The Connecticut Agricultural Experiment Station,

BULLETIN No. 82.

MARCH, 1885.

The object of these Bulletins is to place in the hands of those concerned the results of the Station work as promptly as possible.

As required by law, a package of each Bulletin is mailed to every post-office in the State. The package is directed to the postmaster, with a request to distribute to farmers.

The Bulletins are also regularly sent to every newspaper in the State, and to the Secretary of each Agricultural society and Farmers' club.

The Bulletins will be regularly sent, also, on application, to any address in Connecticut.

To citizens of other States remitting fifty cents, the publications of the current year, including Bulletins and Annual Report, will be mailed as they appear.

The wish has been expressed that a copy of every Fertilizer Analysis should be sent as soon as made by the Station to each Farmers' club or local society in the State. This is scarcely practicable. Samples are, as a rule, not examined one after another, singly, but for economical work a considerable number of analyses must be made, and are ready to publish at the same time. Each occasional publication which the Station makes is a Bulletin. The law requires copies of every Bulletin to be sent to each

post-office in the State, and the Station therefore cannot issue Bulletins to Farmers' clubs alone but must send impartially to all entitled to receive them. Comparatively few analyses can be made and published—in fact, but few samples can be got for analysis—before farmers purchase their supplies. The analyses of previous years must, therefore, be mostly depended on as guides in buying; they indicate, in most cases with certainty, the character and value of the various brands.

The disadvantages of our issue of few Bulletins are, we believe, largely compensated to our farmers by their being put in possession at once of a good number of analyses in a form which admits of comparison.

To Manufacturers and Dealers in Commercial Fertilizers in Connecticut.

Attention is called to the requirements of the Fertilizer Law **now in force in this State.** A prompt and full compliance with its requirements by manufacturers and dealers this season will save them and the Station much annoyance. The full text of the law has been printed and circulated in the Station Bulletins, and copies will be sent on application.

Section 2 requires manufacturers to send a sealed sample of each fertilizer to the director of the Station, and section 9 requires the director to make and publish annually one or more analyses of each brand; but the law does not require that an analysis shall be made on the sample sent by the manufacturer, nor is this commonly done. Such samples are preserved as manufacturers' standards and are only analyzed in exceptional cases, as for instance, when the agents of the Station have not found and drawn samples of the goods from dealers in the State during the season. In such cases it is necessary for the Station, in order to comply with the law, to make the analyses of those brands on the manufacturers' samples. If, however, the manufacturer has neglected to deposit a sample as required by law or has not deposited one during the current year, it may happen that although the analysis fee has been paid, the Station cannot make an analysis of the goods on which it has been paid.

Corrections in the Station Report for 1884.

While using the greatest care to secure accuracy in the publication of analyses, occasional errors are nearly unavoidable. On

page 124 of the Report are certain errata to which the following should be added:

Page 44, Station No. **1305,** Soluble Pacific Guano, under nitrogen guaranteed, for 2.50 read 2.00.

Page 62, Station No. **1229,** Ground Bone, under cost exceeds valuation, for 20.23 read 15.23.

Page 75, 10 lines from the bottom, **1153** is stated to contain 30.03 per cent. of sulphuric acid and 11.17 per cent. of insoluble matters. The number should be **1109** instead of **1153.** 8 lines from the bottom, **1109** is stated to contain 34.46 per cent. of sulphuric acid and 6.05 per cent. of insoluble matters. The number should be **1153** instead of **1109.**

Page 97, Mr. H. H. Austin states that the sample of Cuba tobacco, No. 1, while of good quality in other respects is not a free but a poor burner. This statement agrees with the results of the burning trials given on page 103, and tends to confirm Schlœsing's theory. The conclusions arrived at in the Report, based on a misunderstanding of the burning quality of sample No. 1, require to be modified in accordance with this fact.

The prices of Mapes' Potato Manure, No. **1138,** and Corn Manure, No. **1131,** page 57, were those given by the dealer in New Haven. We are informed by the manufacturer that the regular retail prices are $50.00 and $48.00, respectively.

We are also advised that the analysis made in 1878 of Mapes' Potato Fertilizer, page 53, was of the "Ville Formula" and is not properly classed with the other analyses.

Since the Bulletins and Reports of the Station are constantly coming into the hands of new readers the following explanations are here reprinted for their benefit:

EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.

REVISED.

Nitrogen is commercially the most valuable fertilizing element. *Organic nitrogen* is the nitrogen of animal and vegetable matters. Some forms of organic nitrogen, as those of blood and meat, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. *Ammonia* and *nitric acid* are results of the decay of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda. 17 parts of ammonia or 66 parts of pure sulphate of ammonia contain 14 parts of nitrogen. 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble Phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced, by acting on "insoluble" or "reverted" phosphates, with oil of vitriol. Once well incorporated with the soil it gradually becomes reverted phosphoric acid.

Reverted (*reduced or precipitated*) *Phosphoric acid* means strictly, phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid. In present usage the term signifies the phosphoric acid (of various phosphates) that is freely taken up by strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops.

Recent investigation tends to show that soluble and reverted phosphoric acid are on the whole about equally valuable as plant-food and of nearly equal commercial value. In some cases, indeed, the soluble gives better results on crops, in others the reverted is superior. In most instances there is probably little to choose between them.

Insoluble Phosphoric acid implies various phosphates not soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada Apatite. Bone black, bone-ash, South Carolina Rock and Navassa Phosphate when in coarse powder are commonly of little repute as fertilizers though good results are occasionally reported from their use. When *very finely pulverized* ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones, which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

Potash signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It should be soluble in water and is most costly in the form of sulphate, and cheapest in the shape of muriate (potassium chloride).

The Valuation of a Fertilizer, as practised at this Station, signifies finding *the worth in money or trade-value, of its fertilizing ingredients.* This value, it should be remembered, is *not necessarily proportional to its fertilizing effects* in any special case.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $30 to $60 per ton are paid, depend chiefly for their trade-value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the *Trade Value of the above-named Ingredients*, a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

The average Trade-values or cost in market, per pound, of the

ordinarily occurring forms of nitrogen, phosphoric acid and potash, as recently found in the New England, New York and New Jersey markets are as follows:

These Trade-values have been agreed upon by the Experiment Stations or official chemists of Connecticut, New Jersey, Massachusetts and Pennsylvania for use in their several States.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals for 1885.

Following are the figures to be used by this Station in making the Valuations of Commercial Fertilizers for the season of 1885.

	Cents per lb.
Nitrogen in ammonia salts,	18
" nitrates,	18
Organic nitrogen in dried and fine ground fish,	18
" " in guanos, dried and fine ground blood and meat,	18
" " in cotton seed, linseed meal and in castor pomace,	18
" " in fine ground bone,	18
" " in fine medium bone,	16
" " in medium bone,	14
" " in coarse medium bone,	12
" " in coarse bone, horn shavings, hair and fish scrap,	10
Phosphoric acid, soluble in water,	9
" " soluble in ammonium citrate,*	8
" " insoluble, dry fine ground fish and in fine bone,	6
" " " in fine medium bone,	5½
" " " in medium bone,	5
" " " in coarse medium bone,	4½
" " " in coarse bone,	4
" " " in fine ground rock phosphate,	2
Potash as high grade sulphate,	7½
" kainite,	4½
" muriate,	4½

* Dissolved from 2 grams of the ungrounnd Phosphate previously extracted with pure water, by 100 c.c. neutral solution of Ammonium Citrate, sp. gr. 1.09, in 30 minutes, at 65° C., with agitation. Commonly called "reverted" or "backgone" Phosphoric Acid.

The above Trade-values are the figures at which on March 1st the respective ingredients could be bought at retail for cash in our markets, in the *raw materials* which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to

agree fairly with the *reasonable retail price* in case of standard raw materials used in making mixed fertilizers such as

Sulphate of Ammonia,	Azotin,
Nitrate of Soda,	Dry Ground Fish,
Muriate of Potash,	Cotton Seed,
Sulphate of Potash,	Castor Pomace,
Dried Blood,	Bone,
Plain Superphosphate,	Ground So. Car. Rock.

Trade Values in Superphosphates, Special Manures, and Mixed Fertilizers of High Grades.

The Organic Nitrogen in these classes of goods will be reckoned at the highest figure laid down in the Trade-values of Fertilizing Ingredients in Raw Materials, namely, 18 cents per pound, it being assumed that the organic nitrogen is derived from the best sources, viz: bone, blood, animal matter, Peruvian guano or other equally good form and not from leather, shoddy, hair or any low-priced inferior forms of vegetable matter, unless the contrary is ascertained.

Insoluble Phosphoric acid will be reckoned at 4½ cents, it being assumed that it is derived in good part from bone or similar source and not from rock phosphate, unless found otherwise. In this latter form the insoluble phosphoric acid would be worth commercially only 2 cents per pound or but one-third as much as if from fine bone. Potash will be rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of Potash is reckoned as sulphate.

In most cases the valuation of the Ingredients in Superphosphates and Specials will fall considerably below the retail price of these goods. The difference between the two figures represents the manufacturers' charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents or dealers, long credits, interest on investment, bad debts, and finally, profits.

In 1884 the selling price of superphosphates in Connecticut was, on the average, 22.9 per cent. greater than the Station valuations, or 42.9 per cent. in advance of the wholesale cost of the fertilizing elements in the raw materials.

The selling price of Special Manures was but 13 per cent. greater than their valuations, or 33 per cent. in advance of the

average wholesale cost of the fertilizing elements in the raw materials.

The average cost of Ammoniated Superphosphates and Guanos was about $40.73, the average valuation was $33.13, and the difference $7.60—an advance of 22.9 per cent. on the valuation.

In case of Specials the average cost was $49.95, the average valuation, $44.20, and the difference $5.75, or 13 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer (i. e. the money-worth of its fertilizing ingredients), we multiply the pounds per ton of Nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen-value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

The uses of the "Valuation" are twofold:

1, To show whether a given lot or brand of fertilizer is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be quite sure that the price is reasonable. If the selling price is several dollars per ton more than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

2, Comparisons of the valuations and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuations are deduced from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor.

The Agricultural value of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place, and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

Fertilizer Analyses.

1343. Ashes from Cotton Seed Hulls. This sample represents the hard portion or clinker which is screened out from the fine ashes and is not sold.

1344. Ashes from Cotton Seed Hulls. Sampled by H. S. Frye, Poquonock, from a car-load lot at Suffield.

	1343	1344
Water,	4.33	13.82
Sand, and insoluble in acid,	39.32	6.18
Potash, soluble in water,	9.20	19.51
Potash, insoluble in water,	8.00	2.81
Phosphoric acid, soluble in ammonium citrate,	5.45	8.81
Phosphoric acid, insoluble in ammonium citrate,	3.61	
Cost,		$39.00
Valuation,		42.38

The sample **1343** has considerable value as a fertilizer, though much inferior to the other sample. Much of the potash in it is combined with silicic acid in silicates which are readily decomposed by an acid.

1347. Chittenden's Complete Fertilizer for Tobacco made by the National Fertilizer Co., Bridgeport. Sampled May 19, 1884, by T. R. Atwood, Newington, from stock of J. Dix & Co., Hartford, and sent to this Station March 4, 1885, for analysis.

The sample was in a tin box, tightly closed but unsealed. Its analysis is here given because it is the only sample of that brand which has been received during the year, and because the Director is required by law to annually make and publish one analysis at least of each brand of goods sold in the State. The Trade-values which were in use last year have been applied in making the valuation.

ANALYSIS AND VALUATION.

	1347	
	Found.	Guaranteed.
Water,	10.91	
Nitrogen of organic matter,	2.86	3.3
Soluble Phosphoric Acid,	4.42	6.0
Reverted Phosphoric Acid,	2.70	
Insoluble Phosphoric Acid,	4.41	
Potash,	4.66	4.3
Chlorine,	.88	
Cost per ton,		$45.00
Valuation per ton,		35.17

ANALYSES OF BONE.

1349. Rogers & Hubbard Co.'s Damp Bone Saw Dust.

This is cut by the bone saws which run in water, and is allowed to settle in tanks and then drained off in heaps.

This sample contained 46.39 per cent. of water.

1350. Rogers & Hubbard Co.'s Ground Bone Fine A. X.

1351. Rogers & Hubbard Co.'s Raw Knuckle Bone Meal.

1352. Rogers & Hubbard Co.'s Raw Knuckle Bone. Extra Fine, A.

The above are manufactured by the Rogers & Hubbard Co., Middletown, and were sampled March 9th by the Station agent.

1353. Peck Brothers' Kitchen Bone. Manufactured by Peck Brothers, Northfield. Sampled and sent by C. H. Cables, Thomaston.

1354. Peter Cooper's Ground Bone. Manufactured by Peter Cooper's Glue Factory, N. Y. Sampled and sent by C. H. Cables, Thomaston. This is a steamed bone, being a by-product in the glue manufacture.

Mechanical Analyses.

	1349	1350	1351	1352	1353	1354
Finer than $\frac{1}{80}$ inch,	97	14	32	25	8	40
" $\frac{1}{23}$ "	3	19	33	15	15	15
" $\frac{1}{12}$ "	--	48	35	33	32	24
" $\frac{1}{6}$ "	--	19	--	27	25	21
Coarser than $\frac{1}{6}$ "	--	--	--	--	20	--
	100	100	100	100	100	100

Chemical Analyses and Valuations.

	1349	1350	1351	1352	1353	1354
Nitrogen,	2.35	4.11	3.96	3.96	4.10	1.62
Phosphoric Acid,	15.67	19.51	24.57	25.15	20.91	31.70
Cost per ton,*	$25.00	34.00	38.00	36.00	35.00	23.75†
Valuation per ton,	$27.19	32.03	39.58	37.80	31.13	39.06

* At the mill. † In New York.

S. W. JOHNSON, *Director.*