New York Agricultural Experiment Station.

GENEVA, N. Y.

SOME FACTS ABOUT COMMERCIAL FERTILIZERS IN NEW YORK STATE.

L. L. VAN SLYKE.
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The Bulletins published by the Station will be sent free to any farmer applying for them.

*Connected with Fertilizer Control.
†Absent on leave.
‡In Second Judicial Department.
BULLETIN No. 230.

SOME FACTS ABOUT COMMERCIAL FERTILIZERS IN NEW YORK STATE.

L. L. VAN SLYKE.

SUMMARY.

1. The farmers of New York State expend four and one-half million dollars a year for commercial fertilizers. Therefore, good business judgment should be used in such purchases. The object of this bulletin is to point out how better economy may be realized in purchasing plant-foods.

2. The general practice among farmers is to buy complete medium or low-grade fertilizers in preference to high-grade fertilizers. In high-grade goods, the cost of plant-food is considerably less than in fertilizers of lower grade.

3. Available phosphoric acid is cheapest in the form of dissolved rock (acid phosphate). Bone-meal furnishes a cheap source of phosphoric acid in less available form. Nitrate of soda is one of the cheapest sources of nitrogen, while bone is another. Nitrogen in the form of dried blood is rather high. Potash in the form of muriate is the cheapest source of potash. In mixtures of fertilizing materials, whether complete or incomplete, the plant-food usually costs more than in unmixed materials.
4. When purchasing mixed fertilizers, farmers are advised to purchase only high-grade goods, and then to make a commercial valuation to compare with the selling price. Even in high-grade goods, the selling price should not exceed the commercial valuation by more than $5.

5. For greatest economy, farmers are advised to purchase unmixed materials and do their own mixing; or, in the case of clubs, several farmers can purchase their unmixed materials and hire a fertilizer manufacturer to do the mixing for them.

6. Illustrations are given of three types of plant-food mixtures: (a) A mixture with phosphoric acid high in amount in relation to nitrogen and potash; (b) a mixture of high-grade, in which the potash is high in amount in relation to nitrogen and phosphoric acid; (c) a mixture of high-grade, containing nitrogen, phosphoric acid and potash in quantities more nearly equal than in the other mixtures.

7. A general review is given covering the work of the Station in collecting and analyzing fertilizers during the last five years. In general, it is shown that the number of manufacturers of commercial fertilizers and of brands of fertilizers has decreased since 1899, owing to the requirement of a license fee of $20 for each brand offered for sale. In respect to composition, the average variation from year to year has been within narrow limits. The number of brands found below guarantee has steadily decreased. The average selling price per ton has also gradually decreased and also the difference between the selling price and commercial valuation.
INTRODUCTION.

The farmers of New York State expend for plant-food in the form of commercial fertilizers about four and one-half million dollars a year. Only two or three other states show a larger annual expenditure in this line. While many dairy farmers depend mainly or altogether upon farm-produced or domestic manures as sources of plant-food, all who most profitably and continuously raise cereals, hay and forage crops, potatoes, fruits, flowers, plants, nursery stock, garden crops, hops, tobacco, sugar beets, crops under glass, etc., are compelled to use liberal quantities of commercial fertilizers. The amount of these materials used differs with the character of the agriculture in different sections of the State. The following data, taken from the last U. S. census report, are of interest in this connection as indicating in what portions of the State the largest amount of money is expended for commercial fertilizers:

Long Island (Counties of Nassau, Queens and Suffolk) $1,241,280
Monroe County ........................................ 214,000
Erie County ........................................... 186,370
Cayuga County .......................................... 131,260
Oneida County .......................................... 112,630
Onondaga, Ontario, Wayne, Ulster, Chautauqua, each from $102,000 to ........................................ 110,000

These 12 counties use about one-half of the commercial fertilizers used in the entire State.

In view of these large expenditures, it becomes a matter of economic importance to the many farmers who use materials of this class to exercise good business judgment in the purchase of their plant-food. It is a prominent fact that a very large proportion of the commercial fertilizers used in New York is in the form of so-called complete fertilizers, that is, mixtures containing compounds of nitrogen, phosphoric acid and potash. These vary greatly in composition and in price.

It is the object of this bulletin to call attention to such differences in cost of plant-food as we have actually found in the case of various commercial fertilizers sold in this State during 1902. There are certain noticeable facts which should be made known to
purchasers of complete fertilizers, in order that in the future they may buy more economically than they have in the past. The data presented are based upon the analyses of samples collected during the spring and summer of 1902, contained in Bulletin No. 216.

**DISCUSSION OF DATA.**

**CLASSIFICATION OF FERTILIZERS.**

For the purpose of the study presented in the following pages, we have made an arbitrary division of complete fertilizers into four separate classes, based upon their commercial valuation, that is, the price at which the separate unmixed materials in one ton of fertilizer could be purchased for cash at retail at the seaboard. Our classification is as follows:

1. *Low-grade fertilizers*, those having a commercial valuation of less than $16 a ton.

2. *Medium-grade fertilizers*, those having a commercial valuation greater than $16 and less than $20 a ton.

3. *Medium high-grade fertilizers*, those having a commercial valuation greater than $20 and less than $25 a ton.


We will now study comparatively these four classes of complete fertilizers from several different points of view.

**DISTRIBUTION OF FERTILIZERS AMONG DIFFERENT CLASSES.**

Taking the complete fertilizers, whose analyses are given in Bulletin No. 216, we find that, of the 688 samples collected, they were distributed among the four different classes, as follows:

- Low-grade ......... 171, or 25 per ct. of all.
- Medium-grade ...... 236, or 34.3 per ct. of all.
- Medium high-grade... 163, or 23.7 per ct. of all.
- High-grade ........ 118, or 17 per ct. of all.

Using these data as a basis, we are justified in saying that, of the complete fertilizers sold in this State during 1902, nearly 60 per ct. was medium or low-grade in character. Only about one-sixth could be classed as strictly high-grade in composition. Thus, the general tendency among farmers is to purchase complete fertilizers that are not even medium high-grade in character.
COMPOSITION OF FERTILIZERS IN DIFFERENT CLASSES.

If we compare our four different classes of complete fertilizers in respect to the average amounts of nitrogen, available phosphoric acid and potash contained in them, we have the following table:

<table>
<thead>
<tr>
<th>Class of fertilizers</th>
<th>In 100 pounds of fertilizer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-grade</td>
<td>1.22</td>
</tr>
<tr>
<td>Medium-grade</td>
<td>1.70</td>
</tr>
<tr>
<td>Medium high-grade</td>
<td>2.47</td>
</tr>
<tr>
<td>High-grade</td>
<td>4.00</td>
</tr>
</tbody>
</table>

In the fourth column, under the heading "pounds of total plant-food," we give the sum of the nitrogen, available phosphoric acid and potash. We notice the following points in connection with this table:

(1) The percentage of phosphoric acid does not vary greatly in the different classes of fertilizers.

(2) The percentage of nitrogen and of potash increases in the higher grades.

(3) The total amount of plant-food in 100 pounds of fertilizer increases in the higher grades, this increase being due to increase of nitrogen and potash.

(4) Representing the amount of nitrogen in each grade of fertilizer as 1, we have the following proportions of available phosphoric acid and potash in the different grades:

<table>
<thead>
<tr>
<th></th>
<th>Nitrogen</th>
<th>Available phosphoric acid</th>
<th>Potash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-grade</td>
<td>1</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Medium-grade</td>
<td>1</td>
<td>5.5</td>
<td>2</td>
</tr>
<tr>
<td>Medium high-grade</td>
<td>1</td>
<td>3.5</td>
<td>2.5</td>
</tr>
<tr>
<td>High-grade</td>
<td>1</td>
<td>2</td>
<td>1.8</td>
</tr>
</tbody>
</table>
This form of statement clearly brings out the fact that fertilizers of different grades differ not only in respect to the amounts of plant-food contained, but that the different elements of plant-food bear a different ratio to each other in the different grades. Thus, as the grade grows higher, the proportion of phosphoric acid to nitrogen grows less, or, stated another way, the proportion of nitrogen to phosphoric acid increases. In low-grade fertilizers, there is 7 times as much phosphoric acid as nitrogen, while in high-grade goods there is only twice as much. While the ratio of nitrogen to potash varies, the variation is not great.

(5) The ratio of nitrogen, phosphoric acid and potash found in high-grade fertilizers approximates much more closely the ratio found in plants than does the ratio existing in low-grade goods.

**RELATION OF SELLING PRICE TO COMMERCIAL VALUATION.**

In the table below, we give the average actual selling price and the average commercial valuation in the case of each grade of fertilizers, and also the excess of selling price over the commercial valuation. As the commercial valuation represents the average retail price of the separate unmixed materials contained in one ton of fertilizer at the seaboard, the excess of selling price above commercial valuation represents the cost of mixing, the freight, profits, and cost of business.

**Selling Price and Commercial Valuation of Different Grades of Fertilizers.**

<table>
<thead>
<tr>
<th>Selling Price</th>
<th>Low-grade.</th>
<th>Medium-grade.</th>
<th>Medium high-grade.</th>
<th>High-grade.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest</td>
<td>$16.00</td>
<td>$18.00</td>
<td>$20.00</td>
<td>$25.00</td>
</tr>
<tr>
<td>Highest</td>
<td>34.00</td>
<td>30.00</td>
<td>40.00</td>
<td>44.00</td>
</tr>
<tr>
<td>Average</td>
<td>23.00</td>
<td>24.85</td>
<td>28.30</td>
<td>32.80</td>
</tr>
<tr>
<td>Commercial Valuation</td>
<td>9.51</td>
<td>16.01</td>
<td>20.00</td>
<td>25.07</td>
</tr>
<tr>
<td>Lowest</td>
<td>15 98</td>
<td>19.90</td>
<td>24.90</td>
<td>37.25</td>
</tr>
<tr>
<td>Highest</td>
<td>14 42</td>
<td>17.70</td>
<td>22.15</td>
<td>27.70</td>
</tr>
</tbody>
</table>
Selling Price and Commercial Valuation etc.—(Concluded.)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest</td>
<td>3.60</td>
<td>1.57</td>
<td>0.62</td>
<td>7.25*</td>
</tr>
<tr>
<td>Highest</td>
<td>21.74</td>
<td>12.53</td>
<td>15.20</td>
<td>10.30</td>
</tr>
<tr>
<td>Average</td>
<td>8.58</td>
<td>9.15</td>
<td>6.15</td>
<td>5.10</td>
</tr>
</tbody>
</table>

*Commercial valuation exceeds selling price.

A study of this table suggests several points of interest.

1. We notice that the selling price varies greatly for any one grade of goods. For example, in the low-grade goods, the lowest selling price was $16 a ton, and the highest $34, a tremendous difference when we consider that there was a difference of not more than $6.50 in their actual plant-food value. In all the grades we find a variation in selling price entirely disproportionate to the difference in value of the plant-food contained in them. In the high-grade goods, we find the difference somewhat less marked but still unreasonably great.

2. The excess of selling price over commercial valuation is greater in low-grade and medium goods than in high-grade goods; in other words, the high-grade goods sell, on an average, nearer to their actual plant-food value than do low-grade goods.

3. While the data contained in the preceding table do not show it, our records show that the same brand of goods is often sold by different agents at prices differing as much as $5 to $8 a ton and this, too, under circumstances that do not appear to justify any such difference. In some cases the question of price appears to depend, not upon the value of the goods, but upon the judgment of the seller as to how much he can get.

Cost of One Pound of Plant-food in Different Grades.

The difference in cost of plant-food in high-grade and low-grade fertilizers can best be brought out by showing the cost of one pound of plant-food as purchased by the consumer. In the following table we state the lowest, highest and average cost of one pound of nitrogen, of available phosphoric acid and of potash as actually purchased by consumers in 1902.
### Cost of One Pound of Plant-Food in Different Grades of Fertilizers.

<table>
<thead>
<tr>
<th></th>
<th>Low grade.</th>
<th>Medium grade.</th>
<th>Medium high-grade.</th>
<th>High grade.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of one pound of Nitrogen.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowest</td>
<td>20</td>
<td>17.9</td>
<td>17</td>
<td>13.3</td>
</tr>
<tr>
<td>Highest</td>
<td>36.8</td>
<td>28.3</td>
<td>26</td>
<td>25.0</td>
</tr>
<tr>
<td>Average</td>
<td>26.3</td>
<td>23.2</td>
<td>21</td>
<td>19.6</td>
</tr>
<tr>
<td>Cost of one pound of Available Phosphoric Acid.</td>
<td>6.1</td>
<td>5.4</td>
<td>5.1</td>
<td>4.25</td>
</tr>
<tr>
<td>Lowest</td>
<td>11.1</td>
<td>8.0</td>
<td>8.1</td>
<td>7.9</td>
</tr>
<tr>
<td>Highest</td>
<td>8.0</td>
<td>7.0</td>
<td>6.4</td>
<td>6.0</td>
</tr>
<tr>
<td>Cost of one pound of Potash.</td>
<td>5.2</td>
<td>4.6</td>
<td>4.4</td>
<td>3.4</td>
</tr>
<tr>
<td>Lowest</td>
<td>9.5</td>
<td>7.3</td>
<td>6.9</td>
<td>6.7</td>
</tr>
<tr>
<td>Highest</td>
<td>6.8</td>
<td>6.0</td>
<td>5.4</td>
<td>5.0</td>
</tr>
</tbody>
</table>

From these data, we readily see the truth of the following statements:

1. The cost of one pound of plant-food, whether nitrogen, phosphoric acid or potash, is greatest in low-grade, and least in high-grade, fertilizers. One purchaser of low-grade goods paid 36.8 cents a pound for nitrogen, while the highest price paid in high-grade goods was 26 cents, which is less than the average paid for nitrogen in low-grade goods. The least amount paid for one pound of nitrogen in low-grade goods was 20 cents, in high-grade goods 13.3 cents. Similar relations hold good in respect to the other elements of plant-food.

2. In general, the higher the grade of goods, the lower the cost of each pound of plant-food.

### The Cost of Plant-Food in Mixtures Containing Phosphoric Acid and Potash.

Considerable quantities of commercial fertilizers are sold in the form of mixtures of dissolved phosphate rock (acid phosphate) and muriate of potash, under such names as "alkaline bone and potash," "bone and potash," "dissolved bone and potash," "soluble bone and potash," "alkaline dissolved bone," "acidulated bone and potash," "alkaline phosphate," and vari-
ous other special names. For some years these fertilizers have been popular with many farmers. As they contain no nitrogen, they can be sold at prices that look cheap in comparison with the prices of complete fertilizers. Many farmers consider cost only and not composition in purchasing fertilizers.

In 1902 we found in the market 58 different brands of this kind of fertilizer. In average composition, these mixtures contained 11.10 per ct. of available phosphoric acid and 4 per ct. of potash. The selling price varied from $13.50 to $26 a ton, averaging $19.17, while the commercial valuation varied from $4.69 to $19.01, averaging $14.50. The average selling price exceeded the average commercial valuation $4.67 a ton; in one case, the difference was as great as $13.40. The cost of one pound of available phosphoric acid varied from 4.3 cents to 19.5 cents and averaged 6.6 cents. The cost of one pound of potash varied from 3.7 cents to 16.5 cents and averaged 5.6 cents.

From the foregoing data, we conclude:

(1) That, in cost of plant-food, the lowest prices compared favorably with the lowest prices found in complete high-grade mixtures, while the highest prices were greatly in excess even of the highest prices found in low-grade complete fertilizers. The average prices were somewhat above those found in medium high-grade complete fertilizers.

(2) That the selling prices of mixtures of acid phosphate and potash salts are subject to much wider variations than in complete goods and average dearer than complete high-grade goods.

COST OF PLANT-FOOD IN THE FORM OF ACID PHOSPHATE.

Most of the phosphoric acid in the market is dissolved rock, no matter under what name sold, especially if it contains no guaranteed nitrogen. Real dissolved bone and bone-black are comparatively rare. In 1902 we collected 34 different brands of goods containing only phosphoric acid compounds. In these brands, the available phosphoric acid varied from 11.42 to 17.10 per ct., averaging 14.56 per ct. The selling price varied from $13 to $25 a ton and averaged $14.95. The commercial valuation varied from $11.42 to $17.10 and averaged $14.56 a ton. In one case, the selling price exceeded the commercial valuation $13.58. The cost of one pound of available phosphoric acid
varied from 4.4 to 11 cents and averaged 5.1 cents. On an average, the available phosphoric acid cost less in this form than in mixed goods, but the variation was much greater than it should be. If we did not have a record of the facts, it would be difficult to believe that any seller of fertilizers could bring himself to charge $25 a ton for plain acid phosphate. It is inconceivable that any circumstances should exist that could justify such an enormous overcharge.

COST OF PLANT-FOOD IN THE FORM OF BONE-MEAL.

In the case of 23 different brands of bone-meal, the nitrogen varied from 1.26 to 5.56 per ct. and averaged 3.32 per ct.; the total phosphoric acid varied from 13.42 to 28.48 per ct. and averaged 23.48 per ct. The selling price varied from $21.50 to $35 and averaged $28.50; the commercial valuation varied from $26.28 to $35.75 and averaged $28.74, exceeding the selling price somewhat. The cost of one pound of nitrogen in bone-meal varied from 11.5 to 32 cents and averaged 14.9 cents; the cost of one pound of available phosphoric acid varied from 3.1 to 8.6 cents and averaged 3.96 cents. As compared with the cost of nitrogen and phosphoric in complete fertilizers, these forms of plant-food are considerably cheaper when purchased in bone, but it should be kept in mind that the phosphoric acid in bone-meal is considerably less readily available than in the form of dissolved rock. Where moderately slow action of phosphoric acid is desired, bone-meal may answer the purpose, but for rapid action, one should use the readily soluble forms.

COST OF NITROGEN IN NITRATE OF SODA.

In the samples of nitrate of soda examined by us in 1902, the percentage of nitrogen varied from 15.21 to 16.20, averaging 15.77. The selling price varied from $42 to $48.50, averaging $44.12. The commercial valuation varied from $45.63 to $48.60, averaging $47.30, which was considerably in excess of selling price. The cost of one pound of nitrogen in this form varied from 13 to 15 cents and averaged 13.9 cents. This was much cheaper than the cost of nitrogen in the form of complete fertilizers.
COST OF NITROGEN IN DRIED BLOOD.

In the samples of dried blood analyzed by us in 1902, the percentage of nitrogen varied from 8.72 to 11.88, averaging 10.38. The selling price varied from $35 to $40, averaging $38.33. The commercial valuation varied from $28.78 to $39.20, averaging $34.26. The cost of one pound of nitrogen varied from 14.8 to 22.9 cents, averaging 18.5 cents. This makes the price of the nitrogen of dried blood higher than that in nitrate of soda and bone-meal but somewhat cheaper than nitrogen in complete fertilizers.

COST OF POTASH IN MURIATE OF POTASH.

The percentage of potash was found to vary from 49.06 to 52.04, averaging 50.46. The selling price varied from $46 to $48 and averaged $46.75. The commercial valuation varied from $41.70 to $44.23, averaging $42.89. The cost of one pound of potash varied from 4.4 to 4.9 cents and averaged 4.6 cents. In average price, potash in the form of muriate was cheaper than in the highest grade mixed goods.

TABULATED GENERAL SUMMARY.

In the table following, we give a general summary of the data that have been presented, showing the cost of one pound of plant-food in different forms to consumers.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-grade complete fertilizers</td>
<td>20</td>
<td>36.8</td>
<td>26.3</td>
</tr>
<tr>
<td>Medium-grade complete fertilizers</td>
<td>17.9</td>
<td>28.3</td>
<td>23.2</td>
</tr>
<tr>
<td>Medium high-grade complete fertilizers</td>
<td>17</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>High-grade complete fertilizers</td>
<td>13.3</td>
<td>26</td>
<td>19.6</td>
</tr>
<tr>
<td>Dried blood</td>
<td>14.8</td>
<td>22.9</td>
<td>18.5</td>
</tr>
<tr>
<td>Bone-meal</td>
<td>11.5</td>
<td>32</td>
<td>14.9</td>
</tr>
<tr>
<td>Nitrate of soda</td>
<td>13</td>
<td>15</td>
<td>13.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phosphoric Acid in</th>
<th>Lowest.</th>
<th>Highest.</th>
<th>Average.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-grade complete fertilizers</td>
<td>6.1</td>
<td>11.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Medium-grade complete fertilizers</td>
<td>5.4</td>
<td>8.6</td>
<td>7.0</td>
</tr>
<tr>
<td>Medium high-grade complete fertilizers</td>
<td>5.1</td>
<td>8.1</td>
<td>6.4</td>
</tr>
<tr>
<td>High-grade complete fertilizers</td>
<td>4.25</td>
<td>7.9</td>
<td>6.0</td>
</tr>
<tr>
<td>Phosphoric acid and potash mixtures</td>
<td>4.3</td>
<td>19.5</td>
<td>6.6</td>
</tr>
<tr>
<td>Acid phosphate or dissolved rock</td>
<td>4.4</td>
<td>11.0</td>
<td>5.1</td>
</tr>
<tr>
<td>Bone (total)</td>
<td>3.1</td>
<td>8.6</td>
<td>3.96</td>
</tr>
</tbody>
</table>
COST OF ONE POUND OF PLANT FOOD TO CONSUMERS.—(Concluded.)

<table>
<thead>
<tr>
<th></th>
<th>Lowest.</th>
<th>Highest.</th>
<th>Average.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POTASH IN</strong></td>
<td>Cents.</td>
<td>Cents.</td>
<td>Cents.</td>
</tr>
<tr>
<td>Low-grade complete fertilizers</td>
<td>5.2</td>
<td>9.5</td>
<td>6.8</td>
</tr>
<tr>
<td>Medium-grade complete fertilizers</td>
<td>4.6</td>
<td>7.3</td>
<td>6.0</td>
</tr>
<tr>
<td>Medium high-grade complete fertilizers</td>
<td>4.4</td>
<td>6.9</td>
<td>5.4</td>
</tr>
<tr>
<td>High grade complete fertilizers</td>
<td>3.4</td>
<td>6.7</td>
<td>5.0</td>
</tr>
<tr>
<td>Phosphoric acid and potash mixtures</td>
<td>3.7</td>
<td>16.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Muriate of potash</td>
<td>4.4</td>
<td>4.9</td>
<td>4.6</td>
</tr>
</tbody>
</table>

PURCHASE OF PLANT-FOOD.

The data contained in the preceding tables afford a good basis for calling the attention of farmers to certain facts and for making suggestions connected with the purchase of plant-food.

(1) Farmers are advised, before purchasing, to obtain for themselves prices at which they can actually buy plant-food. It should be kept in mind that the prices given as trade-values in Station bulletins are only averages and do not represent accurately all conditions of the market without regard to time or place. Actual trade-values necessarily vary with localities and with different times of the year. The true values to use in making a commercial valuation of plant-food are those figures which represent the actual prices at which the farmer can purchase the elements of plant-food at a given time. Quotations should be obtained by making inquiries of several manufacturers, asking at what prices they will furnish the specific forms of plant-food that one wishes to use. The prices thus found enable the farmer to make out his own schedule of valuations and they apply accurately to his special conditions.

The following parties have paid license fees permitting them to sell the unmixed materials indicated during 1903:

*Nitrate of soda.*

Bowker Fertilizer Co., 68 Broad St., New York City.
E. Frank Coe Co., 135 Front St., New York City.
The American Agricultural Chemical Co., 26 Broadway,
New York City.
E. Aspinall, 100 Beekman St., New York City.

*Muriate of potash.*


*Kainit.*


Such materials as bone and acid phosphate can be purchased from any large dealer in fertilizers.

(2) *Shall farmers purchase mixed fertilizers or unmixed materials?*

It has been represented to farmers that peculiar virtues are imparted to the elements of plant-food by proper mixing and that this proper mixing can be accomplished only by means not at the command of farmers. Such statements are misrepresentations, based either upon the ignorance of the person who makes them or upon his anxiety to sell mixed goods. Nitrate of soda, for illustration, does its work in plant nutrition in exactly the same manner whether it is added to the soil as part of a mixture or whether the ingredients of the mixture are applied separately. The availability of plant-food is not usually affected by mixing. Other conditions determine whether a fertilizer shall be applied in mixed form or in separate materials.

As to the ability of farmers to mix their own fertilizers, no doubt exists except in the minds of those who desire to sell goods ready mixed. The main consideration that presents itself as between purchasing mixed and unmixed forms of plant-food is the question of economy. What do the figures published above show on this point?

(a) Each pound of nitrogen in mixed fertilizers cost the farmer in this State last year over 20 cents, on an average, while the schedule price is 16½ cents. Hence, on an average, farmers paid for their nitrogen in mixed goods, at least 25 per cent. more than it would have cost them in unmixed forms.

(b) Each pound of available phosphoric acid in mixed fertilizers cost the farmer over 6 cents and in dissolved phosphate, purchased from retail dealers, it cost about 5 cents; while, purchased at schedule prices, it would be 4½ cents; but as a matter of fact farmers were able to purchase available phosphoric acid in the form of dissolved rock for even less.
In this connection, it may be well to state that soluble phosphoric acid has the same value, pound for pound, whatever its source. At present dissolved rock is the cheapest source and this is the form in which farmers should buy phosphoric acid, if they desire to receive the largest amount of actual plant-food for their money.

(c) Each pound of potash, mostly in form of muriate, cost the farmer nearly 6 cents in mixed fertilizers, while in one sample of muriate purchased, the cost was 4.4 cents.

It can readily be seen that, in point of economy, under the conditions actually prevailing last year, farmers could buy their plant-food at much lower prices in unmixed forms than in mixed goods.

(3) How can plant-food be purchased most cheaply?

If each farmer by himself buys plant-food, he can undoubtedly secure most economical results by getting unmixed materials. Still better prices can be realized by co-operation. This method is being effectively carried out in many parts of the State by granges and by farmers' clubs. The unmixed materials are purchased in quantity and distributed to individuals, each of whom mixes his own materials; or the goods are mixed by some manufacturer of fertilizers in accordance with specifications calling for a certain formula and certain ingredients, the mixed goods being delivered to a purchasing agent, who distributes them to individual consumers. Such methods always depend upon cash payment and usually result in the most economical purchase of plant-food.

(4) Purchasing mixed fertilizers.

In purchasing mixed fertilizers, farmers should always make a commercial valuation based on the guaranteed composition of the fertilizer and compare this with the selling price. The difference should not exceed $5. Taking the precaution to compare the commercial valuation and the selling price, it is always wise to purchase high-grade fertilizers. These should furnish plant-food at a less cost than fertilizers of lower grade, owing to lower cost of freight per pound of actual plant-food and lower cost of sucking, etc.
ILLUSTRATIONS OF PLANT-FOOD MIXTURES.

For illustration we will give a few examples, showing how we can prepare different mixtures by using the same materials in varying quantities.

*Mixture No. 1.*

250 pounds nitrate of soda, containing 37.5 pounds of nitrogen,
200 pounds cottonseed-meal, containing 12.5 pounds of nitrogen,
1,300 pounds acid phosphate, containing 180 pounds of available phosphoric acid,
120 pounds muriate of potash, containing 60 pounds of potash,
130 pounds land plaster or other inert material,

This gives us a mixture containing in one ton about 50 pounds of nitrogen, 180 pounds of available phosphoric acid and 60 pounds of potash or, on the basis of 100 pounds, 2.5 per ct. of nitrogen, 9 per ct. of available phosphoric acid and 3 per ct. of potash. In this mixture, we have relatively small amounts of nitrogen and potash in relation to phosphoric acid. The cottonseed-meal, besides furnishing some plant-food, enables us to make a mixture of good mechanical properties that behaves well in a drill.

*Mixture No. 2:*

300 pounds nitrate of soda,
300 pounds cottonseed-meal,
500 pounds bone-meal,
500 pounds acid phosphate,
400 pounds muriate of potash;

or, using only acid phosphate, we may have the following:

400 pounds nitrate of soda,
300 pounds cottonseed-meal,
900 pounds acid phosphate,
400 pounds muriate of potash.

In this mixture, we have about 4 per ct. of nitrogen, 6 per ct. of available phosphoric acid and 10 per ct. of potash, in which the potash is high relative to the other constituents. It will be seen that this mixture differs from the first in being of higher grade, particularly in respect to nitrogen and potash. The use of bone in place of part of the acid phosphate, as indicated in one
form of mixture No. 2, may be found desirable in the case of crops whose growth covers a comparatively long period, when a portion of the phosphoric acid is not needed at once.

Mixture No. 3.

400 pounds nitrate of soda,
300 pounds cottonseed-meal,
500 pounds bone-meal,
500 pounds acid phosphate,
300 pounds muriate of potash;
or, using only acid phosphate, we have the following:
475 pounds nitrate of soda,
275 pounds cottonseed-meal,
950 pounds acid phosphate,
300 pounds muriate of potash.

In this mixture we have about 5 per ct. of nitrogen, 7.5 per ct. of available phosphoric acid and 7.5 per ct. of potash; the nitrogen is high in relation to phosphoric acid and potash, and also the three elements of plant-food are in proportions more nearly equal than in the preceding mixtures. This is also a high-grade mixture.

These three mixtures are given chiefly to illustrate different types of plant-food mixtures that may be found in the market.

GENERAL REVIEW OF RESULTS OF THE WORK OF THE FERTILIZER DEPARTMENT FOR FIVE YEARS.

In tabulated form, we present below some of the results that have been accomplished during the last five years by this Station in its work of collecting and analyzing commercial fertilizers.

| Number of Manufacturers and Brands of Commercial Fertilizers. |
|-------------------|-------|-------|-------|-------|-------|
|                   | 1898  | 1899  | 1900  | 1901  | 1902  |
| Number of manufacturers | 193   | 190   | 113   | 82    | 71    |
| Number of different brands offered for sale | 1,900 | 2,268 | 600   | 550   | 590   |
| Number of samples collected by Station | 1,427 | 1,004 | 638   | 963   | 924   |
| Number of different brands collected and analyzed | 901   | 776   | 450   | 465   | 450   |
It will be noticed that the number of manufacturers of commercial fertilizers decreased very largely in 1900 as compared with preceding years. This marked decrease was due to a new provision of the fertilizer law, first taking effect in 1900, requiring manufacturers to pay a license fee of $20 on each brand offered for sale in this State. Small mixers in the State discontinued their business and manufacturers outside of New York, whose business did not warrant the payment of the license fee, withdrew their goods and business. The number of manufacturers was still farther apparently decreased in 1901 by the combination of over 20 companies under one name.

The most marked effect of the requirement of a license fee for each brand was to reduce the number of brands offered for sale. The increase of different brands had gone on rapidly from a few hundred, until in 1899 it reached the phenomenal number of 2,268. This number fell at once in 1900 to 600 and has since remained between that number and 550. The multiplication of brands by manufacturers had become a most serious abuse, entailing an immense amount of work and expense on the Station in the collection and analysis of the different brands. It was possible to reach this abuse only by the requirement of a license fee.

**The Composition of Fertilizers Analyzed.**

<table>
<thead>
<tr>
<th></th>
<th>1898</th>
<th>1899</th>
<th>1900</th>
<th>1901</th>
<th>1902</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen found, per ct.</td>
<td>2.20</td>
<td>1.97</td>
<td>2.16</td>
<td>2.01</td>
<td>2.24</td>
</tr>
<tr>
<td>Nitrogen found above guarantee, per ct.</td>
<td>0.14</td>
<td>0.14</td>
<td>0.10</td>
<td>0.12</td>
<td>0.32</td>
</tr>
<tr>
<td>Available phosphoric acid found, per ct.</td>
<td>8.65</td>
<td>8.80</td>
<td>8.90</td>
<td>8.80</td>
<td>8.62</td>
</tr>
<tr>
<td>Available phosphoric acid found above guarantee, per ct.</td>
<td>1.00</td>
<td>0.93</td>
<td>1.28</td>
<td>1.13</td>
<td>0.91</td>
</tr>
<tr>
<td>Potash found, per ct.</td>
<td>4.91</td>
<td>4.76</td>
<td>4.84</td>
<td>4.47</td>
<td>4.67</td>
</tr>
<tr>
<td>Potash found above guarantee, per ct.</td>
<td>0.24</td>
<td>0.28</td>
<td>0.41</td>
<td>0.34</td>
<td>0.22</td>
</tr>
<tr>
<td>Water-soluble nitrogen found, per ct.</td>
<td>0.94</td>
<td>0.80</td>
<td>0.89</td>
<td>0.87</td>
<td>0.93</td>
</tr>
<tr>
<td>Water-soluble phosphoric acid found, per ct.</td>
<td>5.08</td>
<td>5.40</td>
<td>5.52</td>
<td>5.04</td>
<td>5.46</td>
</tr>
</tbody>
</table>

From the data embodied in this table, it is readily seen that there has been comparatively little variation in the average composition of fertilizers from year to year. The amounts of nitrogen, phosphoric acid and potash above guarantee have run within comparatively narrow limits. The data show that goods
have been kept up to about the same average without any deterioration.

**NUMBER OF BRANDS BELOW GUARANTEE.**

In the following table, we indicate the number of brands falling more than one-half of one per cent. below guarantee during the past five years:

<table>
<thead>
<tr>
<th></th>
<th>1898</th>
<th>1899</th>
<th>1900</th>
<th>1901</th>
<th>1902</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of brands more than 0.5 per cent. below guarantee in nitrogen</td>
<td>14</td>
<td>12</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Number of brands more than 0.5 per cent. below guarantee in available phosphoric acid</td>
<td>33</td>
<td>24</td>
<td>11</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Number of brands more than 0.5 per cent. in potash</td>
<td>22</td>
<td>58</td>
<td>20</td>
<td>16</td>
<td>30</td>
</tr>
</tbody>
</table>

We notice that from 1898 on there has been a marked continuous decrease in the number of brands that were more than one-half of one per cent. below guarantee. This indicates that manufacturers are doing more uniform work in mixing their goods. The showing is a very satisfactory one.

**Prices of Commercial Fertilizers.**

<table>
<thead>
<tr>
<th></th>
<th>1898</th>
<th>1899</th>
<th>1900</th>
<th>1901</th>
<th>1902</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average selling price, per ton</td>
<td>$27.65</td>
<td>$26.07</td>
<td>$27.27</td>
<td>$25.71</td>
<td>$26.14</td>
</tr>
<tr>
<td>Average commercial valuation</td>
<td>18.52</td>
<td>18.06</td>
<td>19.72</td>
<td>19.81</td>
<td>20.76</td>
</tr>
<tr>
<td>Excess of selling price above commercial valuation</td>
<td>9.13</td>
<td>8.01</td>
<td>7.55</td>
<td>5.90</td>
<td>5.38</td>
</tr>
<tr>
<td>Cost of one pound of nitrogen in mixed fertilizers</td>
<td>21 cts.</td>
<td>20.2 cts.</td>
<td>21.4 cts.</td>
<td>20.8 cts.</td>
<td>20.8 cts.</td>
</tr>
<tr>
<td>Cost of one pound of available phosphoric acid in mixed fertilizers</td>
<td>6.5 &quot;</td>
<td>6.1 &quot;</td>
<td>6.2 &quot;</td>
<td>6.2 &quot;</td>
<td>6.1 &quot;</td>
</tr>
<tr>
<td>Cost of one pound of potash in mixed fertilizers</td>
<td>6.75 &quot;</td>
<td>6.1 &quot;</td>
<td>6.2 &quot;</td>
<td>5.9 &quot;</td>
<td>5.7 &quot;</td>
</tr>
</tbody>
</table>

We notice that there has been a general tendency in the direction of lower average selling prices and an increase in commercial valuations, resulting in a smaller difference, from year to year, between the selling price and commercial valuation. There has also been a slight tendency in the direction of lower prices for each pound of plant-food.