BULLETIN No. 77.

The Connecticut Agricultural

EXPERIMENT STATION.

APRIL, 1884.

Tuttle, Morehouse & Taylor, Printers, 371 State Street.

The Connecticut Agricultural Experiment Station.

BULLETIN No. 77.

APRIL, 1884.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1884.

Following are the figures to be used by this Station in making the Valuations of Commercial Fertilizers for the season of 1884.

	Cents per lb.
Nitrogen in ammonia salts,	22
" nitrates,	18
Organic nitrogen in dried and fine ground fish,	20
" " 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,	10
" " soluble in ammonium citrate,*	9
" " 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,	2¼
Potash as high grade sulphate,	7¼
" kainite,	4¼
" muriate,	4¼

* Dissolved from 2 grams of the unground Phosphate previously extracted with pure water, by 100 c.c. neutral solution of Am. Cit., sp. gr. 1.09, in 30 minutes, at 40° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phos. 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 calculated value obtained by use of the above figures will be found to agree fairly with the reasonable retail price in case of standard raw materials 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, 20 cents per pound. Insoluble Phosphoric acid will be reckoned at 4½ cents, and Potash at 4¼ cents if sufficient chlorine is present in the fertilizer to combine with it. 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 calculated value of Superphosphates and Specials will fall considerably below the retail price. The difference between the two will represent the manufacturer's expenses in converting raw materials into the manufactured articles. These expenses include grinding and mixing, bagging or barreling, storage and transportation; commission to agents or dealers; long credits, interest on investment, bad debts, and finally profits.

Last year the selling price of the superphosphates and specials in Connecticut was on the average 18 per cent greater than the Station valuations or 38 per cent. in advance of the wholesale cost of the fertilizing elements in the raw materials. The average cost of Ammoniated Superphosphates and Guanos was about $41.50, the average estimated value was $35, and the difference $6.50.

In case of Specials the average cost was $50, 17 per cent. greater than the average valuation, $42.50.

FERTILIZER ANALYSES.

SULPHATE OF AMMONIA.

A sample of this article (**1102**) drawn by a Station agent from stock at the factory of E. H. Wardwell* in New Haven contained 20·22 per cent. of nitrogen, equivalent to 24·56 of ammonia or 95·32 per cent. of ammonium sulphate. Early in March it was offered free on board in New Haven at from 3⅛ to 3¼ cents per pound, which would make the actual cost of nitrogen per pound about 16 cents.

Linseed Meal and Castor Pomace.

1081. Linseed Meal. Sampled and sent by H. H. Austin, Suffield.

1080. Castor Pomace. Sent by H. J. Baker & Bro., N. Y. City, as sample of their new stock.

Analysis.

	1081	1080
Nitrogen,	5.73	5.33
Phosphoric acid,	2.50	1.68
Potash,	1.60	1.06
Cost per ton,	$28.00	$24 to $25
Valuation per ton,	$24.99	$22.11

The attention of those using castor pomace is called to the fact that it is extremely poisonous when taken internally, causing violent vomiting and purging. A small number of the beans from which the pomace is prepared, are reported in several instances to have caused the death of adult persons who have eaten them. The beans are not at first unpleasant to the taste. There is little doubt, therefore, that cattle may be poisoned if they are allowed to get at the pomace.

Guanos.

1100. Standard Peruvian Guano.

1099. Guaranteed Peruvian Guano.

1098. Peruvian Guano Lobos.

The above are from the Stock of Seth Chapman's Son & Co., New York, *and were sampled by them.* They were sent to the Station by C. H. Cables, Thomaston.

* Address is 10 Warren St., New York.

1091. Penguin Island Guano. From stock of Charles Spear, Jr., N. Y. Sent by C. H. Cables.

ANALYSES AND VALUATIONS.

	1100	1099	1098	1091
Nitrogen in nitrates,	.22	.29	.22	
" ammonia salts,	7.35	5.78	3.75	
" organic matter,	.48	.59	.87	.20
Soluble phosphoric acid,	2.54	2.00	4.04	
Reverted phosphoric acid,	3.72	4.98	4.38	6.41
Insoluble phosphoric acid,	8.60	10.89	8.76	16.49
Potash,	2.48	3.06	3.46	
Chlorine,	1.00	1.45	3.91	
Cost per ton in New York,	\$59.82*	\$56.00	\$46.42†	\$25.00
Valuation per ton,	\$57.21	\$54.63	\$47.20	\$27.17

* \$67 per 2240 lbs. † \$52 per 2240 lbs.

The above articles have a guaranteed composition.

SUPERPHOSPHATES.

1110. Dickinson's Ammoniated Bone Phosphate. From stock of David Dickinson, Middle Haddam. Sampled and sent by A. H. Worthington, Middle Haddam.

1101. Home-made Superphosphate. Sent by R. E. Pinney, Suffield.

1111. Home-made Superphosphate from C. P. Augur, Whitneyville.

ANALYSES AND VALUATIONS.

	1110	1101	1111
Nitrogen,	4.30	4.09	2.04
Soluble phos. acid,	4.41	none	7.34
Reverted phos. acid,	4.20	3.68	3.41
Insoluble phos. acid,	4.76	3.06	4.10
Potash, soluble in water,	....	7.24	
Cost per ton,	\$45.00	....	
Valuation per ton,	\$37.87	\$36.21	\$32.67

In making the valuations for mixed goods, such as the above, it is assumed that the organic nitrogen contained in the mixed fertilizers 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. In the case of insoluble phosphoric acid it is also assumed that it is from bone or other similar source and not from rock phosphate. In this latter form the insoluble phosphoric acid would be worth commercially only 2¼ cents per pound or a little over one-third as much as if from fine bone. We have repeatedly cautioned the farmers against placing a too literal construction on the "valuations" as given by the Station to the fertilizers, and we again repeat the caution in view of the fact that it is not always practicable in the analysis of a fertilizer to distinguish some of the best from some of the poorest forms of the ingredients.

Comparison of the Guaranteed (G) and Actual (A) Composition of the above named Goods.

No.	Brand.	Nitrogen. G	Nitrogen. A	Phos. Acid. G	Phos. Acid. A	Potash. G	Potash. A
1100	Standard Peruvian Guano.	7.4–8.2	8.1	13–15	14.9	2.0	2.5
1099	Guaranteed Peruvian Guano,	5.4	6.6	17	17.9	3.0	3.1
1098	Peruvian Guano Lobos,	4.1–4.5	4.8	15–17	17.2	2.3	3.5
1091	Penguin Island Guano,	1.2	0.2	23.4	22.9		
1110	Dickinson's Phosphate,	4–5	4.3	14.0*	8.6		

* Soluble and reverted.

Further Explanations Concerning Analysis and Valuation of Fertilizers.

Nitrogen is commercially the most valuable fertilizing element. *Organic nitrogen* is the nitrogen of animal and vegetable matters. Some forms of organic nitrogen, as that of blood and meat, are highly active as fertilizers; others, as that of 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 shortly becomes reverted phosphoric acid.

Reverted (reduced or precipitated) Phosphoric acid means strictly, phosphoric acid that was once freely soluble in water, but from chemical change has become insoluble in that liquid. It 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 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. When *very finely pulverized* ("floats") they often act well in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble in this sense, 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 is soluble in water and is most costly in the form of sulphate, and cheapest in the shape of muriate or chloride.

The Valuation of a Fertilizer 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 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 Connecticut and New York markets, and now employed by the Station, are given and defined on page 1.

To obtain the Valuation of a Fertilizer 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, 1st, 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. 2d, Comparisons of the valuations and selling prices of a number of 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.

Analyses of the Ash of Healthy and Diseased Peach Wood.

P. M. Augur, Esq., the State Pomologist, recently sent to the Station for examination two samples of wood marked,

I. "From Mt. Rose peach tree supposed to be healthy."

II. "From diseased Mt. Rose peach tree."

The disease from which II was suffering was stated to be the "Yellows."

For analysis twigs of equal size were selected from the two lots. They were about $\frac{5}{16}$ inch diameter at the butt end and $\frac{3}{16}$ to $\frac{4}{16}$ inch diameter at the tip and were of last year's growth.

The pure ash of I, (carbonic acid, coal and water excluded) amounted to 1·87 per cent. The pure ash of II amounted to 1·61 per cent. The analyses of 100 parts of the ashes are as follows:—

	I. *Healthy.*	II. *Diseased.*
Silica and matters insoluble in acid,	5.38	9.47
Oxide of iron,	1.09	2.09
Lime,	54.20	54.05
Magnesia,	9.49	7.49
Potash,	16.31	13.95
Soda,	1.18	1.19
Phosphoric acid,	4.34	4.68
Sulphuric acid,	6.90	6.53
Chlorine,	.46	.43
	99.35	99.88

In comparing the above analyses we note that the ash of diseased twigs contains :—

4.09 per cent. more silica, etc.,
1.00 per cent. more oxide of iron,
.34 per cent. more phosphoric acid,
.15 per cent. less lime,
2.00 per cent. less magnesia,
2.36 per cent. less potash and
.37 per cent. less sulphuric acid

than the ash of healthy twigs.

Dr. Goessmann, in his analyses of Crawford's Early Peach,* reported in the ash of branches diseased by Yellows

0.93 per cent. more oxide of iron,
9.71 per cent. more lime,
2.70 per cent. more magnesia,
3.00 per cent. less phosphoric acid and
10.34 per cent. less potash

than in ash of healthy branches, taken from a once slightly affected tree which had been restored by treating (for three years ?) "with a phosphatic fertilizer in the usual proportion, adding at the same time from three to four pounds of muriate of potash for every tree, the diseased branches," at the outset, having been "cut back to healthy wood." Dr. Goessmann infers that "the diseased objects (wood and fruit) contain less potash and more lime than the healthy ones."

Dr. Goessmann leaves out of the account the items, Silica and matters insoluble in acid, Soda, Sulphuric acid and Chlorine, which in the above analyses amount to 13.92 per cent. of the ash of the healthy twigs and 17.62 per cent. of the ash of the

* Paper read before Mass. Hort. Society, March 18, 1882.

diseased twigs. To omit those would somewhat increase the differences between the ash of the two, and would make lime in the ash of diseased twigs 3 per cent. more than in the healthy ones.

A more correct comparison is that of the absolute quantities of the several ash-ingredients contained in the same amount of the fresh twigs, as follows :—

In 10,000 parts of peach twigs there are :

	Healthy.	*Diseased.*
Silica and insoluble,	10.07	15.25
Oxide of iron,	2.04	3.36
Lime,	101.44	86.99
Magnesia,	17.75	12.05
Potash,	30.55	22.45
Soda,	2.20	1.91
Phosphoric Acid,	8.14	7.53
Sulphuric Acid,	12.91	10.51
Chlorine,	0.87	.70
	185.97	160.75

Here it becomes manifest that 10,000 pounds of diseased twigs contain

5.2 pounds more silica,
1.3 pounds more oxide of iron,
14.5 pounds less lime,
5.7 pounds less magnesia,
8.1 pounds less potash,
0.3 pounds less soda,
0.6 pounds less phosphoric acid,
2.4 pounds less sulphuric acid and
.2 pounds less chlorine

than the healthy twigs. The diseased twigs in this case thus manifest, as compared with the healthy ones, a *poverty of all the ash-ingredients*, the first two alone excepted.

S. W. Johnson,
Director.