fertilizer	Sunderland	34.00	24.89	38.61
" " " "	"	35.00		
Chittenden's Complete Root Fertilizer	Saundersville	38.00	25.68	47.98
Chittenden's Complete Tobacco Fertilizer	N. Hadley	36.00	24.98	44.12
Chittenden's Complete Tobacco Fertilizer	N. Hadley	33.00		
" " " "	"	36.00		
" " " "	Hadley	36.00	26.21	34.30
" " " "	Sunderland	35.00		
" " " "	Bradstreet	36.00		
Chittenden's Complete Tobacco Fertilizer	Sunderland	—	25.14	—
Chittenden's Complete Tobacco Fertilizer	Amherst	33 00	26.56	24.34
Chittenden's Connecticut Valley Tobacco Grower	N. Amherst	46.00	32.21	42.81
Chittenden's Connecticut Valley Tobacco Grower	Bradstreet	—	34.38	—
Chittenden's Connecticut Valley Tobacco Grower	N. Hadley	46.00	31.58	45.66
Chittenden's Connecticut Valley Tobacco Starter	N. Amherst	46.00	36.37	26.48

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
		Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
652	10.93	3.71	.53	4.24	4.12	1.38	4.78	1.58	7.74	8.00	6.16	7.00	6.07*	5.00
549, 650	10.88	3.44	.58	4.02	4.12	.93	4.71	1.56	7.20	6.00	5.64	6.00	6.73	6.00
234, 323, 493	11.61	1.94	.79	2.73	2.47	.77	6.86	3.06	10.69	10.00	7.63	8.00	6.82	6.00
322	13.15	2.35	.25	2.60	2.47	1.40	1.44	1.20	4.04	3.50	2.84	—	2.81	2.50
778	11.04	2.06	.59	2.65	2.47	.57	10.43	1.76	12.76	12.00	11.00	10.00	3.35	2.50
348	12.80	1.23	.69	1.92	1.65	trace	4.90	3.34	8.24	8.00	4.90	6.00	3.62	3.00
852	9.60	1.87	.75	2.62	2.06	.42	2.98	1.66	5.06	5.00	3.40	3.00	11.20	10.00
828	7.50	4.60	.29	4.89	4.94	trace	2.12	1.38	3.50	4.00	2.12	2.50	2.27‡	2.00
800	9.59	4.65	1.58	6.23	6.18	trace	3.06	3.16	6.22	4.50	3.06	—	10.27*	10.50
326, 452, 536, 724	12.60	2.49	.62	3.11	3.29	.74	7.76	1.96	10.46	10.00	8.50	8.00	4.73	4.00
541, 691, 742	13.72	2.04	1.50	3.54	3.29	6.38	2.16	1.58	10.12	9.00	8.54	8.00	7.02	6.00
3	12.25	1.71	1.33	3.04	2.88	5.38	1.76	1.40	8.54	7.00	7.14	6.00	4.14	4.00
179, 643	13.01	1.35	1.95	3.30	2.38	6.00	2.01	1.33	9.34	7.00	8.01	6.00	3.84	4.00
23	12.94	1.04	1.61	2.65	2.47	5.10	1.24	1.46	7.80	6.00	6.34	5.00	3.58	3.00
82, 101	13.89	.98	1.84	2.82	2.47	3.76	1.93	1.53	7.22	6.00	5.69	5.00	3.03	3.00
151, 547	7.59	1.73	1.27	3.00	2.47	5.71	2.20	1.33	9.29	9.00	7.91	8.00	5.52	6.00
77	14.84	1.17	.74	1.91	1.65	6.99	1.14	1.56	9.69	9.00	8.13	8.00	2.60	2.00
683	14.16	1.24	.73	1.97	1.65	6.42	2.91	1.53	10.86	9.00	9.33	8.00	2.52	2.00
251	5.75	4.76	.45	5.21	5.76	5.20	1.18	.90	7.28	6.00	6.33	5.00	9.63*	10.00
90	14.29	1.63	.78	2.41	2.06	6.61	1.91	1.51	10.03	9.00	8.52	8.00	5.53	6.00
532, 759	14.06	1.59	1.02	2.61	2.06	5.77	2.23	2.02	10.02	9.00	8.00	8.00	7.22	6.00
11	13.23	2.41	.99	3.40	3.29	5.93	1.99	1.40	9.32	9.00	7.92	8.00	6.70	6.00
24	12.13	1.83	1.47	3.30	3.29	6.93	1.37	1.96	10.26	9.00	8.30	8.00	6.34	6.00
36	11.73	2.67	.69	3.36	3.29	5.68	2.51	1.91	10.10	9.00	8.19	8.00	5.89	6.00
114, 153	12.34	2.26	1.07	3.33	3.29	6.10	1.96	1.99	10.05	9.00	8.06	8.00	6.49	6.00
676	14.03	1.51	1.75	3.26	3.29	5.46	2.54	2.20	10.20	9.00	8.00	8.00	7.09	6.00
63	8.93	1.71	1.44	3.15	3.29	7.31	2.13	.56	10.00	9.00	9.44	8.00	5.35*	5.00
91, 107, 128, 160, 185	12.11	1.91	1.72	3.63	3.29	7.40	1.32	.77	9.49	9.00	8.72	8.00	5.24*	5.00
149	13.96	2.39	1.15	3.54	3.29	7.59	.58	1.17	9.34	9.00	8.17	8.00	5.17*	5.00
886	12.26	1.75	1.81	3.56	3.22	6.23	2.04	2.47	10.79	9.00	8.32	8.00	5.54*	5.00
35	9.31	1.80	2.87	4.67	4.94	trace	3.01	1.40	4.41	4.00	3.01	1.00	8.9[illegible]*	8.00
10	3.50	1.73	3.20	4.93	4.94	trace	4.16	.90	5.06	4.00	4.16	1.00	8.23*	8.00
103	10.11	1.90	3.10	5.00	4.94	trace	2.63	1.58	4.21	4.00	2.63	1.00	8.31*	8.00
33	7.71	7.32	1.85	9.17	8.23	trace	3.91	.43	4.34	4.00	3.91	3.00	2.34*	2.50

*No. 652	Chlorine .37%, equivalent to .49% potash, 5.58% potash as sulfate										
‡ " 828	Potash as sulfate										
* " 800	Chlorine .82%, equivalent to 1.09% potash, 2.70% potash as sulfate, 6.18% potash as carbonate										
" 251	"	.90%	"	1.19%	"	8.44%	"	"			
" 63	"	.49%	"	.65%	"	4.70%	"	"			
" 91-107-128-160-185	"	.24%	"	.31%	"	4.93%	"	"			
" 149	"	.22%	"	.30%	"	4.87%	"	"			
" 35	"	1.13%	"	1.50%	"	1.86%	"	"	5.54%	"	
" 10	"	.47%	"	.62%	"	.73%	"	"	6.93%	"	
" 103	"	2.13%	"	2.83%	"	1.35%	"	"	4.13%	"	
" 33	"	.43%	"	.57%	"	1.77%	"	"			
" 886	"	.56%	"	.74%	"	4.80%	"	"			

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
National Fertilizer Co. (Continued.)				
Chittenden's Connecticut Valley Tobacco Starter	N. Hadley	$46.00	$34.14	34.74
Chittenden's Connecticut Valley Tobacco Starter	Sunderland	47.00	34.37	36.75
Chittenden's Tobacco Special	N. Hadley	35 00	30.94	13.12
Chittenden's Tobacco Special	N. Amherst	35.00	28.69	22.00
Chittenden's Tobacco Special	N. Hadley	35.00	27.93	25.09
Chittenden's Tobacco Special	Sunderland	35 00	28 68	22.04
Chittenden's Tobacco Special	N. Hadley	35.00	28 71	20.76
" " "	N. Hadley	34 00		
" " "	Hadley	35.00		
Chittenden's Complete Grass Fertilizer	Millis	39.50	26.74	44.91
" " "	Leominster	38.00		
Chittenden's Eureka Potato Fertilizer	So. Deerfield	—		
" " " "	Millis	37.50	22 66	64.39
" " " "	Hopedale	37.00		
New England Fert. Co., 40A N. Market St., Boston.				
New England Corn Phosphate	Brockton	30 60	17.36	76.27
New England Potato Fertilizer	Brockton	30.60	16.63	38.21
" " " "	Southbridge	32.00		
New England High Grade Potato Fertilizer	Brockton	34.20	20.86	63.95
New England Corn and Grain Fertilizer	Southbridge	30.00	13.44	123.21
New England Potato Grower	So. Lowell	37.00	24 35	51.95
New England Superphosphate	Brockton	34.20	19 50	75.38
Olds & Whipple, Hartford, Conn.				
Olds & Whipple Complete Onion Fertilizer	N. Hadley	34.00	25 61	32.76
Olds & Whipple Complete Onion Fertilizer	N. Hadley	35.00	25.55	33.14
" " " " "	So. Deerfield	33.00		
Olds & Whipple Complete Grass Fertilizer	So. Deerfield	34.00	28.42	19.64
" " " " "	"	34.00		
Olds & Whipple Complete Tobacco Fertilizer	N. Hadley	37.00	30.17	22.64
Olds & Whipple Complete Tobacco Fertilizer	N. Hadley	36.00	28.24	27.48
Olds & Whipple Complete Tobacco Fertilizer	N. Hadley	36.50	27.03	36.26
" " " " "	Sunderland	37.00		
" " " " "	Bradstreet	37.00		
Olds & Whipple Complete Tobacco Fertilizer	Sunderland	37.00	28.35	30.51
Olds & Whipple High Grade Potato Fertilizer	So. Deerfield	37.00	29.30	26.28
Olds & Whipple Fish and Potash	N. Hadley	30.00	18.06	66.14
Olds & Whipple Complete Corn & Potato Fert.	Sunderland	34.00	27.35	24.32
" " " " " " "	Bradstreet	34 00		
Parmenter & Polsey Fert. Co., Boston, Mass.				
P. & P. Plymouth Rock Brand	Marblehead	29 00	19 83	63 54
" " " "	N. Attleboro	33 00		
" " " "	Hopedale	34.00		
" " " "	Adams	34.00		
P. & P. Special Potato Fertilizer	N. Attleboro	39.00	25 99	51 93
" " " "	Hopedale	40 00		
P. & P. A. A. Brand	So. Lowell	42 00	26 75	57.01
P. & P. Potato Fertilizer	N. Attleboro	33 00	17 10	92 98
" " "	Adams	33 00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid Reverted.	Phosphoric Acid Insoluble.	Phosphoric Acid Total. Found.	Phosphoric Acid Total. Guaranteed.	Phosphoric Acid Available. Found.	Phosphoric Acid Available. Guaranteed.	Potash (K_2O)* in 100 lbs. Found.	Potash (K_2O)* in 100 lbs. Guaranteed.
62	8.58	6.40	1.80	8 20	8.23	trace	4.01	1.17	5.18	4.00	4.01	3.00	3.09*	2 50
67	8.30	6.28	1.87	8.15	8.23	trace	4.44	.94	5.38	4.00	4.44	3.00	3.18*	2 50
4	10.55	1.95	2.81	4.76	4.53	trace	4.72	2.56	7.28	4.00	4.72	3.00	5.98*	5 50
29	10.21	1.88	2.80	4.68	4.53	trace	4.36	2.81	7.17	4.00	4.36	3.00	5.67*	5.50
55	11.37	1.59	3.25	4.84	4.53	trace	4.49	3.24	7.73	4.00	4.49	3.00	4.90*	5.50
72	9.80	2.12	2.74	4.86	4.53	none	4.77	2.31	7.58	4.00	4.77	3.00	5.35*	5.50
105, 106, 127	11.31	1.82	2.89	4.71	4.53	.68	3.02	3.67	7.37	4.00	3 70	3.00	5.78*	5 50
530, 653	11 21	2 97	1.80	4.77	4.11	2.04	2.74	1.86	6.64	7.00	4.78	6.00	6.20	5.00
254, 538, 620	12 79	1.30	1 14	2.44	2 47	4 57	2.37	1 33	8.27	7 00	6.94	6.00	8 70	10.00
378	9.22	.96	92	1.88	1.64	5.87	2.95	74	9.56	9.00	8.82	8.00	3.14	3.00
557, 751	6.51	1.06	.81	1.87	1.64	4 08	2.93	1.25	8.26	8 00	7.01	7.00	4.11	4.00
376	7.34	1.46	.99	2.45	2.46	4.97	2.64	1.40	9.01	9.00	7.61	8.00	5.99	6.00
713	7.23	.75	.68	1.43	1.23	4.08	3.06	1.30	8.44	8.00	7.14	7.00	1.93	2.00
732	7 51	1.51	1.25	2.76	2.46	3.57	2.73	1.28	7.58	7.00	6.30	6.00	10.14	10.00
380	7 63	1.64	.84	2.48	2.46	5.49	2 29	1.30	9.08	10.00	7.78	8.00	4.24	4.00
34	7.40	1.48	1.99	3.47	3.30	trace	7.34	3.09	10.43	7.00	7.34	6.00	6.82	6.50
94, 132	8 15	1.58	2 09	3.67	3 30	trace	6.56	3.34	9.90	7.00	6.56	6.00	6.52	6.50
190, 248	6.70	2.21	2 15	4.36	3.30	trace	7.69	2 72	10.41	7.00	7.69	6.00	6.25*	6.00
37	7.43	2.54	2.55	5.09	4.50	trace	4.19	.48	4.67	3.50	4.19	3.00	6.00*	5 50
59	8.85	2.97	2.11	5.08	4.50	none	3.50	.51	4.01	3.50	3.50	3.00	6.40*	5 50
104, 119, 186	8.63	2.50	2.40	4 90	4.50	none	3.26	1.20	4.46	3 50	3.26	3.00	5.62*	5 50
478	8.76	2.74	2 07	4.81	4 50	trace	3 50	58	4.08	3 50	3.50	3.00	6 20*	5.50
188	7.55	1.72	2.36	4.08	3.30	trace	5.74	2.88	8.62	7.00	5.74	6.00	9.54*	10.00
30	10.52	.37	2.20	2.57	2.50	none	4.84	3 02	7.86	6.00	4.84	5.00	3 53	3 00
113, 134	7 82	1.83	2 46	4.29	3.30	.45	5.60	2 22	8.27	7.00	6.05	6.00	6 90	6 00
534, 608, 661	8 51	1 45	.98	2.43	2 46	5 71	2.61	1 23	9.60	9 00	8 32	8.00	4 15	4 00
320, 614, 664	9.53	1.75	1 49	3 24	3.23	5 68	3.12	1.07	9.87	9.00	8.80	8.00	7.52	7 00
766	6.60	2.69	1.20	3.89	4.10	5.40	1 67	.84	7.91	8.11	7.07	7.00	8.00	8.00
607, 313	6 95	.83	.96	1.79	1.64	3.74	2.02	1 38	7 14	7.00	5 76	6.00	5 95	6 00

No. 62 Chlorine 1.57%, equivalent to 2.09% potash, 1.00% potash as sulfate
" 67 " 1.60%, " 2.12% " 1.06% " "
" 4 " .45%, " .60% " .77% " " 4.61% potash as carbonate
" 29 " .98%, " 1.31% " 2.04% " " 2.32% " "
" 55 " 1.05%, " 1.40% " 2.99% " " .51% " "
" 72 " 1.58%, " 2.10% " 1.65% " " 1.60% " "
" 105–106–127 " 1.39%, " 1.82% " 1.76% " " 2.20% " "
" 190–248 " 3.72%, " 4.95% " 1.30% " "
" 37 " .54%, " .71% " 1.27% " " 1.02% " "
" 59 " 2.23%, " 2.93% " 1.21% " " 2.23% " "
" 104–119–186 " 1.83%, " 2.43% " 1.39% " " 1.80% " "
" 478 " 1.22%, " 1.63% " .72% " " 3.85% " "
" 188 " 4.60%, " 6.11% " 3.43% " "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Parmenter & Polsey Fert. Co. (Continued.)				
P. & P. Potato Grower	Millis	$35.00	$23.09	60.24
" " "	Adams	39.00		
P. & P. Star Brand Superphosphate	Hopedale	30.00	15.70	91.08
P. & P. Aroostook Special	Adams	43.50	27.99	55.41
P. & P. Grain Grower	Adams	28.50	13.00	119.25
R. T. Prentiss, Holyoke, Mass.				
R. T. Prentiss Complete for Potatoes & Root Crops	Concord	34.00	24.99	36.05
R. T. Prentiss Complete for Top Dressing	Holyoke	41.00		
" " " " " "	Holyoke	43.00	31.66	30.54
" " " " " "	Clinton	40.00		
R. T. Prentiss Complete for Potatoes	Holyoke	36.00	27.01	33.28
" " " " "	Holyoke	36.00		
R. T. Prentiss Complete Corn and Grain	Holyoke	34.00	25.17	35.08
Pulverized Manure Co., Chicago, Ill.				
Pulverized Sheep Manure	Taunton	30.00		
" " "	Concord	30.00	12.19	157.00
" " "	Boston	34.00		
Pulverized Hog Manure	Taunton	27.00	10.44	158.62
W. W. Rawson & Co., Boston, Mass.				
Rawson's Lawn and Garden Dressing	Boston	50.00	23.21	115.42
Rogers Manufacturing Co., Rockfall, Conn.				
All Round Fertilizer	Worcester	32.00	16.62	92.54
Complete Potato and Vegetable Fertilizer	Sunderland	32.00	21.73	47 26
Complete Potato and Vegetable Fertilizer	N. Hadley	35.00	22.16	55.69
" " " " "	Hopedale	34.00		
High Grade Corn and Onion Manure	Fitchburg	37.00		
" " " " " "	Hopedale	38.00	26.24	42.26
" " " " " "	Agawam	37.00		
Fish and Potash	Taunton	29.00	21.77	33.21
High Grade Oats and Top Dressing	Sunderland	45.00	37.30	20.64
High Grade Oats and Top Dressing	Sunderland	44.00		
" " " " " "	N. Hadley	44.50	37.12	19.42
" " " " " "	Deerfield	44 50		
High Grade Oats and Top Dressing	Taunton	44.00	35.47	26.87
" " " " " "	Fitchburg	46.00		
High Grade Grass and Grain for Seeding Down	Hopedale	42.00	35.88	15.66
" " " " " " " "	Fitchburg	41 00		
High Grade Tobacco and Potato Manure	Deerfield	38 50		
" " " " " "	Fitchburg	40 00	31.64	23.26
" " " " " "	Amherst	38.50		
High Grade Soluble Tobacco Manure	N. Hadley	43.50		
" " " " "	Deerfield	43.50	37.20	18.28
" " " " "	Hadley	44.00		
" " " " "	Fitchburg	45.00		
High Grade Tobacco Grower	Hadley	39.00	29.78	29.23
" " " "	N. Hadley	38.00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs. Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
548, 809	6.50	1.15	1.16	2.31	2.46	3.51	2.29	1.48	7.28	7.00	5.80	6.00	10.81	10.00
674	10.05	.74	.98	1.72	1.64	4.59	2.07	.79	7.45	8.00	6.66	7.00	3.88	4.00
815	3.58	1.70	1.72	3.42	3.69	5.71	1.60	1.26	8.57	8.00	7.31	7.00	10.29	10.00
324	6.60	.54	.66	1.20	1.23	4.06	3.16	1.66	8.88	8.00	7.22	7.00	2.11	2.00
368	13.62	1.76	.93	2.69	2.68	6.35	1.36	.59	8.30	8.50	7.71	8.00	9.81*	10.00
600, 603, 705	10.78	3.10	2.24	5.34	5.76	4.97	1.06	.61	6.64	6.50	6.03	6.00	8.35*	8.00
599, 604	12.63	1.50	1.78	3.28	3.30	6.38	1.13	.51	8.02	8.50	7.51	8.00	9.36*	10.00
602	12.30	2.24	.99	3.23	2.88	5.97	2.68	.99	9.64	8.50	8.65	8.00	6.63*	8.00
327, 369, 550	10.70	—	2.38	2.38	1.80	—	—	—	1.30	—	—	1.00	1.76†	1.00
332	7.55	—	2.07	2.07	2.10	—	—	—	1.43	1.20	—	1.00	1.16†	1.35
457	8.47	3.58	.15	3.73	3.29	3.29	4.01	.56	7.86	5.00	7.30	4.00	5.60	5.00
630	9.32	1.02	.92	1.94	1.65	1.08	6.29	3.52	10.89	10.00	7.37	8.00	2.67	2.00
38	10.35	1.15	1.29	2.44	2.25	5.78	3.41	1.68	10.87	10.00	9.19	8.00	5.05	5.00
197, 669	10.52	1.28	1.36	2.64	2.25	5.01	3.16	2.37	10.54	10.00	8.17	8.00	5.45	5.00
655, 684, 777	8.42	2.01	1.77	3.78	3.60	2.78	3.37	3.75	9.90	8.00	6.15	6.00	7.09	7.00
307	10.89	1.59	1.98	3.57	3.25	3.23	1.88	3.62	8.73	6.00	5.11	4.00	3.41	3.75
41	6.22	4.09	2.33	6.42	6.30	2.21	5.54	2.02	9.77	9.00	7.75	7.00	9.01	7.50
115, 201, 253	6.08	4.53	2.24	6.77	6.30	2.30	4.49	3.39	10.18	8.00	6.79	7.00	7.31	7.50
317, 654	6.53	4.25	2.06	6.31	6.30	2.61	3.44	3.57	9.67	9.00	6.05	7.00	8.35	7.50
646, 670	7.53	.47	2.49	2.96	3.00	trace	11.25	6.25	17.50	16.00	11.25	—	15.20	12.50
255, 672, 229	6.32	1.35	2.84	4.19	3.50	1.51	4.54	4.56	10.61	9.00	6.05	7.00	9.26*	8.75
199, 252, 501, 651	3.75	2.34	2.84	5.18	5.00	.96	5.31	4.06	10.33	8.00	6.27	6.00	11.78*	11.00
196, 198	9.95	2.11	2.84	4.95	5.00	trace	4.06	2.88	6.94	5.00	4.06	4.00	7.42	6.00

*No. 368 Chlorine 6.11%, equivalent to 8.12% potash, 1.69% potash as sulfate
* " 600-603-705 " 5.67%, " 7.52% " .83% " "
* " 599-604 " 5.55%, " 7.38% " 1.98% " "
* " 602 " 2.51%, " 3.34% " 3.29% " "
* " 255-672-229 " .58% " .76% " 8.50% " "
* " 199-252-501-651 " .79%, " 1.05% " 10.73% " "
* " 196-198 " .78%, " 1.03% " 6.39% " "

†Total potash, associated with organic matter Valued at 5 cts. per pound

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Rogers & Hubbard Co., Middletown, Conn.				
Hubbard's Bone Base Complete Phosphate	N. Westport	30 00	17.85	64.32
" " " " "	Southboro	29.00		
" " " " "	N. Hanover	29.00		
Hubbard's Bone Base Potato Phosphate	Amherst	33.00	21.20	58 82
" " " " "	N. Westport	34.00		
" " " " "	N. Hanover	34.00		
Hubbard's Bone Base New Mark't Gar. Phosphate	Amherst	35.00	23 18	55 22
" " " " " " "	N. Westport	36 00		
" " " " " " "	N. Hanover	37.00		
Hubbard's Bone Base Sol. Corn & Gen. Crops Man.	Amherst	38.00	23 81	58 55
" " " " " " " " "	Seekonk	36.00		
" " " " " " " " "	N. Westport	38.00		
" " " " " " " " "	Southboro	39.00		
Hubbard's Bone Base Soluble Potato Manure	Amherst	44.00	30 77	43.00
" " " " " "	N. Westport	44.00		
Hubbard's Bone Base Soluble Tobacco Manure	Amherst	49.00	35.58	34.91
" " " " " "	N. Westport	47.00		
" " " " " "	Seekonk	48.00		
Hubbard's Bone Base Fruit, Grass & Grain Fert.	Amherst	44.00	30.39	44 78
Hubbard's Bone Base Fert. for Oats & Top Dress.	Amherst	7 00	39 64	46 92
" " " " " " " " "	N. Westport	58.00		
" " " " " " " " "	Seekonk	56.00		
" " " " " " " " "	N. Hanover	58 00		
Ross Bros. Co., 88-92 Front St., Worcester, Mass.				
Potato and Vegetable Fertilizer	Worcester	35.00	19 73	77 39
Corn, Grain and Grass Fertilizer	Worcester	38.00	26.61	42 80
High Grade Potato Fertilizer	Waban	35 00	28 43	23 11
N. Roy & Son, South Attleboro, Mass.				
Complete Animal Fertilizer	S. Attleboro	33.00	32 43	1 76
Complete Animal Fertilizer	Man'f't'r's sample	-	29 68	
Sanderson Fertilizer & Chemical Co., New Haven, Ct.				
Sanderson's Formula "A"	Sunderland	32 30	26.68	21 06
Sanderson's Formula "A"	Sunderland	34.00	26 28	29 38
" " "	"			
" " "	"			
Sanderson's Formula "A"	Dighton	32.50	24.16	34 52
Sanderson's Formula "B"	Sunderland	32.30	29.23	10.16
Sanderson's Formula "B"	Sunderland	32 30	29.16	10 77
Sanderson's Formula "B"	Sunderland	34.00	26.68	24.63
" " "	"	32.50		
" " "	"	-		
Sanderson's Formula "B"	Sunderland	34 00	24.76	37.32
Sanderson's Top Dressing for Grass and Grain	Sunderland	34.20	27.45	24.59
Sanderson's Special with 10% Potash	N. Amherst	32.00	26 17	22.28
Sanderson's Corn Superphosphate	Gt. Barrington	28 00	16.57	68.98
Atlantic Coast Bone, Fish and Potash	Dighton	25.00	20 92	19 52
" " " " " "	Gt. Barrington	25 00		

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Nitrogen in 100 lbs.					Phosphoric Acid in 100 lbs.							Potash (K_2O) in 100 lbs.	
				Total.					Total.		Available.			
	Moisture.	Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
352, 455, 571	10.73	.81	.70	1.51	1.50	3.48	4.46	2.04	9.98	8.00	7.94	7.00	5.31	5.00
226, 272, 566	11.67	1.34	.75	2.09	2.00	5.42	3.58	3.27	12.27	10.00	9.00	9.00	5.72	5.00
228, 261, 588	8.05	1.34	.68	2.02	2.00	3.61	3.97	1.17	8.75	7.00	7.58	6.00	10.91	10.00
227, 270, 345, 433	8.58	1.70	.96	2.66	2.50	2.65	4.47	1.73	8.85	8.00	7.12	5.50	9.26	8.00
231, 288	12.17	2.84	2.17	5.01	5.00	.89	6.26	4.08	11.23	10.00	7.15	6.60	5.68*	5.00
230, 263, 281	11.49	2.87	1.98	4.85	5.00	.55	6.87	3.60	11.02	10.00	7.42	6.60	11.18*	10.00
225, 224	6.98	.83	1.72	2.55	2.20	trace	7.35	8.14	15.49	16.00	7.35	6.50	13.78	12.00
264, 271, 564	5.63	7.35	.61	7.96	3.50	trace	5.31	4.26	9.57	8.00	5.31	4.50	9.09	8.00
633	12.92	1.05	1.09	2.14	1.65	6.06	2.31	1.15	9.52	8.50	8.37	8.00	5.00	5.00
627	10.67	.96	1.64	2.60	2.88	6.19	2.28	.20	8.67	8.50	8.47	8.00	10.41*	8.00
395	8.01	1.79	1.43	3.22	2.88	6.31	2.24	.38	8.93	8.50	8.55	8.00	10.74*	10.00
709	7.48	2.14	3.07	5.21	4.00	trace	11.33	5.10	16.43	15.00	11.33	--	2.54	3.00
769	7.61	1.34	2.96	4.30	4.00	none	8.02	9.61	17.63	15.00	8.02	--	3.87	3.00
73	11.26	2.01	1.57	3.58	3.33	5.59	2.07	1.66	9.32	9.00	7.66	6.00	7.79	6.00
87, 85, 173	12.49	2.22	1.52	3.74	3.33	5.65	1.62	1.99	9.26	9.00	7.27	6.00	6.95	6.00
420	12.48	2.52	1.04	3.56	3.33	5.52	2.41	.82	8.75	9.00	7.93	6.00	5.54	6.00
18	10.54	2.62	1.99	4.61	3.33	5.59	1.37	1.84	8.80	10.00	6.96	6.00	6.12*	6.00
69	10.21	2.50	1.70	4.20	3.33	4.97	1.76	1.89	8.62	10.00	6.73	6.00	7.84*	6.00
81, 109, 167	12.78	2.43	1.56	3.99	3.33	5.36	1.75	2.02	9.13	10.00	7.11	6.00	5.97*	6.00
492	11.14	1.92	1.38	3.30	3.33	4.38	2.12	.59	7.09	10.00	6.50	6.00	7.42*	6.00
27	12.81	3.16	1.46	4.62	4.00	5.08	1.31	1.40	7.79	7.00	6.39	7.00	5.79	7.00
353	11.61	1.99	1.18	3.17	2.47	4.18	2.64	1.45	8.27	8.00	6.82	5.00	10.15	10.00
819	10.37	.85	.95	1.80	1.67	2.30	5.38	1.56	9.24	8.00	7.68	7.00	3.60	2.00
853, 811	14.74	1.12	1.51	2.63	1.67	1.12	4.70	1.30	7.12	6.00	5.82	4.00	6.16*	4.00

No. 231-288	Chlorine	.62%,	equivalent to	.82%	potash, 4.86%	potash as sulfate
" 230 263-281	"	.69%,	"	.92%	" 10.26%,	" "
" 627	"	4.52%,	"	6.00%	" 1.41%	" "
" 395	"	6.91%,	"	9.22%	" 1.52%	" "
18	"	.51%	"	.68%	" 5.14%	" "
" 69	"	.62%,	"	.83%	" 7.01%	" "
" 81-109-167	"	1.73%,	"	2.30%	" 3.67%	" "
" 492	"	1.01%,	"	1.34%	" 6.08%	" "
" 853 811	"	.76%,	"	1.01%	" 5.15%	" "

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
M. L. Shoemaker & Co., Ltd., Philadelphia, Pa.				
"Swift-Sure" Superphosphate	Sunderland	$33.00	$26.50	24.53
"Swift-Sure" Superphosphate	Sunderland	35.00	26.92	26.30
" " "	"	33.00		
Swift's Lowell Fert. Co., 40 N. Market St., Boston.				
Swift's Lowell Bone Fertilizer	Somerset	28.00	15.97	80.78
" " " "	Millis	30.00		
" " " "	Milford	27.50		
" " " "	Spencer	30.00		
Swift's Lowell Potato Phosphate	Deerfield	32.00	21.84	55.68
" " " "	Mansfield	37.00		
" " " "	Clinton	33.00		
Swift's Lowell Animal Brand for All Crops	Sunderland	30.00	20.57	45.85
" " " " " " "	"	30.00		
Swift's Lowell Animal Brand for All Crops	Mansfield	36.00	19.39	70.19
" " " " " " "	Milford	30.00		
Swift's Market Garden Manure	Taunton	37.50	26.00	47.12
" " " "	Beverly	39.00		
Swift's Lowell Potato Manure	Millis	30 00	16.95	73.10
" " " "	Littleton	30.00		
" " " "	Milford	28.00		
Swift's Lowell Lawn Dressing	Concord	45.00	26.52	79.11
" " " "	Fitchburg	50.00		
Swift's Lowell Special Grass Mixture	Sunderland	37.50	27.20	37.87
Swift's Potato Grower	Somerset	37.50	26.60	41.92
" " "	Ayer	38.00		
Swift's Tobacco Manure	So. Lowell	44.00	30.29	45.26
Swift's Lowell Dissolved Bone and Potash	Millis	29.00	17.72	58.02
" " " " " "	Milford	27.00		
Swift's Lowell Empress Brand	Milford	24.00	12 59	108.50
" " " "	Sterling	27.00		
" " " "	Webster	26.00		
" " " "	Spencer	28.00		
Swift's Lowell Sterling Phosphate	Sterling	29.00	14.85	95.29
Swift's Lowell Perfect Tobacco Grower	Sunderland	38 00	26.11	45.54
Swift's Lowell Seeding Down Fertilizer	So. Lowell	34.00	23.05	47.51
Swift's Lowell Special Potato Fertilizer	Beverly	36.00	23.26	63.37
" " " " "	Woburn	40.00		
" " " " "	Springfield	33.00		
Swift's Superior Fertilizer with 10% Potash	Concord	36.00	27.97	32.29
" " " " " " "	Ayer	38.00		
Swift's Special Corn and Vegetable Manure	Woburn	38.00	24 59	54.52
W. G. Todd, East Bridgewater, Mass.				
Ground Pigeon Manure	Man'f't'r's sample	40.00	21 30	33.43
Whitman & Pratt Rend. Co., Lowell, Mass.				
Whitman & Pratt's Corn Success	Billerica	31.00	21.00	47.62
Whitman & Pratt's All Crops	Billerica	34.00	23.61	44.01
Whitman & Pratt's Potato Manure	Billerica	34.00	22.27	52.67
Whitman & Pratt's Vegetable Grower	Billerica	40.00	27.69	44.46

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs Found.	Guaranteed.
39	9.12	1.72	1.26	2.98	2.88	8.42	2.78	2.32	13.52	12.00	11.20	9.00	5.29*	4.50
118, 144	9.19	1.74	1.31	3.05	2.88	8.67	2.14	2.81	13.62	12.00	10.81	9.00	5.50*	4.60
333, 544, 647, 752	9.37	.91	.78	1.69	1.64	6.16	1.55	1.17	8.88	9.00	7.71	8.00	3.16	3.00
246, 506, 700	9.17	1.43	1.20	2.63	2.46	6.06	1.69	1.56	9.31	9.00	7.75	8.00	5.93	6.00
33, 99	10.22	1.14	1.39	2.53	2.46	5.59	2.73	1.61	9.93	10.00	8.32	8.00	4.13	4.00
473, 643	8.15	1.59	.91	2.50	2.46	6.38	1.38	1.02	8.78	10.00	7.76	8.00	4.01	4.00
325, 412	10.13	2.16	1.81	3.97	4.10	5.59	1.10	1.63	8.32	8.00	6.69	7.00	6.22	6.00
543, 615, 644	7.42	1.00	.92	1.92	1.64	4.44	2.52	1.28	8.24	8.00	6.96	7.00	4.17	4.00
394, 673	4.44	4.11	.29	4.40	4.10	5.55	1.75	.10	7.40	8.00	7.30	7.00	6.79	5.00
89	8.14	2.29	2.01	4.30	4.11	4.91	2.00	1.28	8.19	8.00	6.91	7.00	6.23	6.00
309, 606	8.03	1.77	1.65	3.42	3.28	4.38	1.69	1.43	7.50	7.00	6.07	6.00	9.98	10.00
743	6.69	2.37	1.75	4.12	4.00	4.27	2.67	1.58	8.52	7.00	6.94	6.00	9.26*	10.00
542, 662	7.29	1.19	1.00	2.19	1.64	5.40	3.02	2.22	10.64	10.00	8.42	9.00	2.05	2.00
649, 697, 715, 736	8.21	.72	.62	1.34	1.25	4.18	2.30	1.22	7.70	8.00	6.48	7.00	2.02	2.00
630	3.87	.30	.72	1.02	.82	5.87	2.14	1.53	9.54	9.00	8.01	8.00	4.01	4.00
79	5.72	1.66	2.47	4.13	4.00	.80	2.67	2.78	6.25	5.00	3.47	4.00	7.19*	6.00
757	8.29	1.89	1.13	3.02	2.46	4.69	2.91	1.48	9.08	9.00	7.60	8.00	6.28	6.00
414, 595, 775	7.02	1.27	1.20	2.47	2.46	3.44	2.81	1.15	7.40	7.00	6.25	6.00	10.10	10.00
389, 617	8.46	1.90	1.61	3.51	2.69	4.85	2.55	1.10	8.50	8.00	7.40	7.00	10.12	10.00
584	8.73	1.31	1.81	3.12	3.29	5.29	2.36	1.99	9.64	9.00	7.65	8.00	6.72	7.00
887	11.81	—	—	3.90	3.75	—	—	—	2.00	2.00	—	—	5.65†	5.50
575	10.45	1.18	1.76	2.94	1.64	.36	5.86	3.98	10.20	10.00	6.22	8.00	4.21	3.00
496	9.78	1.54	1.69	3.23	2.46	.77	7.67	3.88	12.32	11.00	8.44	9.00	4.17	4.00
495	11.10	1.44	1.66	3.10	2.45	1.15	4.82	3.52	9.49	9.00	5.97	7.00	5.54	5.00
511	10.10	1.61	2.07	3.68	3.29	3.38	4.47	3.83	11.68	10.00	7.85	8.00	7.19	7.00

*No. 39 Chlorine .32%, equivalent to .42% potash; 4.87% potash as sulfate
" 118–144 " .12%, " .16% " 5.34% " "
" 743 " .82%, " 1.08% " 8.18% " "
" 79 " 1.20%, " 1.59% " 5.60% " "

†Total potash, associated with organic matter. Valued at 5 cts. per pound

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Whitman & Pratt Rend. Co. (Continued.)				
Whitman & Pratt's Potash Special	N. Chelmsford	—	$25 20	—
Wilcox Fertilizer Co., Mystic, Conn.				
Wilcox Potato, Onion and Vegetable Phosphate	Amherst	$35 00	25.96	34 82
Wilcox Potato, Onion and Vegetable Phosphate	New Bedford	36.00	24.72	44.30
" " " " " "	Hatfield	35.00		
" " " " " "	Monson	36.00		
Wilcox Grass Fertilizer	Seekonk	36.00	27.68	30.06
Wilcox High Grade Tobacco Special	Amherst	36.00	30.08	18.02
" " " " "	N. Hadley	35.00		
Wilcox Complete Bone Superphosphate	Fall River	29.00	20 52	41.33
" " " "	Marblehead	—		
Wilcox Potato Fertilizer	Fall River	29 00	19.57	48.19
" " "	Monson	29.00		
Wilcox Fish and Potash	Amherst	28.00	19 32	44.93
" " " "	Seekonk	26.00		
" " " "	New Bedford	30.00		
" " " "	Marblehead	28.00		
A. H. Wood & Co., Framingham, Mass.				
Wood's B. B. Fertilizer	Framingham	30.00	21.87	37.17
Wood's S. P. Fertilizer	Framingham	40.00	34.99	14.32
Wood's 777 Fertilizer	Framingham	45.00	36.20	24.31

Fertilizers Furnishing Nitrogen, Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen in 100 lbs. Organic.	Nitrogen in 100 lbs. Total. Found.	Nitrogen in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid in 100 lbs. Reverted.	Phosphoric Acid in 100 lbs. Insoluble.	Phosphoric Acid in 100 lbs. Total. Found.	Phosphoric Acid in 100 lbs. Total. Guaranteed.	Phosphoric Acid in 100 lbs. Available. Found.	Phosphoric Acid in 100 lbs. Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
753	7.52	1.32	1 54	2 36	2 33	2 17	3.60	2.27	3 04	. 00	5.77	6 00	10 63	10.00
60	14 22	1 96	1 45	3 41	3 30	6 06	2 30	.26	8 62	8 00	8 36	7 00	7 17*	6.00
277 561 748	16 13	1 94	1.42	3 30	3 30	5.97	1 28	.99	8 24	8.00	7 25	7.00	6 72*	6 00
347	11.31	2.30	1 71	4 51	4 11	3.55	2 37	1 23	7 70	7 00	6 42	6 00	6 47*	5.00
142 838	7 63	1 45	2 35	3 80	3 30	none	3 44	3 32	6 76	7.00	3 44	5 00	11.96†	7.00
416 539	17.53	1.04	1.39	2 43	2 05	3 04	5.02	3 32	11 33	9.00	8 06	8.00	4.17	3 00
423 719	15.17	1 06	1.35	2 41	2.05	1 76	4.49	2 02	8.27	7 00	6 25	6.00	5.33×	4 50
136 275 291 577	19 69	.34	1 97	2.31	2 46	2 14	3 15	1.73	7.02	6 00	5 29	5 00	4.25	3.00
714	9.21	1.09	1 56	2.65	2 50	2 72	4.14	3 33	10.74	11 00	6 36	7.00	5 63	5 00
431	5.59	3.06	1 64	4 70	4 00	2 78	3.16	2 91	3.85	9.00	5 94	0.00	12.62*	13.00
446	6.75	5.98	.89	6.37	7.00	2.61	3.49	2 55	8.65	9 00	6 10	7 00	8 64	7 00

*No. 60 Chlorine 3.34%, equivalent to 4.44% potash; 2.73% potash as sulfate
" 277-561-748 " 3.44%, " 4.56% " 2.16% " "
" 347 " 2.99%, " 3.98% " 2.49% " "
† " 142-838 Potash as sulfate
× " 423-719 Chlorine 2.67%, equivalent to 3.55% potash; 1.78% potash as sulfate
" 431 " .84%, " 1 13% " 11.49% " "

Fertilizers Furnishing Phosphoric Acid and Potash.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
PHOSPHATE AND POTASH.				
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Tobacco Ash Elements	Northampton	$30.00	$24.01	24.95
Bowker's Tobacco Ash Elements	Springfield	33.00	18.71	76.38
Coe-Mortimer Co., New York City.				
E. Frank Coe's Famous Prize Brand Grass & Grain	S. Williamstown	25.00	9.74	156 67
E. Frank Coe's Famous Prize Grass & Grain	N. Adams	—	10 36	—
Lister's Agricultural Chem. Works, Newark, N. J.				
Lister's Grass and Grain Fertilizer	Fall River	24.00	13 02	34.40
WOOD ASHES.				
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Hardwood Ashes	Sunderland	10.50	** 9.08	15.64
Bowker's Hardwood Ashes	Sunderland	10.50	** 8.86	18.51
Bowker's Hardwood Ashes	Amesbury	18 00	**11.03	63.20
H. C. Green Co., London, Ontario, Canada.				
Wood Ashes	Amherst	†	** 4.67	—
Wood Ashes	Hubbardston	†	** 5.57	—
Wood Ashes	Hubbardston	†	** 4.35	—
John Joynt, Lucknow, Ontario, Canada.				
Pure Hardwood Ashes	N. Amherst	12.00	**12.83	‡6.83
Pure Hardwood Ashes	Amherst	12.00	**11.12	7.91
Pure Hardwood Ashes	N. Amherst	12.00	** 6.34	89.27
Pure Hardwood Ashes	Sunderland	12.00	**11.63	2.74
Pure Hardwood Ashes	So. Deerfield	12 50	**10.59	18.03
Pure Hardwood Ashes	Sunderland	11 50	** 9.99	15 11
Chas. Stevens, Napanee, Ontario, Canada.				
Canada Wood Ashes	Taunton	20 00	**10.76	85.87
W. L. Mitchell, New Haven, Conn.				
Lime Ashes	Millis		** 2 83	
GROUND ROCKS.				
Farmhood Corporation, Boston, Mass.				
Farmfood	Man'f't'r's sample		1 65	
New England Mineral Fert. Co., Boston, Mass.				
New England Mineral Fertilizer	Amherst	17.00	.24	6983.33

**The potash in ashes is largely present as Carbonate and has been valued at 8 cts. per pound. The lime in ashes has been valued at the same price as for agricultural lime, namely .0034 cts. per pound of actual calcium oxide

†A letter received from Ross Bros. Co. of Worcester of whom these ashes were purchased, states that they do not intend to make any charge for the three car loads of ashes represented by Nos. 889, 891 and 892, as they were of such poor quality

‡Value in excess of selling price

Fertilizers Furnishing Phosphoric Acid and Potash.

Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed	Calcium Oxide (CaO) in 100 lbs.
214	7.29	13	6 30	6.10	12.53	7.00	6.43	6.00	16.59*	15.00	—
772	3 45	1 72	5 36	4 90	12 43	7 00	7.58	6.00	10.52*	15.00	—
323	6.06	5.97	3.06	.41	9.44	11.00	9.03	10.00	2.07	2.00	—
391	6 98	5 37	4 01	1 19	11.07	11.00	9.83	10.00	1.63	2 00	—
424	12 61	9 13	3 04	1 12	13 34	11 00	12.22	10.00	2.21	2 00	—
148	23.65	—	—	—	1.30	—	—	—	4.09	4.00	24.01
155	24.36	—	—	—	1.17	—	—	—	4.01	4.00	23.84
397	4.45	—	—	—	1 10	—	—	—	5.09	4 00	31.22
389	31.93	—	—	—	.89	—	—	—	1.53	—	23.55
392	9.41	—	—	—	1.43	—	—	—	1 80	—	24.91
393	21 84		—	—	1.22	—	—	—	1.32	—	20.45
23	21 19	—	—	—	1 49	1.00	—	—	6.16	5.00	29.14
204	13 29		—	—	1.71	1.00	—	—	4.42	3.00	41.85
218	7 49	—	—	—	.97	1.00	—	—	2.48	3.00	24.70
488	20.76	—	—	—	1.53	1.00	—	—	5 72	3.00	21.42
601	17 84		—	—	1 12	1 00	—	—	4.60	3.00	36.00
304	23 63			—	87	1 00	—	—	4.73	3.00	25.49
314	20 91		—	—	1 61		—	—	4.77	—	29.46
338	8 14				10	50			20	.50	35 95
711	55	none	38	2.17	2.55	2.00	.38	—	56*	5 00*	—
519	2 21	none	.18	none	.13	23		—	.10*	1.50	—

No. 711 Acid soluble potash .66%. Guaranteed 2%, total phosphoric acid and 5% potash iu bond
" 519 Total potash .35%
" 214 Chlorine .9%, equivalent to 1.20% potash, 15.39% potash as sulfate. Acid soluble potash 16.94%
" 772 Acid soluble potash 10.87%. Potash as Sulfate

Fertilizers Manufactured for Private Use, Officially Collected (Not Licensed).

Name of Manufacturer and Brand.	Where Sampled.	Manufacturer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Armour Fertilizer Works, Baltimore, Md.				
Armour's High Grade Potato Fertilizer	Seekonk	$33 00	$27 73	15.40
Atlantic Fertilizer Co., Baltimore, Md.				
XXtra Top Dressing	Millis	26 68	22.15	20.45
Early Truck and Vegetable Manure	Millis	26 40	23.71	11.34
H. G. Truck and Potato Special	Millis	29 70	28.40	4 58
Berkshire Fertilizer Co., Bridgeport, Conn.				
Hibbard's Special Mixture	N. Hadley	—	32.28	—
Cook's Special Mixture	Hadley	35 00	31.02	12.83
J. W. Peck & Sons' Special Mixture	Seekonk	32 00	27.13	17.95
D. S. Peck's Special Mixture	Seekonk	35 00	29 23	19 74
R. L. Blood, Pepperell, Mass.				
Blood's Special Mixture	Pepperell	—	13 38	—
Bowker Fert. Co., 43 Chatham St., Boston, Mass.				
Bowker's D Brand Fish and Potash	Middleboro	30.00	16 38	33 15
Bowker's Square Brand Bone and Potash	Northampton	26 00		
" " " " " "	Dighton	27.55	16.04	66.96
Bowker's Potash or Staple Phosphate	Orange	27.00	15.47	74.53
Bowker's Fisherman's Brand Fish and Potash	Southwick	27.00	21.99	22.78
Hubbard's Special Tobacco Mixture	Sunderland	—		—
" " " "	Sunderland	—	28.55	—
Smith's Special Tobacco Mixture	Sunderland	45.00	34.56	30.21
Smith's Special Onion Mixture	Sunderland	36 00	29 31	22.82
Coe-Mortimer Co., 24-26 Stone St., N. Y. City.				
Cowl's Special 4-6-6	N. Amherst			
" " "	N. Amherst		26.66	—
" " "	N. Amherst	—		
" " "	N. Amherst			
Cowl's Special 4-7-8	N. Amherst			
" " "	N. Amherst	—	30 80	—
" " "	N. Amherst			
E. Manchester & Sons, Winsted, Conn				
Manchester's Formula	N. Wilbraham	28 00	25 17	11 24
Mitchell Fertilizer Co., Tremley, N. J.				
Mitchell's Vegetable Fertilizer	Seekonk	34.00	25.01	35.95
Mitchell's Special Fertilizer	Seekonk	38.00	29.39	29.30
National Fertilizer Co., 92 State St., Boston, Mass.				
Chittenden's Special Grass Formula	N. Amherst	40.00	34.63	15.51
New England Fert. Co., 40A N. Market St., Boston.				
New England Top Dressing for Grass and Grain	Brockton	36.90	26.31	40.25
New England Complete Manure	Brockton	34.20	26.73	27.95
New England Market Garden Manure	Billerica	41.00	28.37	44.52
Olds & Whipple, Hartford, Conn.				
O. & W. Special Phosphate	So. Deerfield	35.00	25.31	38.29
Conant's Special Mixture for Onions	N. Hadley	35.00	27.78	25.99

Fertilizers Manufactured for Private Use, Officially Collected (Not Licensed).

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen Organic.	Nitrogen Total. Found.	Nitrogen Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash (K_2O) in 100 lbs. Found.	Potash Guaranteed.
260	10.37	2.58	.69	3.27	2.88	6.95	1.81	.92	9.68	8.50	8.76	8.00	10.15	10.00
537	8.96	1.95	1.12	3.07	4.11	3.06	3.42	1.89	8.37	—	6.48	5.00	6.00	2.00
545	3.22	1.96	.95	2.91	3.30	2.74	6.17	1.96	10.87	—	8.91	6.00	6.45	5.00
556	13.07	2.06	1.18	3.24	3.31	8.14	1.38	none	9.52	—	9.52	8.00	10.19	10.00
74	8.91	2.20	2.10	4.30	3.30	6.61	1.17	.28	8.06	—	7.78	8.00	9.89*	8.00
203	8.35	2.48	1.25	3.73	3.30	6.70	.57	.79	8.06	—	7.27	8.00	11.38*	10.00
278	12.07	2.26	1.32	3.58	8.30	7.27	.79	.92	8.98	—	8.06	8.00	8.38	7.00
285	9.70	2.54	1.32	3.86	3.30	7.33	.99	.74	9.06	—	8.32	8.00	8.22*	7.00
861	16.02	.20	.21	.41	--	none	.92	1.45	2.37	—	.92		6.61**	--
450	16.24	1.14	.64	1.78	1.65	6.48	2.66	1.40	10.54	7.00	9.14	6.00	1.94	2.00
221 330	15.25	.90	1.01	1.91	1.65	5.46	1.71	1.94	9.11	7.00	7.17	6.00	2.42	2.00
799	12.50	.74	.48	1.22	.82	6.44	1.58	1.96	9.98	9.00	8.02	8.00	3.93	3.00
829	8.95	1.61	1.70	3.31	2.47	3.95	1.02	2.07	7.04	5.00	4.97	4.00	5.68	4.00
156 159	8.93	.85	4.09	4.94	—	3.44	1.15	.51	5.10	—	4.59	-	5.79*	-
116	7.29	2.17	3.85	6.02	—	.83	1.98	3.95	6.76	—	2.81		8.37*	
110	10.23	1.61	2.09	3.70	—	4.57	3.03	3.42	11.02	—	7.60	-	7.99*	-
439 453 466 508	[illegible].74	2.12	1.89	4.01	4.00	2.40	4.34	1.81	8.55	—	6.74	6.00	6.12*	6.00
467 481 494	11.63	1.99	2.17	4.16	4.00	4.40	4.07	1.53	10.00	—	8.47	7.00	8.08*	8.00
760	6.81	.59	2.85	3.44	3.50	2.04	3.55	2.27	7.86	—	5.59	8.00	7.40	7.50
274	15.05	2.03	1.35	3.38	3.29	6.03	2.27	1.40	9.70	9.00	8.30	8.00	6.24	6.00
293	13.60	2.91	1.52	4.43	4.11	6.22	2.12	.84	9.18	9.00	8.34	8.00	7.48	8.00
25	7.79	6.41	.11	6.52	6.58	2.53	5.43	1.43	9.39	8.00	7.96	--	7.64	8.00
375	8.28	2.21	1.77	3.98	4.11	4.50	2.83	1.53	8.86	8.00	7.33	7.00	6.16	6.00
531	9.28	1.76	1.54	3.30	3.28	3.99	2.70	1.22	7.91	7.00	6.69	6.00	10.23	10.00
573	7.50	2.46	1.87	4.33	4.11	4.76	2.74	1.40	8.90	8.00	7.50	7.00	7.05	7.00
247	8.52	1.88	2.53	4.41	4.13	trace	5.72	2.88	8.60	—	5.72	4.00	3.41‡	3.00
117	8.85	1.88	1.42	3.30	3.00	1.21	8.12	2.30	11.63	9.00	9.33	—	8.91	9.00

*No. 74 Chlorine .25%, equivalent to .33% potash; 9.56% potash as sulfate
" 156–159 Chlorine 2.75%, equivalent to 3.63% potash, 2.16% potash as sulfate
" 116 " .30%, " .38% " 7.99% " "
" 110 " .45%, " .59% " 7.40% " "
** " 861 Potash as carbonate
*No. 439-453-466-508 Chlorine .77%, equivalent to 1.00% potash; 5.12% potash as sulfate
" 467-481-494 " .79%, " 1.04% " 7.04% " "
‡No. 247 Potash as sulfate
*No. 203 Chlorine .57%, equivalent to .76% potash; 10.62% potash as sulfate
" 285 " .45%, " .59% " 7.63% " "

Fertilizers Manufactured for Private Use, Officially Collected (Not Licensed).

Name of Manufacturer and Brand.	Where Sampled.	Manufacturer's Cash Price per Ton.	Commercial Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Parmenter & Polsey Fert. Co., Boston, Mass.				
P. & P. Potato Phosphate	So. Lowell	$34 00	$21 67	56.90
Sanderson Fert. and Chem. Co., New Haven, Conn.				
Field's Mixture Fish and Potash	N. Hadley	37 00	31 93	15 88
Whitman & Pratt Rend. Co., Lowell, Mass.				
Parsons' Mixture for Onions	Northampton	34 00	32 07	6 02
Coe-Mortimer Co., New York City.				
High Grade Soluble Phosphate	Sunderland	17.60	12 73	38.26
Berkshire Fert. Co., Bridgeport, Conn.				
Ground Castor Pomace	N. Hadley	24.30	18.60	33.33
Muriate of Potash	N. Hadley	42.40	49.37	‡14.12
H. G. Sulfate of Potash	N. Hadley	46 40	51.00	‡9.02
American Linseed Co., New York City.				
Cleveland Flaxmeal	Salem	39 00	22.00	77.27
Atlantic Fert. Co., Baltimore, Md.				
Nitrate of Soda	Millis	55 00	48 96	12 34
Mitchell Fert. Co., Tremley, N. J.				
Mitchell's Nitrate of Soda	Seekonk	45 00	47.49	‡5.24
Swift's Lowell Fert. Co., Boston, Mass.				
Dissolved Animal Bone	Taunton	25 00	19.76	26.52
Dry Ground Fish	W. Berlin	41 00	46.46	‡11 75
Libby, Lane & Libby, Vinal Haven, Maine.				
Unground Fish	Sunderland	30.00	39 29	‡23.64
Berkshire Fert. Co., Bridgeport, Conn.				
Blood Tankage	N. Hadley	40 40	34 80	16 09
Albert G. Markham, Springfield, Mass.				
Markham's Tankage	Springfield	25 00	29 62	‡15.60
Benjamin Randall, East Boston, Mass.				
Tankage	Waban	25.00	22.45	11.36

‡ Valuation in excess of selling price

Fertilizers Manufactured for Private Use, Officially Collected (Not Licensed).

Laboratory Number.	Moisture.	Nitrogen in 100 lbs: Water Soluble.	Nitrogen: Organic.	Nitrogen Total: Found.	Nitrogen Total: Guaranteed.	Phosphoric Acid in 100 lbs.: Water Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid Total: Found.	Phosphoric Acid Total: Guaranteed.	Phosphoric Acid Available: Found.	Phosphoric Acid Available: Guaranteed.	Potash (K_2O) in 100 lbs.: Found.	Potash (K_2O) in 100 lbs.: Guaranteed.
744	3.62	1.44	1.06	2.50	2.46	5.23	2.63	1.30	9.21	9.00	7.91	8.00	6.41	6.00
827	6.53	.62	4.03	4.65	5.14	trace	2.53	2.27	4.85	3.75	2.58	—	10.97*	10.12
232	3.84	1.75	1.31	3.06	2.47	1.66	10.10	4.87	16.63	—	11.76	12.00	9.83*	10.00
836	3.65	—	—	—	—	10.37	3.90	.71	14.98	15.00	14.27	14.00	—	—
96	11.77	—	—	4.65	4.50	—	—	—	—	—	—	—	—	—
791	.55	—	—	—	—	—	—	—	—	—	—	—	58.03	51.00
785	1.16	—	—	—	—	—	—	—	—	—	—	—	51.00	48.00
364	11.37	—	—	5.50	5.76	—	—	—	—	—	—	—	—	—
546	2.12	—	—	15.30	—	—	—	—	—	—	—	—	—	—
290	3.14		—	14.84	—	—	—	—	—	—	—	—	—	—
315	6.31	1.32	1.10	2.42	1.64	2.72	8.44	4.85	16.01	12.00	11.16	8.00	—	—
690	10.38	—		10.19	7.50	—	5.52	3.21	8.73	11.00	5.52	—		
146	10.76			7.62	—		6.53	8.83	15.46	—	6.53	—	—	—
													Mechanical Analysis Fine Bone	Coarse Bone
797	9.02	—	—	8.26	8.00	—	—	—	7.19	5.00	—	—	55.55	44.45
779	5.07	—	—	5.80	—		—	—	14.01		—	—	30.67	69.33
396	10.00	—	—	3.14	—	—	—		15.10	—	—		52.94	47.06

*No. 827 Chlorine .57%, equivalent to .76% potash; 10.21 % potash as sulfate
" 232 " .60%, " .80% " 9.03% " "

Ground Bone.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
American Agricultural Chemical Co., Boston, Mass.				
Fine Ground Bone	Amherst	$31.00	$27.71	11.87
Farquhar's Pure Ground Bone	Boston	32 00	28 14	13.72
Armour Fert. Works, Baltimore, Md.				
Armour's Bone Meal	Swansea	30 00	29 63	1.25
Beach Soap Co., Lawrence, Mass.				
Beach's Fertilizer Bone	Lawrence	27 00	31 31	‡10.57
" " "	Boston	29.00		
Bowker Fert. Co., Boston, Mass.				
Fresh Ground Bone	Northampton	29 50	26.66	20.67
" " "	Dighton	32.00		
" " "	Mansfield	35.00		
Fresh Ground Bone	Man'f't'r's sample		28 52	—
Buffalo Fertilizer Co., Buffalo, N. Y.				
Bone Meal	Pepperell	30 00	29.58	1.42
John C. Dow Co., Boston, Mass.				
Dow's Pure Ground Bone	Concord	38 00	27.53	38 03
Essex Fert. Co., Boston, Mass.				
Essex Ground Bone	Taunton	30.00	31 81	‡5 69
Thos. Hersom & Co., New Bedford, Mass.				
Pure Bone Meal	New Bedford	28 00	31.32	‡10 60
Home Soap Co., Worcester, Mass.				
Ground Bone	Worcester	28 00	28 07	‡ .25
G. E. Marsh Co., Lynn, Mass.				
Marsh's Pure Bone Meal	Concord	35.00	30 43	15 02
D. M. Moulton, Monson, Mass.				
Grouud Bone	Monson	30.00	26.18	14 59
National Fertilizer Co., Boston, Mass.				
Chittenden's Fine Ground Bone	Leominster	31.00	28 23	9 81
Olds & Whipple, Hartford, Conn.				
Pure Bone Meal	N. Hadley	29 00	27 67	4 81
Patrons' Co-operative Association, Boston, Mass.				
Fine Ground Bone	Sunderland	26 60	26 30	1 14
Ground Bone	Campello	25 00	29 51	‡15.28
W. W. Rawson & Co., Boston, Mass.				
Rawson's Fine Ground Bone	Boston	35 00	25 55	36 99
Rogers Mfg. Co., Rockfall, Conn.				
Pure Knuckle Bone Flour	Hadley	34 00	32 61	4 26
Knuckle Bone Flour	N. Amherst	33.00	30 96	6 59

‡Valuation in excess of selling price

Ground Bone.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.: Water Soluble.	Nitrogen in 100 lbs.: Organic.	Nitrogen in 100 lbs.: Total. Found.	Nitrogen in 100 lbs.: Total. Guaranteed.	Phosphoric Acid in 100 lbs.: Water Soluble.	Phosphoric Acid in 100 lbs.: Reverted.	Phosphoric Acid in 100 lbs.: Insoluble.	Phosphoric Acid in 100 lbs.: Total. Found.	Phosphoric Acid in 100 lbs.: Total. Guaranteed.	Phosphoric Acid in 100 lbs.: Available. Found.	Phosphoric Acid in 100 lbs.: Available. Guaranteed.	Mechanical Analysis: Fine Bone.	Mechanical Analysis: Coarse Bone.
140	8.13			3.01	2.47	—			22.91	22.88		—	49.76	50.24
450	11.04		—	2.78	2.47	—	—	—	24.32	22.88		—	53.41	46.59
397	7.27			2.25	2.47	—	—		27.60	24.00		—	70.95	29.05
436 551	4.82			3.39	3.00		—		24.31	20.00	—		70.70	29.30
206 311 462	6.26	—	—	2.57	2.47	—			23.09	22.80			57.28	42.72
332	6.91		—	2.93	2.47	—	—	—	23.24	22.88	—	—	65.99	34.01
363	3.02	—	—	4.00	2.90	—	—	—	20.00	22.00	—		59.67	40.33
373	5.44	—	—	2.04	1.64	—	—	—	26.26	24.00	—	—	64.79	35.21
335	8.01	—	—	3.99	2.47	—	—	—	22.46	23.00	—	—	65.96	34.04
265	4.32	—	—	2.70	2.22	—	—	—	27.32	23.54	—	—	75.52	24.48
635	7.71	—	—	4.55	2.00	—	—	—	17.78	23.00	—	—	31.16	68.84
370	5.60		—	2.59	2.46	—	—	—	27.56	23.00	—	—	62.78	37.22
721	9.46		—	4.25	4.26	—	—	—	17.96	18.03	—	—	16.33	83.67
665	6.30		—	3.29	2.47	—	—	—	21.30	22.33	—	—	63.66	36.34
730	7.64	—	—	3.12	2.50	—		—	22.02	22.00		—	54.48	45.52
169	17.97	—	—	1.37	2.46	—	—	—	27.94	22.88	—	—	63.22	36.78
341	12.45	—	—	2.50	2.46		—	—	27.28	22.88	—	—	55.74	44.26
444	11.79	—	—	2.99	2.47	—			29.08	22.88			50.54	49.46
130	10.46	—	—	3.72	3.30		—		24.90	24.00	—	—	64.76	35.24
333	9.24	—	—	4.00	3.30		—		24.26	24.00	—	—	30.81	69.19

Ground Bones, Dissolved Bones and Tankage.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Rogers & Hubbard Co., Middletown, Conn.				
Hubbard's "Bone Base" Pure Raw Knuckle B. Flour	E. Milton	$39.00	$32.26	20.89
Hubbard's "Bone Base" Strictly Pure Fine Bone	E. Milton	35.00	27.89	25.49
M. L. Shoemaker & Co., Ltd., Phila., Pa.				
Swift-Sure Bone Meal	Sunderland	34.00	39.37	‡13.64
Springfield Rendering Co., Springfield, Mass.				
Steamed Ground Bone	N. Amherst	30.20	29.82	1.27
T. L. Stetson, Randolph, Mass.				
Ground Bone	Brockton	35.00	29.01	20.65
Swift's Lowell Fert. Co., Boston, Mass.				
Ground Bone	Beverly	28.40	29.92	‡1.50
" "	Fall River	32.00		
" "	Ayer	28.00		
A. L. Warren, Northboro, Mass.				
Warren's Pure Ground Bone	Northboro	27.00	32.16	‡16.05
Warren's Bone Meal	Northboro	—	34.12	—
Whitman & Pratt Rend. Co., Lowell, Mass.				
Pure Ground Bone	Lowell	—	28.72	—
Sanford Winter Co., Brockton, Mass.				
Pure Ground Bone Fertilizer	Brockton	29.50	31.47	‡6.28
" " " "	Man'f'tr's samp	—		
DISSOLVED BONES.				
W. H. Abbott, Holyoke, Mass.				
Abbott's Animal Fertilizer	Sunderland	27.00	26.87	2 34
" " "	Sunderland	28.00		
Mapes Form. & Peruv. Guano Co., N. Y. City.				
Dissolved Bone	Conway	34.00	25.46	33.54
TANKAGE.				
Amer. Agric. Chem. Co., Boston, Mass.				
Fine Ground Tankage	Man'f'r's sample	—	32.69	—
Bowker Fertilizer Co., Boston, Mass.				
Bowker's 6 and 30 Tankage	Northampton	30.00	30.26	‡ .87
Bowker's 6 and 30 Tankage	Southampton	30.00	29.66	1.15
Thos. Hersom & Co., New Bedford, Mass.				
Meat and Bone	New Bedford	28.00	33.71	‡16.94
G. E. Marsh Co., Lynn, Mass.				
Ground Tankage	Concord	33.00	28.72	14.90
Ground Tankage	Framingham	33.00	29.98	10.07
Olds & Whipple, Hartford, Conn.				
Tankage	Florence	27.50	26.06	5.53

‡Valuation in excess of selling price

Ground Bones, Dissolved Bones and Tankage.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs.				Phosphoric Acid in 100 lbs.							Mechanical Analysis.	
				Total.					Total.		Available.			
		Water Soluble.	Organic.	Found.	Guaranteed.	Water Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine Bone.	Coarse Bone.
356	9.63	—	—	3.81	3.50	—	—	—	23.73	24.50		—	68.31	31.69
361	10.55	—	—	3.69	2.85		—	—	19.93	22.00	—		49.94	50.06
103	4.37	—	—	5.26	4.53		—		23.80	20.00			70.20	29.30
120	3.20		—	2.17	2.47				26.95	23.00			84.47	15.53
612	9.50	—	—	4.34	4.20			—	21.15	20.66			18.41	81.59
365, 425, 639	6.67			2.93	2.47				24.75	23.00			70.50	29.50
685	6.78		—	4.03	2.00	—	—	—	23.29	20.00		—	59.20	40.80
121	9.11			4.26	4.16				22.88	20.00	—		46.68	53.32
745	7.29		—	2.48	2.47	—			25.46	25.00			68.70	31.30
357, 768	7.88			3.68	3.00				24.95	25.00	—		48.00	52.00
*147, 175	12.17	1.41	2.58	3.99	3.00	1.19	10.31	5.20	17.20	15.00	12.00	12.00	—	
789	9.18	—	—	3.26	2.06	4.82	8.76	2.68	16.26		13.58	12.00		
377	8.81			8.13	7.48				7.32	9.00			35.81	64.19
211	10.12			5.25	4.94				15.10	13.73			58.22	41.78
463	8.08			5.56	4.04		5.04	7.81	12.85	13.73			58.22	41.78
279	5.07		—	5.08	4.66				18.08	17.81			84.51	15.49
392	6.61			5.22	6.09	—			12.86	11.44			62.27	37.73
517	7.13	—		5.55	6.58				13.67	14.00			54.49	45.51
773	7.40	—	—	4.60	4.94				12.22	0.00			63.74	36.26

*No. 147–175 Potash .28%

Tankage and Dry Ground Fish.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Sanderson Fert. & Chem. Co., New Haven, Conn.				
Sanderson's Blood, Bone and Meat	N. Hatfield	$33.50	$35.41	‡ 5 39
Springfield Rend. Co., Springfield, Mass.				
Ground Tankage	N. Amherst	32 20	33 62	‡ 4 24
Swift's Lowell Fert. Co., Boston, Mass.				
Ground Tankage	Marblehead	31.00	29.38	5 37
J. M. Woodward, Greenfield, Mass.				
Unground Bone Tankage	Greenfield	—	31 66	—
Worcester Rendering Co., Worcester, Mass.				
Ground Tankage	Worcester	40 00	34 32	16 55
DRY GROUND FISH.				
Amer. Agric. Chem. Co., Boston, Mass.				
Dry Ground Fish	Bradstreet	40 00	39 99	03
Berkshire Fertilizer Co., Bridgeport, Conn.				
Dry Ground Fish	N. Hadley	40 00	41 25	‡ 3 03
Dry Ground Fish	N. Hadley	38 50	42.96	‡10 38
Dry Ground Fish	Hadley	41.00	41 25	‡ .61
Dry Ground Fish	N. Hadley	42 40	40.08	5 79
Bowker Fertilizer Co., Boston, Mass.				
Bowker's Fine Ground Dry Fish	Sunderland	40.00	39.61	.98
Bowker's Fine Ground Dry Fish	Sunderland	40.00	39 17	2 12
" " " " "	Sunderland	40 00		
Essex Fertilizer Co., Boston, Mass.				
Essex Dry Ground Fish	Worcester	44.00	43 61	89
National Fertiizer Co., Boston, Mass.				
Chittenden's Dry Ground Fish	N. Amherst	39 00	36 91	5 66
Chittenden's Dry Ground Fish	Bradstreet	—	35 86	—
Chittenden's Dry Ground Fish	N. Hadley	40 00	36 79	8.73
Chittenden's Dry Ground Fish	Bradstreet	40 00	37 52	6.61
Olds & Whipple, Hartford, Conn.				
O. & W. Dry Ground Fish	Cushman	39 00	38 40	1.56
O. & W. Dry Ground Fish	N. Hadley	38 00	38 91	‡ 2.34
O. & W. Dry Ground Fish	N. Hadley	40 00	38 18	4 77
Patrons' Co-operative Association, Boston, Mass.				
Dry Ground Fish	Sunderland	38 00	36 73	3 46
Rogers Mfg. Co., Rockfall, Conn.				
Dry Ground Fish	Amherst	38 00	35 62	9 48
" " "	Deerfield	40 00		

‡ Valuation in excess of selling price.

Tankage and Dry Ground Fish.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Organic.	Total. Found.	Total. Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Mechanical Analysis. Fine Bone.	Coarse Bone.
40	7.67		--	6.69	5.76	—	-	--	13.73	10.00	—	-	70.98	29.02
70	8.57		-	6.35	5.00				15.18	12.00			50.56	49.44
503	9.31	--		5.55	5.00				18.09	14.00		--	50.48	49.52
704	6.07	--	-	4.30	4.50	—	-	—	10.35	—	—	-	49.53	50.47
631	5.45		—	6.96	7.00	--	-		12.36	12.00			53.79	46.21
46	9.40	—	-	8.71	8.24		5.38	2.12	7.50	7.00	5.38		-	
53	10.67		—	8.83	8.00		6.25	2.32	8.57	9.00	6.25	—	-	—
56	10.09		-	9.42	8.00		5.72	1.76	7.48	9.00	5.72		—	-
194	11.33		--	9.08	8.00	—	4.72	2.88	7.60	9.00	4.72		--	—
734	13.72		--	8.54	8.00		6.40	1.99	8.39	6.00	6.40	-	—	—
76	13.05			9.36	8.23		6.76	1.91	8.67	7.00	6.76	-	—	-
100 154	13.11			8.25	8.23	89	5.36	2.70	8.95	7.00	6.25	—	—	—
640	13.03			9.45	7.50	none	5.80	2.93	8.73	11.00	5.80		—	-
1	8.25	-	—	8.14	8.23	-	4.36	2.14	6.50	6.00	4.36	-	—	-
6	8.29		—	7.30	8.23	—	3.95	3.75	7.70	6.00	3.95	-	--	—
54	8.69	-		7.95	8.23		4.06	4.36	8.42	6.00	4.06	-	—	--
133	11.68	-		8.34	8.23	-	3.72	2.96	6.68	6.00	3.72	-		—
7	16.20		—	8.44	8.25	--	5.10	1.40	6.50	6.00	5.10	4.50	—	-
58	17.37		—	8.47	8.25	trace	5.32	02	6.74	6.00	5.32	4.50	-	-
163	12.58		--	8.27	8.25	--	4.67	3.39	8.06	6.00	4.67	4.50	--	—
334	11.01			7.75	7.00	-	6.00	2.32	8.32	5.00	6.00	-		—
223 256	14.18			7.87	8.20	—	4.75	.84	5.59	5.00	4.75	3.50	-	—

Dry Ground Fish.

Name of Manufacturer and Brand	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.
Sanderson Fert. & Chem. Co., New Haven, Conn.				
Sanderson's Fine Ground Fish	N. Hatfield	$40.00	$38.70	3.36
Sanderson's Fine Ground Fish	Sunderland	40.00	38.57	1.12
" " " "	Sunderland	38.00		
Sanderson's Fine Ground Fish	Sunderland	38.00	39.29	‡3.28
Sanderson's Fine Ground Fish	Sunderland	38.00	37.48	1.39
Wilcox Fert. Co., Mystic, Conn.				
Wilcox Dry Ground Fish Guano	Amherst	40.00	41.20	‡1.70
" " " " "	Somerset	41.00		
Wilcox Dry Ground Acidulated Fish	Fall River	38.00	36.26	4.80

‡Valuation in excess of selling price.

Dry Ground Fish.

Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Water Soluble.	Nitrogen: Organic.	Nitrogen Total: Found.	Nitrogen Total: Guaranteed.	Phosphoric Acid in 100 lbs. Water Soluble.	Phosphoric Acid: Reverted.	Phosphoric Acid: Insoluble.	Phosphoric Acid Total: Found.	Phosphoric Acid Total: Guaranteed.	Phosphoric Acid Available: Found.	Phosphoric Acid Available: Guaranteed.	Mechanical Analysis. Fine Bone.	Mechanical Analysis. Coarse Bone.
31	10.29	—	—	8 24	8 22	1.31	4.48	2 45	8 24	6.00	5.79	—	—	—
111, 168	10.83	—	—	8 21	8.23	—	5.44	3.44	8.88	6.00	5 44	—	—	—
71	11.85	—	—	8 30	8.22	—	6.14	2 96	9 10	6.00	6.14	—	—	—
489	10.20	—	—	8 02	8 23	—	5.13	3 24	8 37	6.00	5 13	—	—	—
132, 498	11.53	—	—	9 00	8 50	—	5.18	2.65	7.83	6 00	5 18	4 00	—	—
401	13.05	—	—	8 03	7 81	—	4.28	1.79	6 07	5 00	4 28	4 00	—	—

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Nitrogen in ... Found. Moisture.	Water Soluble.	Organic.
SULFATE OF AMMONIA.								
American Agric. Chem. Co., Boston, Mass.								
Sulfate of Ammonia	Framingham	$68 00	$69 50	‡2 16	477	.69	21.72	—
Bowker Fert. Co., Boston, Mass.								
Sulfate of Ammonia	Man'f't'r's sample	—	66 94	—	331	1 47	20 92	—
NITRATE OF SODA.								
American Agric. Chem. Co., Boston, Mass.								
Nitrate of Soda	Amherst	52 00	48 29	4 58	187	2 20	15 09	—
" " "	Sunderland	49 00			161			
Bowker Fert. Co., Boston, Mass.								
Nitrate of Soda	Northampton	49 50	48 93	1 16	210	1.72	15.29	—
Essex Fert. Co., Boston, Mass.								
Nitrate of Soda	Leominster	55 00	49 98	10 04	704	1.83	15 62	—
Lister's Agr. Chem. Works, Newark, N. J.								
Nitrate of Soda	So. Hadley	50 00	49 95	10	138	1 54	15.61	—
Mapes' Form. & Peruv. Guano Co., N. Y.								
Nitrate of Soda	Taunton	53 40	49 44	6 59	351	1.67	15 45	—
" " "	Conway	52 00			792			
National Fert. Co., Boston, Mass.								
Nitrate of Soda	Bradstreet	—	48.10	—	9	1.55	15.03	—
Nitrate of Soda	N. Hadley	50.00	48.16	3.82	57	2.75	15.05	—
Nitrate of Soda	Sunderland	49.00	49.34	‡ .69	145	2.13	15.42	—
Nitrate of Soda	W. Springfield	54.00	49.25	9.64	181	1.59	15 39	—
Nitrate Agencies Co., New York City.								
Nitrate of Soda	Sunderland	46 50	48 70	‡4 52	112	2.49	15.22	—
Olds & Whipple, Hartford, Conn.								
Nitrate of Soda	N. Hadley	55 00	49.76	10 56	172	2 15	15.55	—
Patrons' Co-op. Association, Boston, Mass.								
Nitrate of Soda	Hadley	48.00	49 66	‡4.35	435	2.62	15 52	—
" " "	Marlboro	—			846			
" " "	Campello	47.00			848			
Sanderson Fert. & Chem. Co., New Haven, Ct.								
Nitrate of Soda	N. Hatfield	57 00	48 16	18 36	43	1 65	15.05	—
Swift's Lowell Fert. Co., Boston, Mass.								
Nitrate of Soda	Taunton	48 00	50 56	‡2 41	298	1 90	15 80	—
" " "	Marblehead	49 00			590			
" " "	Ayer	51.00			613			
Whitman & Pratt Rend. Co., Lowell, Mass.								
Nitrate of Soda	Northampton	49 00	48 86	29	233	2 08	15 27	—
Wilcox Fert. Co., Mystic, Conn.								
Nitrate of Soda	Seekonk	50.00	48 38	5.42	268	2.34	15 12	—
" " "	Somerset	52.00			485			
DRIED BLOOD.								
Bowker Fert. Co., Boston, Mass.								
Dried Blood	Northampton	45 00	42 49	5 91	215	12 83		10.43
" "	Concord	45 00			*391			
Lister's Agr. Chem. Works, Newark, N. J.								
Lister's Dried Blood	So. Hadley	45 00	44 92	.18	*133	14.19	—	11.28
Whitman & Pratt Rend. Co., Lowell, Mass.								
Dried Blood	Northampton	39.00	42 06	‡7 28	*240	17.66	—	9.97
CASTOR POMACE.								
H. J. Baker & Bro., New York City.								
Baker's Pure Castor Pomace	N. Hadley	24 00	20 08	19 52	75	9.95	—	5.02
Olds & Whipple, Hartford, Conn.								
Grey Castor Pomace	Hatfield	26 00	24 68	5 35	18	7.82	—	6.17
Grey Castor Pomace	N. Hatfield	24.00	20 36	17 88	14	7.90	—	5.09

*No. 215-391 Phosphoric acid 1.05%
" 133 " " 2.83%
" 240 " " 2.91%
‡Valuation in excess of selling price
Note. Castor pomace contains on the average 2 12 per cent of phosphoric acid and 1.20 per cent potash

Nitrogen Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Nitrogen in 100 lbs. Found. Water Soluble.	Nitrogen in 100 lbs. Found. Organic.	Nitrogen in 100 lbs. Guaranteed.
stor Pomace. (Concluded.)									
nderson Fert. & Chem. Co., New Haven, Ct.									
Castor Pomace	Hatfield	$23.50	$25.00	14.00	522	9.80	-	6.25	5.50
Castor Pomace	N. Hadley	—	24.02		832	9.75	-	6.23	6.00
Castor Meal	N. Hadley	23.50	23.04	0.45	851	9.33	-	6.51	6.50
COTTONSEED MEAL.									
erican Cotton Oil Co., N. Y. City.									
Choice Cottonseed Meal	N. Hadley	36.00	25.24	42.63	17	8.73	-	6.31	6.50
Choice Cottonseed Meal	N. Hadley	37.50	25.16	49.05	19	8.82	-	6.29	6.50
Choice Cottonseed Meal	Northampton	37.50	25.00	50.00	21	8.75		6.25	6.50
Choice Cottonseed Meal	Hatfield	35.50	26.56	33.66	520	8.97	—	6.64	6.50
Choice Cottonseed Meal	Greenfield	35.00	25.36	38.01	523	9.33	—	6.34	6.50
Choice Cottonseed Meal	Hatfield	37.00	24.16	53.14	524	9.37	—	6.04	6.50
Choice Cottonseed Meal	N. Hadley	37.50	26.04	44.01	803	7.51	—	6.51	6.50
W. Brode & Co., Memphis, Tenn.									
Owl Brand Cottonseed Meal	N. Hadley	36.50	24.88	46.70	20	7.73	-	6.22	6.50
Owl Brand Cottonseed Meal	Greenfield	35.00	27.80	25.90	521	7.48	-	6.95	6.50
Dove Brand Cottonseed Meal	Littleton	38.00	24.92	52.49	809	7.08	-	6.23	6.00
mphreys, Godwin & Co., Memphis, Tenn.									
Dixie Brand Cottonseed Meal	Sunderland	37.00	25.20	46.83	16	6.47	-	6.30	6.16
Dixie Brand Cottonseed Meal	Southwick	37.00	26.12	41.66	257	8.60	-	6.53	6.17
Dixie Brand Cottonseed Meal	Southwick	—	26.12	-	258	7.82	-	6.53	6.17
Dixie Brand Cottonseed Meal	Millis	35.00	23.68	47.80	529	8.52	—	5.01	6.16
Dixie Brand Cottonseed Meal	Sunderland	36.00	25.80	39.53	708	8.41		6.4[illegible]	6.56
Caw Mfg. Co., Cincinnati, Ohio.									
McCaw's Prime Cottonseed Meal	N. Amherst	37.00	25.48	45.22	480	8.08		6.37	6.20
s & Whipple, Hartford, Conn.									
Cottonseed Meal	Hatfield	42.00	30.12	39.44	12	8.42		7.53	7.40
Cottonseed Meal	Bradstreet	40.00	30.40	31.58	15	8.37		7.60	7.40
E. Soper & Co., Boston, Mass.									
Choice Cottonseed Meal	Southwick	—	26.20	—	259	6.85	—	6.55	6.50

Note.—Cottonseed meal contains from 2 to 3 per cent of phosphoric acid and from 1.50 to 2.5 per cent of pot-, of which about 1.28% is water soluble

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Potash (K_2 in 100 lbs. Found.	Potash (K_2 in 100 lbs. Guaranteed
HIGH GRADE SULFATE OF POTASH.								
American Agr. Chem. Co., Boston, Mass.								
H. G. Sulfate of Potash	Bradstreet	$48.00	$50 88	‡6 08	84	.80	50.88	48.
" " " "	Amherst	48 00			136			
" " " "	Sunderland	46.00			162			
Bowker Fert. Co., Boston, Mass.								
H. G. Sulfate of Potash	Northampton	47 25	49.60	‡4.74	209	1.29	49.60	48.
Coe-Mortimer Co., New York City.								
H. G. Sulfate of Potash	Concord	48.00	50 08	‡5 05	381	.39	50.08	48.
" " " "	Sunderland	47.10			839			
Lister's Agric. Chem. Works, Newark, N. J.								
H. G. Sulfate of Potash	So. Hadley	48.00	49.68	‡3 38	128	2.06	49.68	48
National Fert. Co., Boston, Mass.								
H. G. Sulfate of Potash	Bradstreet	—	50.19	—	5	.87	50.19	48
Nitrate Agencies Co., New York City.								
H. G. Sulfate of Potash	Sunderland	48 00	49.64	‡3.30	171	.40	49.64	48.
Patrons' Co-op. Association, Boston, Mass.								
Sulfate of Potash	Marlboro	--	50.00	—	849	.50	50.00	48.
Swift's Lowell Fert. Co., Boston, Mass.								
Sulfate of Potash	Framingham	46.00	50.60	‡9.09	497	.52	50.60	48.
Whitman & Pratt Rend. Co., Lowell, Mass.								
Sulfate of Potash	Northampton	50.00	51.08	‡2.11	239	.75	51.08	48.
SULFATE OF POTASH-MAGNESIA.								
Mapes Form. & Peruv. Guano Co., N. Y. City.								
Double Manure Salts	Conway	31 00	26 48	17.07	787	4 70	26.48	25.
National Fert. Co., Boston, Mass.								
Double Manure Salt	N. Amherst	29.00	29.76	‡2.60	2	3.37	29.76	26.
Double Manure Salt	Northampton	30.00	26.80	11.94	22	3 65	26.80	26.
Double Manure Salt	Bradstreet	32.00	27.82	15 03	191	3 67	27.82	26.
Double Manure Salt	Hadley	32 00	26.04	22.89	*193	2 61	26.04	26.
Olds & Whipple, Hartford, Conn.								
Sulfate of Potash-Magnesia	N. Hadley	29 00	26 28	10 35	796	6 40	26.28	26.
Sanderson Fert. & Chem. Co., New Haven, Ct.								
Sulfate of Potash-Magnesia	N. Hatfield	29 50	31.50	‡6 35	48	3 24	31.50	27.
CARBONATE OF POTASH.								
Olds & Whipple, Hartford, Conn.								
H. G. Carbonate of Potash	Hatfield	100 00	106.11	‡5 76	562	1.43	66.32	65.
MURIATE OF POTASH.								
American Agr. Chem. Co., Boston, Mass.								
Muriate of Potash	Amherst	44.00	45 29	‡2 85	125	.67	53 28	50.
Muriate of Potash	Hadley	44 00	42.13	2.07	131	1.41	49.56	49.
" " "	Sunderland	42 00			152			
Bowker Fert. Co., Boston, Mass.								
Muriate of Potash	Northampton	42 00	43 69	‡6 75	216	73	51 40	49.
" " "	Florence	39 48			774			
Buffalo Fert. Co., Buffalo, N. Y.								
Muriate of Potash	Pepperell	--	47.97	--	860	.37	56.44	48.
Coe-Mortimer Co., New York City.								
Muriate of Potash	Sunderland	41 60	41 38	.53	835	.46	43.63	48.
German Kali Works, Baltimore, Md.								
Muriate of Potash	Swansea	43.00	44 30	‡4 06	302	1 17	52 12	49.
" " "	Littleton	42.00			616			

*No. 193 Acid soluble potash 27.81%

‡Valuation in excess of selling price

Potash Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Potash (K_2O) in 100 lbs. Found.	Potash (K_2O) in 100 lbs. Guaranteed.
MURIATE OF POTASH. (Concluded.)								
Nitrate Agencies Co., New York City.								
H. G. Muriate of Potash	Sunderland	$42.00	$42.02	‡ .05	177	1.52	49.44	50.00
Olds & Whipple, Hartford, Conn.								
Muriate of Potash	Florence	42.00	43.86	‡4.24	771	.93	51.60	50.00
Patrons' Co-op. Association, Boston, Mass.								
Muriate of Potash " " "	Hadley Campello	40.00 37.30	42.23	‡8.48	502 342	2.42	49.68	48.61
Sanderson Fert. & Chem. Co., New Haven, Ct.								
Muriate of Potash	N. Hatfield	44.00	43.05	2.21	32	1.29	50.64	50.56
Swift's Lowell Fert. Co., Boston, Mass.								
Muriate of Potash " " "	Taunton Marblehead	40.00 42.00	43.79	‡6.37	316 573	1.62	51.52	50.00
KAINIT.								
American Agric. Chem. Co., Boston, Mass.								
Kainit	Seekonk	11.25	11.30	‡ .44	267	4.24	13.29	12.00
Bowker Fert. Co., Boston, Mass.								
Bowker's Kainit	Man'f'r's sample	—	11.39	—	875	1.95	13.40	12.00

Phosphoric Acid Compounds.

Name of Manufacturer and Brand.	Where Sampled.	Dealer's Cash Price per Ton.	Comparative Valuation per Ton.	Percentage Difference Between Selling Price and Valuation.	Laboratory Number.	Moisture.	Phosphoric Acid in 100 lbs. Water Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.
DISSOLVED BONE BLACK.													
Amer. Agr. Chem. Co., Boston, Mass.													
Dissolved Bone Black	M'f'r's sample	—	$12 92	..	363	10 37	10 32	3.72	.51	15 05	16 00	14 54	15 00
National Fert. Co., Boston, Mass.													
Dissolved Bone Black	Bradstreet	—	14 63		3	14 27	11 71	4 73	.90	17 34	17 00	16 44	16.00
Whitman & Pratt Rend. Co., Lowell, Mass.													
Dissolved Bone Black	Northampton	$10.00	13 39	41 00	241	10 40	11 36	3 07	.66	15 59	—	14 93	15 00
ACID PHOSPHATE.													
Amer. Agr. Chem. Co., Boston, Mass.													
Plain Superphosphate	Amherst	16.00	13 34	10 94	141	12.67	11 61	2 22	2 73	16 61	15 00	13 33	14 00
Bowker Fert. Co., Boston, Mass.													
Bowker's Acid Phosphate " " "	Northampton Florence	17 00 15.93	13 00	10 49	205 732	9 06	12.12	2 93	1 23	16 33	15 00	15 10	14 00
Lister's Agr. Chem. Works, Newark, N. J.													
Buyer's Choice Acid Phosphate	So. Hadley	13.50	13 21	2 95	129	13 40	11.36	2.99	.33	15 23	15 00	14 35	14 00
National Fert. Co., Boston, Mass.													
Acid Phosphate	W. Springfield	14.00	12 46	12 36	176	7 30	7 05	6.52	2 22	15 79		13 57	
Olds & Whipple, Hartford, Conn.													
Acid Phosphate	Florence		13 33		783	9.00	1 19	19.31	3 64	24 64		21 00	22 00
Patrons' Co-op. Associat'n, Boston.													
Acid Phosphate " "	Campello Marlboro	17 00	14 65	16 04	344 345	11 32	15.03	1 35	.10	16 48	12 00	16 33	
Sanderson Fert. & Chem. Co., New Haven.													
Plain Superphosphate	N. Hatfield	16.00	12 35	29.56	35	14 41	9 67	3.51	2.10	15 28		13 18	14 00
Swift's Lowell Fert. Co., Boston, Mass.													
Acid Phosphate " "	Taunton W. Berlin	14.00 14.00	12 18	14 94	306 700	9 55	10 12	3 17	1.33	14 62	14 00	13 29	12 00
Acid Phosphate	Concord	16 00	10.39	46 92	360	3 55	3 02	3.14	.07	12 93	14 00	12 06	12 00
Acid Phosphate	Framingham	17.00	13.36	27 25	512	9.64	10 66	4.11	1.20	15 97		14 77	14 00
Whitman & Pratt Rend. Co., Lowell, Mass.													
Acid Phosphate	Northampton	14 00	11 92	16 44	233	10 39	10 31	2 73	.39	13 93		13 04	12 00
BASIC SLAG PHOSPHATE.													
Amer. Agric. Chem. Co., Boston, Mass.													
Basic Slag	Sunderland	17 00	†12.55	35 46	164	.32	-	14.76	2 10	16 86	17 00	14 76	
Coe-Mortimer Co., New York City.													
Basic Slag Phosphate	W. Springfield	14.00	†13 04	7 36	100	.32	—	15.22	2 15	17 37	17 00	15 22	15.00*
Basic Slag Phosphate	Concord	—	†13 37	—	377	.09	—	15.97	1.48	17 45	17 00	15 97	15.00**
Basic Slag Phosphate	Marlboro	—	†13.05	—	340	.07	—	14.61	3.40	18 01	17 00	14 61	15.00*
Patrons' Co-op. Association, Boston.													
Basic Slag	Campello	18.00	†13.24	35.95	343	.16	—	15.32	2.46	17.78	18 00	15.32	—

*No. 178 Stock of 1909

**Guarantee based on Wagner's method of analysis

†Valuation based upon availability of phosphoric acid as determined by Wagner's method of analysis, which shows the phosphoric acid dissolved by a 2 per cent. citric acid solution. The available ...

Lava Fertilizers.

Brand.	Laboratory Number.	Moisture.	Organic and Volitile Matter.	Insoluble Matter.	Nitrogen. Water Soluble.	Nitrogen. Organic.	Nitrogen. Total.	Potash (K_2O). Water Soluble.	Potash (K_2O). Total.	Total Phosphoric Acid.	Calcium Oxide.	Magnesium Oxide.	Iron and Aluminum Oxides.	Sodium Oxide.	Comparative Valuation per Ton.	Cash Price per Ton F. O. B. Passaic, N. J.
Vesuvius Brand	2021	5.47	38.59	28 55	.06	.38	1.34	.11	.28	11	12 36	6 19	2 23	4.23	$7.60	$20 00
Pelee "	2022	5 31	33.63	29.40	.71	.62	1 33	39	.42	.11	13 16	6 66	2 32	5 65	6.05	20 00
Tacoma "	2023	1.04	28 41	20.08	—	—	.19	03	.18	05	25 10	7 48	1 33	4 12	2 54	15 00
Chimborazo "	2024	4.99	33.40	34.62	.29	.93	1.22	.01	.23	.04	9 34	4 41	2 08	4 42	5 15	20.00
Aetna "	2025	4.03	34.26	28.87	—	—	.62	04	.21	none	10 77	4 50	2.36	0.03	3.24	22.00
Timboro "	2026	3.63	33.41	19.03	2.01	.65	3.56	.23	.28	27	8 37	4.08	17 58	11 05	12 37	30 00
Mauna Loa "	2027	4.09	26.94	55.47	1.56	.61	2.17	16	.59	13	1 96	1 08	2 36	3.54	7 79	20 00
Coba "	2028	.68	26 33	5.99	9.56	.11	9.67	1.04	1 05	none	11.08	5 78	.68	24 05	33.44	45.00
Spata "	2029	9.71	55.21	9.84	.36	1.66	2.02	.04	.05	.13	7 33	3 70	2 35	4 63	3.41	18 00
Luvine "	2030	3 35	29 32	19.25	—	—	.54	.17	.22	.18	18 01	7.07	1 52	0 04	3 52	15.00
Carbonate of Lava	2031	.14	7 60	17.31	—	—	.10	.02	11	Sl. trace	31 07	11 67	1 60	51	2 45	12 00
Chloride " "	2032	.27	15 44	25 33	—	—	.12	03	17	trace	0 61	3 23	1 35	22 36	36	20 00