CONNECTICUT

Agricultural Experiment Station

NEW HAVEN, CONN.

BULLETIN 194, JULY, 1917.

MANURE FROM THE SEA.

By E. H. JENKINS and JOHN PHILLIPS STREET.

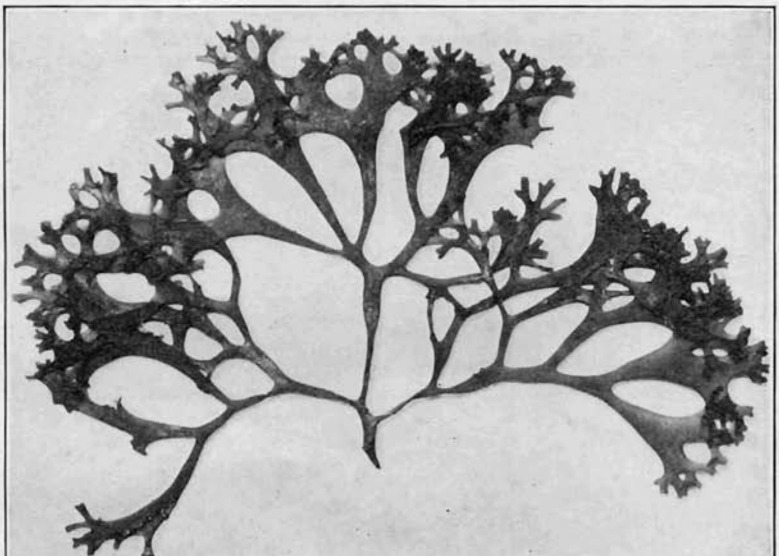

PLATE I.—Irish Moss or Carrageen (*Chondrus crispus*).

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

BOARD OF CONTROL.

His Excellency, Marcus H. Holcomb, *ex-officio, President.*

James H. Webb, *Vice President*................................Hamden
George A. Hopson, *Secretary*..............................Wallingford
E. H. Jenkins, *Director and Treasurer*......................New Haven
Joseph W. Alsop..Avon
Wilson H. Lee ....Orange
Frank H. Stadtmueller......................................Elmwood

---

Administration.	E. H. JENKINS, PH.D., *Director and Treasurer.* MISS V. E. COLE, *Librarian and Stenographer.* MISS L. M. BRAUTLECHT, *Bookkeeper and Stenographer.* WILLIAM VEITCH, *In charge of Buildings and Grounds.*
Chemistry.	
Analytical Laboratory.	JOHN PHILLIPS STREET, M.S., *Chemist in Charge.* L. MONROE BAILEY, PH.D., C. B. MORISON, B.S., C. E. SHEPARD, W. L. ADAMS, B.S. *Assistants.* HUGO LANGE, *Laboratory Helper.* V. L. CHURCHILL, *Sampling Agent.*
Proteid Research.	T. B. OSBORNE, PH.D., D.SC., *Chemist in Charge.* MISS E. L. FERRY, M.S., *Assistant.*
Botany.	G. P. CLINTON, SC.D., *Botanist.* E. M. STODDARD, B.S., *Assistant Botanist.* FLORENCE A. MCCORMICK, PH.D., *Scientific Assistant.* G. E. GRAHAM, *General Assistant.*
Entomology.	W. E. BRITTON, PH.D., *Entomologist; State Entomologist.* B. H. WALDEN, B.AGR., *First Assistant.* Q. S. LOWRY, B.SC., I. W. DAVIS, B.SC., M. P. ZAPPE, B.S., *Assistants.* MISS G. A. FOOTE, B.A., *Stenographer.*
Forestry.	WALTER O. FILLEY, *Forester; also State Forester and State Forest Fire Warden.* A. E. MOSS, M.F., *Assistant State and Station Forester.* MISS E. L. AVERY, *Stenographer.*
Plant Breeding.	DONALD F. JONES, M.S., *Plant Breeder.* C. D. HUBBELL, *Assistant.*
Vegetable Growing.	————

MANURE FROM THE SEA

E. H. Jenkins and John Phillips Street.

Before commercial fertilizers were widely used, there were fine meadows and pastures in our shore towns, and abundant crops were grown. These were produced with the aid of farm manure, chiefly made on home-grown feeds, among which were the finer salt-marsh grasses (the coarser being used for litter), and also by the use of manures got from the sea—seaweeds and marine mud. Some "old-fashioned farmers" are to-day using such manures with success.

At this time, when commercial fertilizers cost more than ever, when potash salts cannot be bought at any price, and when some of the materials used in making fertilizers, like nitrates and sulphuric acid, are needed for munitions, it is worth while to inquire whether those having shore farms cannot return in some measure to the ways of our forefathers and in a time of scarcity make more use of what our predecessors used.

It is partly a question in economics. With the present scale of prices, will it pay better to handle and use low-grade manures, which cost little but require much labor, than to pay war prices for fertilizers which cost much money but require relatively little labor?

It is also partly a question of soil sanitation. We have been using relatively much concentrated plant food and less and less humus-forming vegetable matter. We know more than we once did of the value of these humus-forming materials in amending soils, especially our light sandy soils, and in increasing the soluble plant food in them. May not a partial change for a time in our system of fertilizing be an advantage? This change will consist in an added emphasis on the use of quickly decaying vegetable matters with lime. We believe that many fields will respond profitably to such a change. We do not, of course, advocate the entire abandonment of commercial fertilizers, but rather, as a war measure, urge every effort to prepare, preserve and use every kind of vegetable manure, supplementing it, particularly on the short-lived cash crops, with commercial fertilizers.

This bulletin treats of the value of seaweeds and of marine mud. Other bulletins may follow, regarding the preparation and use of other somewhat neglected resources of the farm.

What Seaweeds Contain.

Table I gives the average composition of such seaweeds as make up the larger part of this material on the New England

Plate II.—Round-stalked Rockweed (*Ascophyllum nodosum*).

coast, and which have been analyzed at the Rhode Island, Massachusetts and Connecticut Stations.

Plates I to VI show the general appearance of the weeds named in the Table and in this bulletin.

In most respects the different species are fairly alike in composition. Irish moss (nine analyses) seems to contain more potash than the others. Further analyses of other species of which only one analysis was made will be needed to prove whether they consistently contain more potash than the average.

The larger amount of lime in one of the species is due to adhering shells.

All analyses have been calculated to 75.0 per cent of moisture, as this fairly approximates the water-content of fresh drained weeds.

The following is a fair statement of the average composition of fresh mixed seaweeds and will not differ widely from the average of any one of them.

For comparison are given the average composition of our

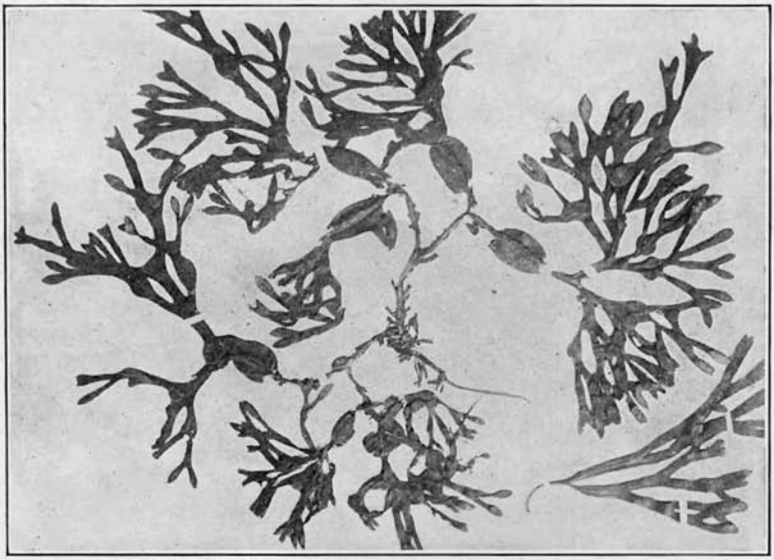

PLATE III.—Flat-stalked Rockweed (*Fucus vesiculosus*).

analyses of New York stable manure as sold in this state and of fresh cow manure with litter (Thorne's compilation).

	Seaweeds	New York Horse Manure	Cow Manure with Litter
Water	75.00%	68.83%	86.8%
Organic matter	17.64	27.12	....
Mineral matter	7.36	4.05	....
	100.00	100.00	....
Nitrogen	0.49	0.62	0.46
Phosphoric acid	0.13	0.42	0.41
Potash	0.69	0.58	0.43
Lime	0.66	0.52	....
Magnesia	0.34	0.24	....

Comparison with Animal Manure

From the above it appears that the average seaweed contains less organic matter, nitrogen and phosphoric acid than New York horse manure, and compared with cow manure it has about the same amount of nitrogen, much less phosphoric acid and more potash. *Seaweeds are relatively deficient in phosphoric acid.*

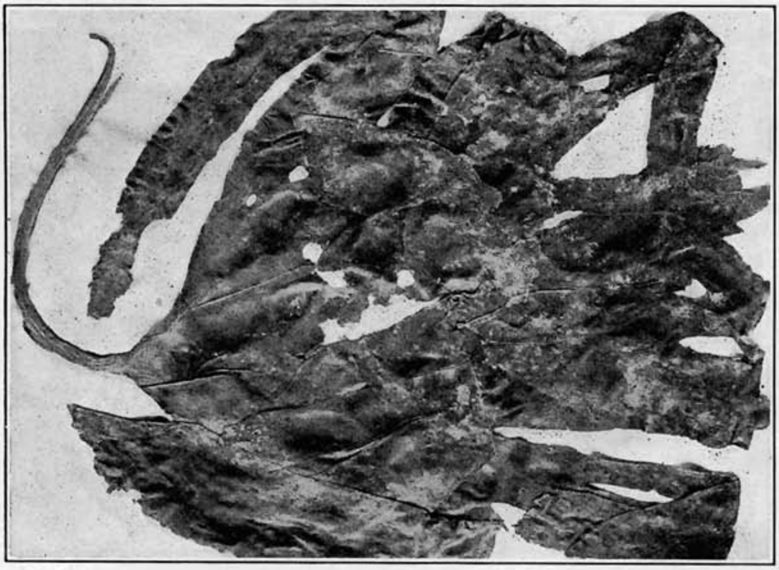

Plate IV.—*Laminaria flexicaulis.*

Judging from the chemical analysis alone, it might be expected that seaweed would be somewhat inferior to horse or cow manure, chiefly because of the smaller amount of vegetable (humus-forming) matter in it. The larger amount of salt (from 2 to 5 per cent) in seaweed may have sometimes a compensating effect.

Eel-grass is generally regarded as inferior to the rockweeds as manure, though the composition of the fresh material is not strikingly different. It is not a true alga, like the others, but belongs to the duckweed family and is usually gathered when dead and cast up by storms, while rockweed is mostly gathered while growing on the rocks. As long as seaweeds are alive, their constituents are not dissolved by the water which surrounds them, but when dead these constituents are in part leached out by the sea-water.

PLATE V.—Ribbon Weed, Kelp, Tangle (*Laminaria saccharina*).

THE VALUE AND USE OF SEAWEED.

Its value as manure has long been known. On the coast and neighboring islands of Great Britain seaweed has long been prized as a manure. In Ireland, where it is extensively used on potato land instead of farmyard manure, it is often carted long distances. Tests in three successive years by the Department of Agriculture indicate that weight for weight it seldom yields as heavy a crop of potatoes as does farm manure.

Seaweed gives its best results on light soils and possibly in dry seasons. (Jour. Dept. Agr. for Ireland, 14, p. 270.)

On the light soils of the Scilly Islands as much as 50 tons per acre of weed are used on early potatoes.

On Thanet 10-15 tons per acre are used as a fertilizer for early vegetables.

In a suit brought in England to determine compensation for deprivation of right to collect seaweed on the coast for fertilizing purposes, the evidence tended to show that seaweed was fully equal if not superior to barnyard manure.

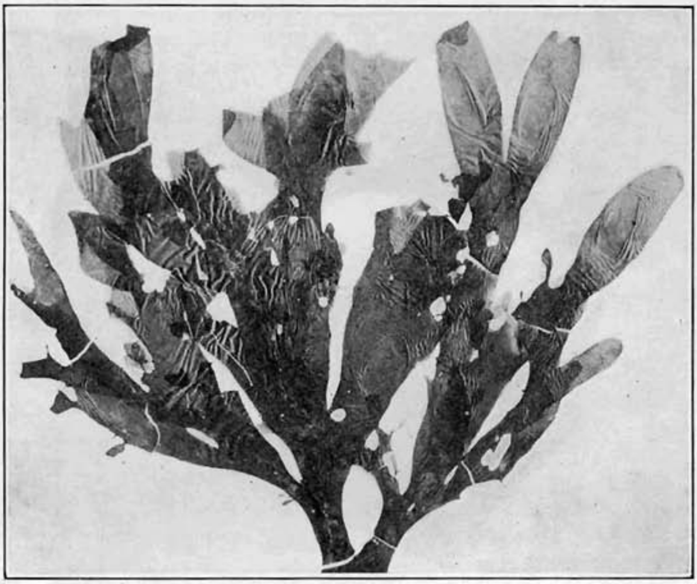

PLATE VI.—Dulse, Dillusk (*Rhodymenia palmata*).

The following quotations from Storer refer to the use of seaweeds in our own country:

"Here in New England there is abundant evidence of the great value of sea manure."

"The strip of country behind Rye Beach, in New Hampshire, comprising the towns of Rye, Greenland, and Northampton, affords a striking example."

"Abundant crops of hay, and (in former times more than now) of potatoes, are there grown and sold year after year, while the country remains fertile and fortunate."

The unusual excellence of pasturage on shore farms in Guilford and other shore towns in past years may fairly be ascribed to the abundant use of manures taken from the seashore.

A summary of testimony in its favor is given by Wheeler and Hartwell in an excellent bulletin (No. 21) of the Rhode Island Station, which has been freely used in this article.

Both the round-stalked and the flat-stalked rockweed have been much used on our shore farms, farmers sometimes paying five cents a bushel for it as cut from the rocks.

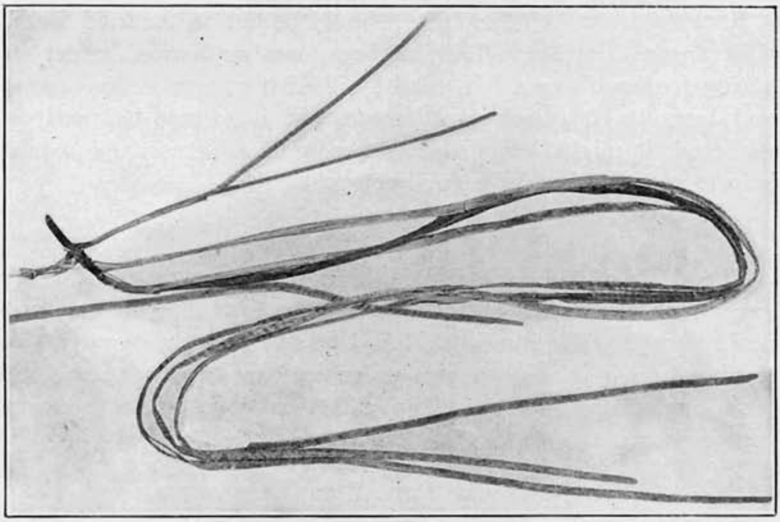

PLATE VII.—Eel-grass, Seaweed (*Zostera marina*).

In Rhode Island it is prized and is sometimes hauled eight or ten miles inland.

With the present scarcity and high price of stable manure, seaweed has become more valuable and should be more extensively tested and used.

On corn land and land to be seeded down or used for growing vegetables it has yielded excellent results.

Applied to potato land in the spring, it may perhaps injure the quality of the crop because of the salt in it, but if used the year before no injury need be feared from moderate dressings.

It is also claimed by those who have used seaweed extensively that it "holds moisture," that, is, that lands dressed with it do not suffer from drought in summer so severely as those not so treated.

How to use Seaweed.

Eel-grass, as has been said, is of inferior value. As gathered, it contains less plant food and it is slow to decay. Partly dried, it can be used for protection from frost, and in the pig-pen it is an absorbent and adds to the organic matter of the manure. It does not pay as top-dressing or to plow under unless it has been well rotted.

Rockweed, on the other hand, should be put on the land fresh, either as a winter top-dressing for grass or plowed under in spring for hoed crops. If piled by itself it rots to a slimy mass and loses its fertilizer constituents. If it cannot be used as gathered, it might be piled together with eel-grass and would help to rot it and make a good compost.

Time of Gathering.

The work of Wheeler and Hartwell indicates that, with few exceptions, seaweed gathered in January and March contains more nitrogen, phosphoric acid and potash than the same varieties gathered in September. Convenience and expense of gathering probably more than offset seasonal differences in composition.

Extraction of Potash from Seaweed.

Public attention has been frequently called to certain kelps found on the Pacific coast, which contain relatively large quantities of potash. So far as known, however, none of the marine growths on the Atlantic coast contains any large amount of that element.

On the coast of Ireland and elsewhere seaweeds have been dried and burned and iodine and potash extracted from the ash. This process cannot pay here. A ton of any kind of fresh seaweed will not yield more than 150 lbs. of pure ashes and 14 lbs. of potash. The ashes would contain over 9 per cent of potash. But for the labor of gathering, drying and burning a ton of weeds, the income would be, approximately, 14 lbs. of potash and less than 3 lbs. of phosphoric acid, which are worth at present $3.60.

MARINE MUD.

This is mud taken from flats at low tide or cast up on the shore of an inlet. If it is put in heaps above the highest tides and left over winter to drain and weather, it falls to a fine powder, but if heaped in summer it is apt to bake into hard lumps.

In some places vast quantities of small shells, ground fine by the waves, are cast up with the mud. Such mud may contain 3 or 4 per cent of carbonate of lime, which increases the value of the mud.

The average composition of nine samples from various places on the Connecticut shore analyzed at this Station and calculated to 48 per cent of moisture (about the average found) was:

Water	48.00
*Organic matter	3.95
Mineral matter	48.05
	100.00

Of the 48 per cent of mineral matter, about 40 per cent is sand.

The four samples in which further determinations were made contained:

Potash	0.35%
Soda	0.72
Lime	0.43
Magnesia	0.52
Phosphoric acid	trace
Chlorine	0.93
Sulphuric acid	0.53
Salt	(equivalent to the chlorine and soda; about 1.5%)

Though the percentages of organic matter, nitrogen and potash are small, applications of 1,000 to 2,000 bushels per acre have given excellent results, due in part, no doubt, to the action of the mud as an amendment, making the soil more retentive of water, and perhaps in part also to the action of salt.

It will not pay probably to haul this mud far, but for seashore farms it is quite worth consideration.

* Containing 0.15 per cent of nitrogen.

TABLE I:—THE AVERAGE COMPOSITION OF SEAWEEDS, OF MARINE MUD CALCULATED

"COMMON SEAWEEDS"	No. of Analyses.	Water.	Organic matter.
Ribbon weed, Kelp, Tangle[1]	8	75.00	(19.76)*
Broad Ribbon Weed, Broad-leaved Kelp[2]	7	75.00	.....
Round-stalked Rock Weed[3]	11	75.00	(19.47)
Flat-stalked Rock Weed[4]	12	75.00	(19.34)
Carrageen, Irish Moss[5]	9	75.00	(18.75)
Eel-Grass, Grass Wrack[6]	13	75.00	(10.90)
Dulse, Dillusk[7]	1	75.00	.....
LESS COMMON SEAWEEDS			
Phyllophosa membrani folia	3	75.00	.....
Cladostephus verticellatus	1	75.00	.....
Polyides rotundus	1	75.00	.....
Ahnfeldtia plicata	1	75.00	.....
"Fine Branching Seaweed"	1	75.00	.....
Sea Lettuce	1	75.00	.....
Coarse Sponge	1	75.00	.....
MARINE MUD			
		48.00	5.49
		48.00	3.20
		48.00	4.34
		48.00	3.27
		48.00	28.80
		48.00	2.27
		48.00	2.86
		48.00	4.30
		48.00	5.35
		48.00	4.47
		48.00	11.26

* Most figures in brackets are results of single analysis and not average.

[1] *Laminaria saccharina.*

[2] *Laminaria digitata.*

[3] *Ascophyllum nodosum.*

[4] *Fucus vesiculosus.*

[5] *Chondrus crispus.*

[6] *Zostera marina.*

[7] *Rhodymenia palmata.*

CALCULATED TO 75 PER CENT MOISTURE AND ANALYSES TO 48 PER CENT OF MOISTURE.

Mineral matter.	Nitrogen.	Phos. Acid.	Potash.	Soda.	Lime.	Magnesia.	Iron Oxide.
(5.24)	0.39	0.13	0.51	(0.45)	0.83	0.35	(0.07)
.....	0.45	0.12	0.62	....	0.69	0.38	....
(5.53)	0.39	(0.02)	0.79	(1.30)	0.49	0.38	(0.02)
(5.66)	0.43	0.12	0.50	(1.36)	0.47	0.30	(0.03)
(6.25)	0.70	0.13	1.15	....	....	....	....
(14.10)	0.41	0.15	0.42	0.53	0.91	0.30	(0.21)
.....	0.68	0.17	1.98	....	0.87	0.16	....
.....	0.80	0.11	0.72	....	3.66	0.50	....
.....	0.39	0.19	1.23	....	0.75	0.31	....
.....	0.82	0.15	0.36	....	0.60	0.18	....
.....	0.42	0.09	0.88	....	0.22	0.28	....
.....	0.98	0.24	1.74	....	0.31	0.24	....
.....	0.33	0.06	0.48	....	....	....	....
.....	1.04	0.25	0.29	....	0.14	0.25	....
46.51	0.27	0.02	0.40	0.42	0.38	0.38	3.83
48.80	0.25	tr.	0.32	1.08	0.48	0.92	4.75
47.66	0.17	tr.	0.34	0.53	0.86	0.05	5.88
48.73	....	0.69	0.34	0.85	3.70	0.74	3.83
23.20	0.79	0.22	0.23	....	....	....	....
49.73	0.06	0.04	....	....	....	....	....
49.14	0.09	0.03	....	....	....	....	....
47.70	0.13	0.05	....	....	....	....	....
46.65	0.19	....	....	....	....	....	....
47.53	0.19	0.21	....	....	....	....	....
40.74	0.53	0.42	0.03	....	0.67	....	....