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REPORT

OF AN

**Analysis of Cotton-Wool, Cotton-Seed, Indian Corn and
the Yam Potato,**

MADE FOR THE

7 **BLACK OAK AGRICULTURAL SOCIETY.**

BY

Harlan
PROF. C. U. SHEPARD.

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REPORT, &c.

1st Cotton-Wool.

One hundred parts by weight of cotton-wool on being heated in a platina crucible, so long as a brightly burning gas continued to be emitted, lost 86.09 parts—the residuum being a perfectly charred cotton, which, on being ignited under a muffle until every particle of carbon was consumed, lost 12.985, and left an almost purely white ash, whose weight was rather under 1 p. c. or, 0.9247. Of this ash, about 44 p. c. was found to be soluble in water. It contained 12.88 p. c. of silicious sand, which must have been acquired adventitiously in the process of harvesting the fibre. Deducting the sand from the ash, the constitution of the latter is as follows:—

Carbonate of Potassa (with possible traces of Soda,)	-	44.19
Phosphate of Lime with traces of Magnesia,	-	25.44
Carbonate of Lime,	-	8.87
Carbonate of Magnesia,	-	6.35
Silica,	-	4.12
Alumina, (probably accidental,)	-	1.40
Sulphate of Potassa,	-	2.70
Chloride of Potassium,	} and loss,	6.43
Chloride of Magnesium,		
Sulphate of Lime,		
Phosphate Potassa,		
Oxide Iron in minute traces,		
		100.00

But since it is obvious that the carbonic acid in the above mentioned salts must have been derived during the incineration of the cotton, the following view will more certainly express the important mineral ingredients abstracted by the cotton from the soil for every 100 parts of its ash.

Potassa (with possible traces of Soda,)	-	31.09
Lime,	-	17.05
Magnesia,	-	3.26
Phosphoric acid,	-	12.30
Sulphuric acid,	-	1.22
		64.92

For every 10,000 lbs. of cotton wool, then, about 60 lbs. of the above mentioned ingredients are subtracted from the soil in the proportion indicated by the numbers appended, i. e. omitting fractions.

Potassa,	-	-	-	-	-	-	-	-	31 pounds.
Lime,	-	-	-	-	-	-	-	-	17
Magnesia,	-	-	-	-	-	-	-	-	3
Phosphoric acid,	-	-	-	-	-	-	-	-	12
Sulphuric acid,	-	-	-	-	-	-	-	-	1

Several queries were submitted to me along with the sample to be analyzed, relative to the effect of soils on cotton. I regret to state that the almost total ignorance in which we are still left respecting the composition of the varieties of this fibre, and the soils producing them prevents me from hazarding any explanations on the subject. This is the first distinctive analysis every made (at least so far as my knowledge extends,) of the cotton-wool. Nor am I acquainted with the properties of the soil which afforded it. Prior to any deductions, it is clear we must know the composition of each variety of cotton, as well as that of the soil it affects. At present I can only venture on connecting together two facts, which appear to occupy important relations to one another. The soil of St. Stephen's, which is said by F. A. Porcher, Esq., to be a stiff clayey loam, produces the strongest and finest fibre of the Santee varieties. The Sea-Island qualities are supposed to owe their superiority to the use of marsh mud, which I have ascertained to be a clayey admixture, rich in alkalies and alkaline earths. Whether the similarity between these two staples is influenced most (if it is affected at all,) by the chemical or mechanical qualities of the soils producing them, it is impossible to decide. It is also conceivable that the two sets of qualities may conspire to one and the same end.

2nd—Cotton Seed.

One hundred parts, heated as above, lost 77.475, and the thoroughly charred residuum burned under the muffle, left 3.856 parts of a perfectly white ash. The composition was found to be as follows:

Phosphate of lime (with traces of Magnesia,)	-	-	-	-	-	-	-	61.64
Phosphate of Potassa (with traces of Soda,)	-	-	-	-	-	-	-	31.51
Sulphate of Potassa,	-	-	-	-	-	-	-	2.55
Silica,	-	-	-	-	-	-	-	1.74
Carbonate of Lime,	-	-	-	-	-	-	-	0.41
Carbonate of Magnesia,	-	-	-	-	-	-	-	26
Chloride of Potassium,	-	-	-	-	-	-	-	25
Carbonate of Potassa,	-	-	-	-	-	-	-	} & loss, 1.64
Sulphate of Lime,	-	-	-	-	-	-	-	
Sulphate of Magnesia,	-	-	-	-	-	-	-	
Alumina & oxides of iron & manganese in traces,	-	-	-	-	-	-	-	
								100.00

In comparing the above table with that afforded by the cotton-wool, a marked dissimilarity presents itself. The ash of the cotton seed is fourfold that of the fibre; while the former has also treble the phosphoric acid possessed by the latter, as will the more clearly

appear, when we present the analysis under another form, corresponding with the second table under cotton-wool.

Phosphoric Acid, - - - - -	45.35
Lime, - - - - -	29.79
Potassa, - - - - -	19.40
Sulphuric acid, - - - - -	1.16
	95.70

From the foregoing analysis it would appear difficult to imagine a vegetable compound, better adapted for fertilizing land, than the cotton seed; nor can we any longer be surprised at the well known fact, that soils long cropped with this staple, without a return to them of the inorganic matters withdrawn in the seed, become completely exhausted and unproductive.

3d—*Indian Corn.*

One hundred parts heated to redness in a crucible, so long as a brightly burning flame was emitted, lost 81.05 parts. The completely charred residuum on being ignited beneath a muffle, upon a platina foil, until all the carbon was consumed, left 0.95 parts of less than 1 per cent. of an easily flowing clear glass. This ash has the following composition:—

Silica, - - - - -	38.45
• Potassa (with traces of Soda,) - - - - -	19.51
Phosphate of lime, - - - - -	17.17
Phosphate of Magnesia, - - - - -	13.83
Phosphate of Potassa, - - - - -	2.24
Carbonate of lime, - - - - -	2.50
Carbonate of Magnesia, - - - - -	2.16
Sulphate of Lime, }	
Sulphate of Magnesia, }	.79
Silica mechanically present, - - - - -	1.70
Alumina, - - - - -	traces.
Loss, - - - - -	1.65
	100.00

Omitting the Silica as an unimportant loss to the soil, and the Carbonic acid which is a product of the analysis, we have in every 100 parts of the ash of the Indian corn, the following important inorganic constituents:—

Potassa, - - - - -	20.87
Phosphoric acid, - - - - -	18.80
Lime, - - - - -	9.72
Magnesia, - - - - -	5.76
	55.15

That is to say, for every 1000 pounds of Indian corn sold from an estate, the land is robbed of $9\frac{1}{2}$ lbs. inorganic matter, whereof about $5\frac{1}{2}$ lbs. consist of principles of prime value to all species of crops.*

4th—Sweet Potato, (Yam)

The tubers analyzed, though fresh from the market, were obviously drier than when first harvested.

One hundred parts of the thinly sliced tubers on being thoroughly dried at a temperature of 200° , lost 58.96 per cent. of water.

One hundred parts of the undried potato gave 1.09 parts, or rather over 1 per cent. of a whitish ash stained in points of a bluish green color.

Its composition was as follows:—

Carbonate of Potassa, (with traces of Soda),	-	-	-	-	-	-	60.00
Phosphate of Lime,	-	-	-	-	-	-	14.57
Phosphate of Magnesia,	-	-	-	-	-	-	5.60
Carbonate of Lime,	-	-	-	-	-	-	5.39
Carbonate of Magnesia,	-	-	-	-	-	-	3.80
Chloride of Potassium,	-	-	-	-	-	-	4.60
Sulphate of Potassa,	-	-	-	-	-	-	4.35
Silica,	-	-	-	-	-	-	70
Chloride of Calcium,	} and loss,						99
Sulphate of Magnesia and Lime,							
Alumina,							
Oxides of Iron and manganese in traces,							100.00

One hundred parts of the ash from the sweet potato tuber, contains then the following inorganic principles which must have been withdrawn from the soil.

Potassa,	-	-	-	-	-	-	43.59
Phosphoric acid,	-	-	-	-	-	-	11.08
Lime,	-	-	-	-	-	-	10.12
Magnesia,	-	-	-	-	-	-	3.80
Potassium,	-	-	-	-	-	-	2.42
Chlorine,	-	-	-	-	-	-	2.18
Sulphuric acid,	-	-	-	-	-	-	1.90
							85.09

* In a recent number of the Boston Journal of Natural History, I observe some observations by Dr. Charles T. Jackson, on the inorganic constitution of Indian corn, wherein Dr. J. supposes phosphoric acid to be present in the grain, in a free or uncombined state. The experiment which led him to form this conjecture, did by no means succeed in my hands as described by him; for although the grain was repeatedly incinerated upon a bright platina foil under muffle, still the metal lost none of its polish or malleability. Neither can I agree with Dr. J. in his opinion of the presence of ammonia as a base in Indian corn, the volatile alkali obtained by him, being a product rather than an educt of the analysis.

Tabular view of some of the foregoing results.

	In Cotton Wool.	Cotton Seed.	Indian Corn.	Potato.
Weight of Ash,	0.9247 p. c.	3.856 p. c.	0.95 p. c.	1.09 p. c.

Essential inorganic ingredients absorbed from the soil.

	By Cotton Wool.	Cotton seed.	Indian Corn.	Potato.
Potassa, -	31.09	19.40	20.87	43.59
Lime, -	17.05	29.79	9.72	10.12
Magnesia, -	3.26	trace	5.76	3.80
Phosphoric acid,	12.30	45.35	18.80	11.08
Sulphuric acid,	1.12	1.16	trace	1.90
Chlorine,	traces	traces	—	2.18
Potassium,	—	—	—	2.42

One thousand pounds of each crop give of inorganic ingredients, of the 1st, 9½ lbs.; 2d, 38½ lbs.; 3d, 9½ lbs.; and of the 4th, 10 9-10 lbs.

The proportions of inorganic matter that may be regarded as most important, are—In the 1st, 64-100; in the 2d, 95-100; in the 3d, 55-100; in the 4th, 85-100 lbs.

If equal weights of cotton-wool and Indian corn be taken from the same area of land, the deterioration to the soil in inorganic principles should be nearly the same. The yam, if compared with either of these crops, would appear to rob the soil of a still heavier weight of saline matter, although it is noticeable that the proportion of phosphoric acid abstracted by it is considerably less, and that no portion of it is thus withdrawn in the condition of phosphate of potassa.

Finally.—Under the same weights, the cotton seed removes about four times as much of these ingredients as the yam, and six times the quantity that passes off by the cotton-wool, or the Indian corn. Moreover the proportion of phosphoric acid (the most valued mineral constituent of a soil,) in the cotton seed is nearly double that in Indian corn, and treble that in cotton-wool and the yam; whereby the inestimable qualities of the cotton-seed as a fertilizer, becomes still further apparent.

The following letter from Prof. Shepard to F. A. Porcher, Esq., has been communicated for publication since the foregoing report.

Charleston, April 22d, 1844.

TO FREDERICK A. PORCHER, ESQ.

Dear Sir:—I thank you for calling my attention to the analysis of Sea-Island cotton-wool, by Dr. Ure, as quoted in the valuable Memoir on Cotton by the Hon. W. Seabrook. It is the first notice I ever had of any chemical examination besides my own, of the ash of cotton-wool, and it is proper that I should submit a few remarks to your Society respecting the different results arrived at in the two cases.

If the example analyzed by Dr. Ure, was a fair one, of which I confess I entertain some doubts, several discrepancies would appear

to exist between the two varieties examined. Before alluded to these, however, I beg leave to state, that in my analysis, both of the wool and of the seed, I contented myself with the determination of the proportion of the phosphates, without establishing rigorously the ratio of the magnesia to the lime; neither did my analysis give by itself the chloride of potassium, (muriate of potash.) Yet I am able to add, from a recurrence to my notes, that this compound fell short of 3 per cent. I am greatly surprised, however, to find the oxide of iron so high in the Sea-Island variety, since in that of the Santee it cannot equal half a part in one hundred. Should the absence of carbonate of magnesia in the Sea-Island variety be verified, and the extraordinary content in the latter of chlorine and sulphuric acid be established, the inorganic difference between the two staples, will, to say the least, be as remarkable as those existing in their physical qualities.

Comparative Statement.

TABLE I.

	Sea-Island.	Santee.
Earthy phosphates - - - - -	17.4	25.44
Carbonate of lime, - - - - -	10.6	8.87
Carbonate of magnesia, - - - - -	0.0	6.85
Chloride of potassium, (muriate of potash,) -	9.9	3.00 ?
Sulphate of potassa, - - - - -	9.3	2.70
Silica, - - - - -	0.0	4.12
Peroxide of iron, - - - - -	3.0	0.50 ?

TABLE II.

In this table the acids are separated from their bases, and the carbonic acid is omitted.

	Sea-Island.	Santee.
Potassa, - - - - -	35.24	31.09
Lime, - - - - -	10.28	17.05
Magnesia, - - - - -	3.20	3.26
Potassium, - - - - -	5.70	1.50 ?
Phosphoric acid, - - - - -	9.84	12.30
Sulphuric acid, - - - - -	4.75	1.22
Chlorine, - - - - -	4.20	1.50 ?
Peroxide of iron, - - - - -	3.00 less than	0.50
Silica, - - - - -	0.00	4.12
Phosphate of potassa, - - - - -	00	1.50
	76.11	73.99

Very respectfully, yours,

CHARLES U. SHEPARD.

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