true that from carelessly putting the privy well or cesspool and the well for the pump both in the rear of the cottage, underground communication sometimes exists between them. The means of communication need not be sufficient to admit of the passage of solid matter or even of liquid matters absorbed from the cesspool. Gases, evolved by decaying excrement or garbage, may, by entering the pump well above the water line, become dissolved by the water, and thus prove a prolific source of disease. The distance which the gases, without losing their polluting power, may travel through the ground depends upon its nature, and cannot be definitely determined.

If it be composed of porous materials, or of several strata, themselves perhaps impervious, but the interspaces at their surfaces of contact not gas tight, then sources of pollution may be transmitted. The nature of the subsoil and the subjacent strata may sometimes be learned by observing them while the cellar or the first well is being dug. Not unfrequently the digging of a pump well is preliminary to the building operations proper, and the opportunity it sometimes affords of acquiring a knowledge of the strata should not be lost. The dictate of prudence is to put the two kinds of wells as far from each other as the convenience of the tenant will permit. A company which, from the roughness of the surface adjacent to its works, was unable to find sufficient level ground for rows of cottages in pairs, built them closely together. The pump wells were dug in the gardens in front of the cottages, the other wells in the rear. The arrangement is such that the two adjoining dwellings, using the same pump, do not use the same cesspool, and *vice versa*. By digging the two descriptions of wells not in line, but diagonally from each other, the distance between them is increased without extending the ways of access to them from the cottages. In the twin cottage system the pump is placed in the line fence between the two adjoining side yards, and is therefore readily accessible from the side doors of entrance, while the cesspool is dug in the rear on the line of fence between the two cottages which form a pair, and is reached from the back door.

One method of preventing communication is to line the walls and bottom of the cesspool with hydraulic cement. The bottom must be first well rammed and dressed with a covering of small stone, as the least yielding would crack the cement. Through the narrowest cracks, whether in the bottom or on the sides, streams of pollution, liquid or aeriform, may pass. Asphalt answers perfectly, but as it must be applied hot, the interior surface must be first dried by kindling a fire, and maintaining it until the moisture is evaporated to a sufficient depth to prevent contact with the heated asphalt when laid on.—*Textile Record*.

ALGIN: A NEW SUBSTANCE OBTAINED FROM SOME OF THE COMMONER SPECIES OF MARINE ALGÆ.*

By E. C. C. STANFORD, F.C.S.

THE utilization of hitherto waste materials presents a large field for chemical investigation, and many important industries have within the last twenty years resulted from such researches.

There are few materials so abundant, so general, and so easily obtained as the commoner kinds of seaweed thrown up on our coasts, but especially on those exposed to the waves and storms of the Atlantic. The species I refer to—the laminaria and fuci—are found growing on all rocky shores. And it may also be remarked that, except as manure, the great bulk of this material has been long practically unutilized. It is true that, when burnt into the rough slag known as kelp, this material was formerly the means of securing large revenues to the proprietors of the Western Islands. For several well known reasons, that manufacture has long ceased to be profitable, and it never could have been considered as utilizing the seaweed, except in the sense that burning down a forest could be called utilizing it, when it ought to be cut into timber and really utilized in building houses or making furniture.

In 1862, the writer introduced a method of carbonizing the seaweed in retorts, and thus converting the material into charcoal instead of kelp, and preventing the great loss of iodine arising from open air burning. This was simply another step of improvement, and, comparing it again with the forest, was merely equal to making the timber into charcoal instead of burning it into ash. It is not, in a proper and fuller sense, utilizing the seaweed. The results of further attempts in this direction form the subject of this paper. When we remark that the present widespread destitution and want of employment among the poor cottagers is most severe in just those districts in Ireland and the Highlands where this material is most abundant, the importance of this inquiry will be at once seen. Indeed, if a remunerative price can be paid for a waste material that every child in a large family can easily assist in collecting at their own doors, it would go far to settle many existing difficulties, of which the worst is always hunger. And this brings me to mention the value of the algæ as a food material. In my paper, read before the Society of Arts, in 1862, on "The Economic Applications of Seaweed," the various kinds so used were described, and I have called attention more recently, in a paper read before the Chemical Society, to the fact that the analysis of the charcoal obtained from the various algæ approximates more nearly to that of a product of the animal than of the vegetable kingdom. I believe the algæ, generally, to be quite as valuable food products as the fungi, with the advantage that we are unaware of any poisonous species. Both are, however, equally neglected in this country. As the edible fungi are much consumed by other European nations, so the edible algæ are largely enjoyed and realize a high price in China and Japan. A sample of one of the Japanese varieties before us yielded on analysis a composition closely similar to our laminaria. It has, however, evidently been cut up, and presents the appearance of long shreds, and is colored green by the action of an alkali. The poor people in Donegal are now eating the *Fucus vesiculosus* with Indian meal, and it is a common thing to see the Highland cattle browsing on this plant at low tide. The *Alaria esculenta*, or murlins, of which a fine specimen is on the table, may be called our edible species, but the *Rhodomenia palmata*, or dulse, is perhaps better known in Glasgow, being regularly sold on the streets.

The most important species consumed in this country is the *Chondrus crispus*, or Irish moss. This plant contains 79 per cent. of caragheenin, a substance of great gelatinizing power, and largely used in jellies and puddings. This seaweed would, no doubt, secure a considerable market as a size for fabrics, but it cannot be obtained in any great quantity. It is only uncovered at low spring tides, and any very

large demand would soon exhaust the supplies. A recent application of Irish moss is being worked by a limited company, under the name of "velo-plastic," which is said to be made of refuse leather, dried and finely ground and mixed with caragheenin. I am indebted to Mr. John A. Walker, of Dublin, for specimens of green and yellow morocco, poplin, and satin damask, and watered silk, all of which appear to be most successful imitations. The new substance to be described in this paper would probably answer equally well for this application.

Another still more powerful gelatinizing substance is gelose. This was first imported into France from China in 1856. It has ten times the gelatinizing power of isinglass, and will set into a jelly five hundred times its weight of water. It is not nitrogenous, and contains carbon, 42.8; hydrogen, 5.8; oxygen, 51.4. It has not superseded isinglass for jellies, as the fusing point of the jelly is too high to melt in the mouth. I found some years ago, in experiments on every variety of seaweed that could be procured, that this gelatinizing principle was confined to two British species—the *Chondrus crispus* and the *Gelidium cornutum*. An Australian alga, the *Eucheimia spinosa*, or agar agar, is also a jelly-yielding species. Several articles have recently been introduced under various names, such as thao, fucyne, etc., all of which appear to be modifications of, or products from, these plants.

The application of seaweed as manure is very general where it can be obtained. In fact, the practical value placed on it is far above its actual chemical valuation. It usually contains 80 per cent. of water, so that four tons of water are carted to the land for every ton of dry seaweed, and even when dried there is not a large saving in carriage, as it is then very bulky. It is, however, carried long distances in some places, and there is no doubt that it is very valuable on soils that are all sand; but it is more of a mechanical value, as its use is not to manure but to make the soil—a rather expensive manufacture. Kelp waste, a ton of which, dry, represents forty tons of wet seaweed, and contains all the phosphates of the weed in a convenient form, is absolutely unsalable to farmers in this country at any price.

The only other important proposed application of seaweed has been to the manufacture of paper, and about twenty years ago several patents were taken out with this object, and some specimens were exhibited at the Society of Arts on the occasion before referred to. They were all made, however, from the *Zostera marina*, or grass wrack—a marine plant with flowers growing in the sea, but not one of the algæ—and this plant makes a very good paper. It created a good deal of attention at that time, having been proposed as a substitute for cotton during the cotton famine. It is not, however, available in large quantity, and contains very little fiber. The algæ generally contain no fiber, but, as far as my experiments have gone, nearly every species yields a very pure cellulose, which makes a tough, rather transparent paper. The tissue of the plant consists of simple cells of various shapes laid end to end, and in the fuci containing a dark pigment. This cellulose fabric, which forms the paper material, amounts, when quite dry, to 10 per cent. of the air-dry plant. In working on the fuci and the laminariæ my attempts to make a paper pulp were much impeded by a peculiar substance common to both these species, which was found at first difficult to remove, and the presence of which rendered the paper brittle. In fact, this appeared to be always the case unless the cellulose was obtained quite pure. This substance is present in large quantity, and forms the bulk of the plant after the salts are removed.

Any one observing the long flat fronds of the laminaria lying on the sea shore must have noticed two things. 1st, that these are easily bleached by exposure to light; 2d, that, after exposure to rain, the fronds contain in their interior sacs of fluid. These are derived from the endosmosis of the water through the outside membranes, dissolving a peculiar glutinous principle. Upon opening one of these sacs, a neutral glairy, almost colorless, liquid escapes. Sometimes it may be seen partially evaporated on the surface of the frond as a jelly-like substance, which may be drawn out by the fingers in long, tenacious strings. This fluid contains a unique substance of remarkable properties, and to which, from its source, I have given the name of algin. The vesicles are only seen in the long fronds of the various laminaria, especially *L. stenophylla*, known in the Highlands as bar-darrig, or red-top. The large stems or tangle, and the fuci, although containing it in considerable quantity, do not exhibit this appearance.

If the liquid be evaporated to dryness, the scales so produced resemble albumen, and are not all soluble in water, but very soluble on the addition of a little alkali. Several other instances of the solubility of substances when endosmized or dialyzed are well known. The fluid thus naturally obtained is miscible with water, but coagulated by alcohol and by mineral acids. It cannot be obtained in sufficient quantity for exhaustive analysis, but it contains calcium, magnesium, and sodium, in small quantity, in combination with algin. If the laminaria fronds are cut up and macerated in dilute hydrochloric acid, the liquid in the vesicles assumes the form of a colorless, insoluble jelly. If the laminaria fronds are immersed in water containing a little alkali—by preference sodium carbonate—the whole plant becomes disintegrated, and presents a gelatinous mass, consisting of a thick, glutinous, gummy liquid, containing the cellular fabric of the plant completely broken up. This occurs in twenty-four hours in the cold. The mass, although it only contains 2 per cent. of the algin, is so glutinous that it cannot be poured out of the bottle. It is very difficult to deal with, on account of its extraordinary thickness. In fact, as it is, no method of filtration is possible (all known methods, with and without pressure, have been tried). The cells to be removed are so minute that, if pressure be applied, the whole mass passes through any filter or not at all. By cautiously heating the mass it can, however, be filtered. The medium employed is a coarse linen sacking in the form of a Taylor filter. The cellulose is left behind as a gelatinous mass, amounting, when dry, to about 10 per cent. of the air-dried plant.

The algin solution is then evaporated in a somewhat similar manner to gelatin, and, when dry, presents an appearance which is not unlike gum-tragacanth; but it may also be obtained in thin, transparent, flexible sheets. The solution is slightly alkaline; but care must be taken that no great excess of sodium carbonate is present, or the solution decomposes, and in a week, if dilute, becomes quite thin, and contains no algin. This action of the alkali I cannot yet clearly explain. The solution can be neutralized by the careful addition of hydrochloric acid without gelatinizing; but an excess at once precipitates it. A solution of only 2 per cent. becomes semi-solid, treated in this way. The following reactions are obtained with various reagents. For some of these the solution must be carefully neutralized with acetic acid, which does not gelatinize it.

Dilute hydrochloric, nitric, sulphuric, sulphurous, phosphoric, and mineral acids generally, conglute it. Boracic acid has no effect.

Lime water, baryta water, and salts of calcium, barium, and strontium, give white precipitates.

Salts of magnesium do not affect it. Acetic, formic, citric, tartaric, and benzoic acids do not affect it.

It is precipitated by alcohol.

Perchloride of iron gives a dark brown coagulum.

Salts of copper, zinc, aluminum, tin, antimony, cobalt, and nickel all precipitate it.

Protonitrate of mercury forms a white precipitate, but bichloride of mercury and silver nitrate have no effect.

Acetate and subacetate of lead both give white precipitates.

Potassium silicate and bichromate, sodium bichromate,* and potassium ferrocyanide, permanganate, sodium tungstate, stannate, and succinate do not affect it. No precipitate is produced by tannin.

Concentrated sulphuric acid dissolves it; concentrated nitric acid converts it into oxidation products, among which are oxalic acid.

It is distinguished from albumen by not coagulating on heating, and by not precipitating silver nitrate; from gelose by not gelatinizing on cooling, and by containing nitrogen, which gelose does not; and being soluble in cold, weak, alkaline solutions, which gelose is not; and being insoluble in boiling water, in which gelose is soluble. The laminaria has been boiled in water for a month without effecting any solution, and for a week under forty pounds pressure with a similar result.

It is distinguished from gelatine by not giving any reaction with tannin from starch; by giving no reaction with iodine from dextrine; gum arabic, gum tragacanth, and pectin by its insolubility in dilute alcohol and in dilute mineral acids.

I notice as particularly remarkable that it should precipitate all the salts of the alkaline earths except those of magnesium, and most of the metals except silver and mercury, and with regard to the latter that it should precipitate the protonitrate but not the bichloride; and that it gives no precipitate with potassium silicate.

The gelatinous precipitate produced by a mineral acid represents the algin in its pure, insoluble form. It dries up to a hard, horny substance. A specimen can scarcely be distinguished from horn. I have not yet succeeded in getting it pure and definite enough to be certain of its composition; but I am indebted to Prof. Ferguson for a combustion of the soda compound. This had been carefully dialyzed to avoid the presence of excess of alkali, and gave the following numbers:

Carbon	35.65
Hydrogen	4.40
Nitrogen	3.03
Oxygen	37.23
Ash	19.69

100.00

This gives the following composition for the algin. I have appended also that of gelatin, isinglass, gelose, and chitin. In nitrogen it is intermediate between gelose and gelatin, but it approaches nearer to chitin than any other substance. Fremy, however, denies the presence of nitrogen in this substance. It differs entirely from algin in being insoluble in alkalies.

	Algin.	Gelatin.	Isinglass.	Gelose.	Chitin.
Carbon.....	44.39	50.0	50.1	42.77	46.64
Hydrogen....	5.47	6.5	6.6	5.77	6.60
Nitrogen.....	3.77	17.5	18.3		6.56
Oxygen.....	46.37	26.0	25.0	51.46	40.20
	100.00	100.0	100.0	100.00	100.00

(Sulphur, 0.12.)

The percentage of ash in the soda compound does not materially vary. The two following were made—one with sodium hydrate, and the other with sodium carbonate—and yielded almost the same amount of ash:

Sodium hydrate—percentage of ash	31.51
Sodium carbonate, do.	31.37
Mean	31.44

Although I believe the composition to be stated correctly, I cannot construct a formula from these figures; and all attempts to procure definite compounds for analysis have as yet been unsuccessful. The following compounds have been prepared and investigated with this view: Compounds with calcium, aluminum, barium, and lead—but the results have not been uniform enough to show that we have been examining definite compounds.

The sodium carbonate appears to be unaltered in the compound, but completely masked. The carbonic acid comes off only when acidified with an excess of hydrochloric acid, and heated.

The acid has also some decomposing effect, and produces a small quantity of a substance which precipitates Fehling's solution, but does not appear to be glucose.

A solution, 1000 grs. measure, containing 13.2 grs. of algin, was precipitated by standard sulphuric acid, and redissolved by standard sodium hydrate, six times in succession.

1st precipitation took of sulphuric acid (SO ₃), grains	5.430
2d " " " " " "	4.070
3d " " " " " "	3.086
4th " " " " " "	1.975
5th " " " " " "	0.617
6th " " " " " "	0.617
1st resolution took of soda (Na ₂ O), grains	3.778
2d " " " " " "	2.871
3d " " " " " "	2.052
4th " " " " " "	1.530
5th " " " " " "	0.670
6th " " " " " "	0.478

As the precipitate is not soluble in sodium sulphate, there appears to be some decomposition continually going on, and this has not yet been sufficiently investigated to enable me to ascertain the exact action of the hydrochloric acid.

* It can be extracted by a solution of borax.

* Read before the Chemical Section of the Glasgow Philosophical Society, April 2, 1883.

The process proposed to deal with the seaweed is first of all to wash out the salts by simple maceration in cold water. This is very easily done, the salts being almost entirely removed, even by two macerations. On account of the bulk of the material, it is, however, advisable to wash a number of vats exhaustively in turns, in the usual manner of lixivation common in alkali works. The water removes about a third of the weight of the seaweed, and when evaporated to dryness presents a treacly mass containing the salts and a considerable quantity of a saccharine matter which represents mannite, but which precipitates Fehling's solution equal to fifteen per cent. of glucose. It is, however, unfermentable, and I have not yet succeeded in getting it pure enough for analysis, on account of the great difficulty of separating it from the alkaline chlorides which are soluble in alcohol. By the use of sulphate of silver I have separated a small quantity, but still not sufficiently pure. If this can be separated commercially, and is a sugar having sweetness but unfermentable, it would be available for replacing glycerine in some of its applications. Until, however, more is known of its properties it must be sacrificed by carbonizing the salts; the charcoal, of which it yields about fifty per cent., being then treated in the usual manner for separating the iodine and salts. The salts vary from thirty-five to fifty-five per cent. of the whole; or twelve to eighteen per cent. of the original air-dry weed in the laminaria. This is more than is obtained by burning the weed into ash, which does not, as a rule, yield more than ten per cent. of salts on the air-dried weed.

It is interesting to notice the way in which the salts come out, and analyses have been made with this view. The results are shown in the following tables. Calcium sulphate and magnesium chloride are both present in the aqueous solution of the laminaria and in the residue of the fucus—carbonates generally in the salts of the fucus and the residue of the laminaria. In the latter, which is always submerged, the relation of the magnesium to the calcium is singularly like that existing in sea water.

Within certain limits the composition of the salts differs considerably, the age of the plant and the time of gathering both affecting it.

The following samples are from a considerable bulk of mixed salts evaporated:

ANALYSES OF THE SALTS.

	Laminaria stenophylla.	Fucus vesiculosus.
Calcium sulphate ..	1.69	4.33
Potassium sulphate.....	11.29	23.62
Potassium chloride.....	19.90	13.71
Sodium chloride.....	60.96	58.20
Magnesium chloride.....	4.35	
Sodium carbonate	0.53	
Sodium iodide.....	1.26	0.12
	99.98	99.98

In the following tables the composition of the salts are shown as they come out in six successive macerations in cold water.

The residues are always carbonized, and then washed and again ignited—that being the only way to insure perfect combustion in the presence of such an excess of saline constituents.

Laminaria stenophylla—Air-dried.

Containing 14.8 moisture.

4 ozs. = 1,750 grains. Six macerations in cold water; all evaporated, and residues weighed.

	Gr.	P. c.	Gr.	P. c.
1st water-weight of residue....	288	16.45	499	28.5
2d ..	211	12.05		
3d ..	40	2.28		
4th ..	37.2	2.12		
5th ..	21.1	1.20		
6th ..	18.6	1.06		
	615.9	35.16		

	1.	2.	3.	4.	5.	6.
Volatile matter...	23.4	28.0	29.3	40.0	54.5	69.1
Salts.....	67.1	60.1	55.5	40.0	31.8	22.5
Fixed carbon....	3.91	4.97	4.1	4.56	2.23	0.96
Ash.....	5.59	6.93	11.1	15.44	11.4	7.44
	100.00	100.00	100.00	100.00	100.00	100.00

Composition of Salts.

	1.	2.	3.	4.	5.	6.
Calcium sulph.	2.91	1.02	Nil.	Nil.	Nil.	Nil.
Potass. sulph.	7.53	10.08	19.48	20.80	trace.	trace.
Potass. chlor.	34.05	30.95	24.81	23.78	"	"
Sodium chlor.	45.55	53.00	53.57	51.04	"	"
Sodium iodide.	1.95	1.58	2.00	1.25	"	"
Sodium carb.	Nil.	Nil.	trace.	3.30	"	"
Magnes. chlor.	8.55	3.40	trace.	trace.	"	"
	100.54	100.03	99.86	100.17	"	"

Laminaria stenophylla—Air-dried.

Calculated percentage on original weed.

	Per cent.	Volat.	Salts.	Carbon.	Ash.
1st water.....	16.45	3.85	11.04	0.64	0.92
2d ..	12.05	3.35	7.26	0.60	0.84
3d ..	2.28	0.68	1.26	0.09	0.25
4th ..	2.12	0.86	0.85	0.09	0.32
5th ..	1.20	0.656	0.38	0.027	0.137
6th ..	1.06	0.732	0.24	0.010	0.078
	35.16	10.128	21.03	1.457	2.545

Composition of Salts.

	1.	2.	3.	4.	5.	6.	Total.
Calcium sulph.	0.321	0.074	Nil.	Nil.	Nil.	Nil.	0.395
Potass. sulph.	0.831	0.731	0.245	0.177	trace	trace	1.984
Potass. chlor.	3.759	2.247	0.312	0.202	"	"	6.520
Sodium chlor.	4.970	3.846	0.678	0.432	"	"	9.926
Sodium iodide.	0.215	0.115	0.023	0.011	"	"	0.366
Sodium carb.	Nil.	Nil.	trace	0.028	"	"	0.028
Magnes. chlor.	0.944	0.247	trace	trace	"	"	1.191
	11.040	7.260	1.260	0.850	0.38	0.24	21.030

Laminaria stenophylla—Air-dried.

Residual weed—Weight 2 ozs., or 50 per cent.

	Calculated on original weed, per cent.
Volatile matter.....	74.2
Charcoal.....	25.8
	100.0

Charcoal.

Salts ..	18.0	2.32
Fixed carbon	50.7	6.55
Ash.....	31.3	4.03
	100.0	12.90

Salts.

Potassium sulphate.....	35.27	0.818
Potassium chloride.....	6.72	0.156
Potassium carbonate.....	5.00	0.116
Sodium carbonate.....	49.97	1.169
Sodium iodide.....	2.63	0.161
Alkaline earths.....	Nil.	Nil.
	99.49	2.320

Fucus vesiculosus—Dried.

Containing 2.11 per cent. moisture.

4 ozs. = 1,750 grs. Six macerations in cold water—all evaporated, and residues weighed.

	Gr.	Per cent.
1st water-weight of residue, 174.5		= 9.45
2d .. 43.0		= 2.45
3d .. 11.2	0.64	= 0.99
4th .. 6.15	0.35	
5th .. trace		
6th .. trace		
	234.85	= 12.89

	1.	2.	3.	4.
Volatile matter, etc.....	37.78	68.4	47.48	62.86
Salts.....	49.03	27.62	29.22	25.71
Fixed carbon.....	8.09	1.17	3.78	0.74
Ash.....	5.10	2.81	19.52	10.69
	100.00	100.00	100.00	100.00

Salts.

	1.	2.	3.	4.
Potassium sulphate.....	27.25	48.19	trace	trace
Sodium sulphate.....	4.03	0.57	"	"
Sodium chloride.....	61.50	37.62	"	"
Sodium iodide.....	0.026	0.02	"	"
Sodium carbonate.....	7.42	13.36	"	"
	100.226	99.76	"	"

*Fucus vesiculosus—Dried.**

Calculated on original weed.

	Per cent.	Volat.	Salts.	Carbon.	Ash.
1st water.....	9.45	3.58	4.63	0.76	0.48
2d ..	2.45	1.68	0.67	0.03	0.07
3d ..	0.64	0.304	0.187	0.024	0.125
4th ..	0.35	0.221	0.089	0.003	0.037
5th, trace.....					
6th, trace.....					
	12.890	5.785	5.576	0.817	0.712

Composition of Salts.

	1.	2.	3.	4.	Total.
Potass. sulphate....	1.262	0.343	trace	trace	1.605
Sodium sulphate ..	0.186	0.004	"	"	0.190
Sodium chloride ...	2.8378	0.2337	"	"	3.0715
Sodium iodide	0.0012	0.00013	"	"	0.00133
Sodium carbonate...	0.343	0.0895	"	"	0.4325
	4.630	0.6700	0.187	0.089	5.576

Residual Weed—*Fucus vesiculosus*.

Weight, 3 ozs. 175 grains = 85 per cent.

	Calculated on original weed.
Volatile matter.....	65.65
Charcoal.....	34.35
	100.00

Charcoal.

Salts	18.63	5.24
Fixed carbon.....	58.53	17.53
Ash.....	22.84	6.42
	100.00	29.19

Salts.

Potassium sulphate ..	29.41	1.5420
Sodium sulphate	47.58	2.5030
Calcium sulphate.....	9.34	0.4760
Magnesium sulphate...	11.76	0.6160
Magnesium chloride ..	1.30	0.0680
Sodium carbonate.....	0.45	0.0235
Sodium iodide	0.22	0.0115
	100.00	5.2400

After the salts have been removed, the weed is bleached by a weak solution of chlorinated lime, about 2° Tw. The laminaria bleaches easily in a few hours, but the fucus require prolonged and repeated treatment. I will call attention to the extreme beauty of some of the algæ before you when thus bleached, even in the common *Fucus vesiculosus*, or black wrack; you can trace the pores in the cells and lining of the air vessels. The specimen of *Sargassum bociferum* (gulf weed) is beautifully transparent. Other specimens shown are *Laminaria digitata*, stems and fronds, the former looking like sticks of ivory, *L. stenophylla*, *Fucus nodosus*, *F. serratus*, *Alaria esculenta*, *Halidryes siliquosa*, *Rhodominia palmata*, *Rhodomela pinnastroides*, *Zostera marina*, *Enteromorpha compressa*, etc. When sufficiently white, the weed is soured by a very weak solution of sulphuric or hydrochloric acid, and well washed. If the acid be added with the bleach, the action is quicker. It is then acted on in the cold by about a tenth of its weight of sodium carbonate for twenty-four hours, then heated, filtered, and evaporated. The residual cellulose is pressed into cakes for use as a paper material. It is already bleached, and has only to be put at once into the paper beater. There are plenty of fibrous materials in the market, but there is no real substitute forragas, as I believe, this will, to a great extent, prove to be.

*This specimen was abnormally low in salts.

The whole of the plant is thus accounted for; in the laminaria the average yield is as follows:

On the air-dried plant—

Extracted by water ..	30
Extracted by acid	5
Extracted by sodium carbonate = algin.....	35
Cellulose	10
Moisture.....	20
	100

This plant is the only one now employed in making kelp; the least exposure to rain washes out the salts, and renders it useless for this purpose. It does not, however, interfere with its use for extracting the algin, which is insoluble in water. For this purpose, if the salts are sacrificed, it is improved by exposure to rain and light. The wet weed, however, keeps perfectly well if access of air be prevented, for instance in a properly constructed "silo," and there is no reason that any of it should be lost.

Applications of Algin.

Algin has properties which should make it useful for several applications in the soluble form. As a stiffener of fabrics, although not so rigid as starch, it fills the cloth better, is tougher, more elastic, and more transparent. It mixes in all proportions with starch and dextrine, and imparts to the mixture these properties. Unbleached, it forms a cheap material for dressing winseys and such dark goods. Passed through an acid bath, the coating becomes glossy and insoluble, and thus a vegetable mordant is available for dyeing. Lime-water and salts of calcium, barium, and several metallic salts, may be employed for a similar purpose, one of its peculiarities being the ease with which it is rendered insoluble.

I shall only just refer to its probable value as a food material on account of its nitrogenous character, as I have no edible specimens on the table which can be passed round for immediate consumption. As a cattle food there is a large opening for such a material. The agglutinating power of algin enables us to convert into solid blocks many substances which are with difficulty made to cohere. Silica, lime, magnesia, oxide of zinc, phosphate of lime, alumina, chalk, plumbago, charcoal, and many other such substances can be converted into solid, hard blocks. All of these and many more are exhibited. Some of these compounds may be made by mixing the algin with a solution, where both form a joint precipitate with another solution—e. g., sodium silicate and calcium chloride. One application of this agglutinating character has already assumed importance. Charcoal has been long known as our best solid non-conductor of heat, and no doubt it would have been employed long ago as a covering for our steam-boilers had any medium been known capable of agglutinating it. That is now attained by this substance. My "carbon cement," for this purpose, contains ninety-seven per cent. of charcoal, three per cent. of algin being sufficient to make it cohere; and as that charcoal is made from seaweed, it is a remarkable fact that the whole covering is derived from that material. My friend Mr. Spiller, a high authority on the subject, has also found the solution of algin the best thing yet discovered for arresting incrustation in steam-boilers. We are not much troubled with this in Glasgow, but in the South, where the waters are hard, many such fluids are employed. Most of these are organic compounds combined with alkalies. One of the earliest and best was introduced some years ago by Mr. Spiller himself, and I am entirely indebted to him for suggesting the application of algin to this purpose. He speaks of it as highly efficient in precipitating the lime in such a fine state of division that it can easily be blown off from the cock. So that we now propose sea-weed in one form or another as a most comfortable internal and external application to our steam-boilers. In fact, several large steamers are already plowing the ocean, assisted in their conflicts with heavy seas by weapons borrowed from these opponents.

The insoluble form of algin is very like horn, and as it can be pressed into moulds of any size it may be used instead of that article.

It also appears to be an excellent non-conductor of electricity, and in combination with certain other substances may assist in providing the cheap non-conducting material, which may be impervious to moisture, now so much required for underground telegraph and telephone wires.

It is an efficient agent for emulsifying oils, and, being coagulated by alcohol, for fining wines and spirits.

These are some of the probable applications of algin, and, seeing that the substance is new, and the source abundant, I shall not be bold enough to predict what it may not be used for.

[NEW ENGLAND FARMER.]

TRANSPLANTING TREES IN JAPAN.

BEFORE transplanting trees, two pieces of paper or cloth are tied to the branches on the east and west, or north and south sides of the tree, so that it may be planted as it stood before in relation to the sun. Particular care is taken in removing the tree. Large roots which extend so far into the ground that it requires a great deal of labor to dig them out are cut off at certain points, either by the saw or any other cutting implements, fibrous roots being carefully protected. The spot where the tree is to be planted is dug a little larger than the roots absolutely require. If the tree is large, two or four strong posts or stakes of convenient size and length are set about it before digging, and are connected by one or more horizontal slats. The stem of the tree is wrapped in straw matting, and tied firmly to the horizontal slats. Where two horizontal slats are used they are fixed to cross each other at the point where the stem is tied. The tree is thus in a suspended condition, therefore, though we dig around the roots quite deep, it may not only be prevented from falling down, but its fibrous roots, which would otherwise be injured more or less by the heavy pressure of the whole tree, can be saved to a large extent.

After having removed the tree to the desired place, particular care is taken in covering the roots well, and also in watering, especially if the soil is rather light. Press the dirt, which is thrown into the hole a little at a time, firmly around the roots, taking care at the same time to set them in their natural position as far as possible. On the contrary, if we throw in dirt upon the roots all at one time and carelessly, all the roots, large and small, are crowded together in one mass, many of which will be injured, even if the tree is not killed. This is especially true of those trees whose roots are rather stiff, as, for instance, the persimmon tree. After the tree is planted it is examined from all sides to see that it has been planted straight, and then it is tied to three posts which are so set about it as to protect it from the wind. The