Algin and Sodium Alginate and their Economic Uses.

(ABSTRACT from a paper "On the Economic Applications of Seaweed" by Ed. C. C. Stanford, F.C.S., read before the Soc. of Arts, London).

If the long fronds of *Laminaria stenophylla* be observed after exposure to rain, a tumid appearance will be observed, and sacs of fluid are formed from the endosmosis of the water through the membrane, dissolving a peculiar glutinous principle. If the sacs be cut, a neutral glairy colorless fluid escapes. It may often be seen partially evaporated on the frond as a colorless jelly. This substance which is then insoluble in water, is the remarkable body to which I have given the name of *algin*. The natural liquid itself is miscible with water, but coagulated by alcohol and by mineral acids. It contains calcium, magnesium, and sodium in combination with a new acid, called by the author *alginic acid*. When this natural liquid is evaporated to dryness, it becomes insoluble in water, but is very soluble in alkalies. This new substance is so abundant in the plant that, on maceration for twenty-four hours in sodium carbonate in the cold, the plant is completely disintegrated. The mass thus obtained is a glutinous mass of great viscosity, and difficult to deal with on that account. It consists of the cellulose of the plant mixed with sodium alginate. The cells are so small that they pass through many filters, but by cautiously heating it the mass can be filtered through a rough linen filter bag, the cellulose being left behind, and after the algin is removed, this is easily pressed.

The solution contains dextrin and other extractive matter, and is precipitated by hydrochloric or sulphuric acid; the alginic acid precipitates in light gray albuminous flocks, and is easily washed and pressed in an ordinary wooden screw press. A filter press made for me by Messrs. Johnson & Co. answers perfectly well for this operation, but not so well for the preceding. It forms a compact cake, resembling a new cheese, and has only to be stored in ordinary cool drying rooms, where it can be kept any length of time. If desired, by adding a little bleach during the precipitation, it can be obtained perfectly white. The algin can be sent out in this state; it is only necessary to dissolve it in sodium carbonate in the cold for use. If, however, it be sent out as sodium alginate, it must be dissolved to saturation in sodium carbonate, the carbonic acid is disengaged, and sodium alginate is formed. If potassium or ammonium carbonate be used, the alginates of potassium or ammonium are formed, which are similar to the soda salt. The bicarbonates of these alkalies may also be used, but the caustic alkalies are not such good solvents.

The sodium alginate forms a thick solution at two per cent, it cannot be made above five per cent, and will not pour at that strength. Its vicosity is extraordinary. It was compared with well boiled wheat starch, and with gum arabic in an ordinary viscometer tube. It was found that algin had *fourteen* times the viscosity of starch, and *thirty seven* times that of gum arabic. The solution may be alkaline, or neutral, or acid, according to the degree of saturation; if alkaline, it may be made distinctly acid by the addition of hydrochloric acid, but any excess at once coagulates it; a two per cent solution becomes semi-solid on this addition.

The evaporation is effected in a similar manner to that of gelatin, in thin layers on trays or slate shelves in a drying room with a current of air or on revolving cylinders heated internally by steam; high temperatures must be avoided. The solution keeps well. Thus obtained, the sodium alginate presents the form of thin, almost colorless sheets, resembling gelatin, but very flexible. It has several remarkable properties which distinguish it from all others known substances.

Algin or sodium alginate in solution is precipitated or coagulated by alcohol, ethylic and methylic, acetone and collodion (but not by ether), by hydrochloric, nitric, sulphuric, and many other acids, as well as many salts [all enumerated in the original].

The solution is not precipitated nor coagulated by alkalies and salts of alkalies, potass. bichromate and chromate; starch, glycerin, ether, cane sugar, amylic alcohol, boracic acid, acetic, carbolic, tannic, and certain other acids [and some other substances enumerated in the original].

It does not precipitate the ordinary alkaloids.

It is distinguished from albumen which it most resembles, by not coagulating on heating, and from gelose by not gelatinizing on cooling, by containing nitrogen, and by dissolving in weak alkaline solution, and being insoluble in boiling water.

From gelatin, by giving no reaction with tannin; from starch, by giving no color with iodine; from dextrins, gum arabic, tragacanth, and pectin, by its insolubility in dilute alcohol and dilute mineral acids.

It is remarkable that it precipitates the salts of the alkaline earths, with the exception of magnesium, and also most of the metals, but it gives no precipitate with mercury bichloride nor potassium silicate.

Practical Application of Algin.

(The great value of the author's paper appears especially in this portion, in which he points out many useful practical applications of the new substance algin.)

The following practical uses of algin are chiefly dwelled upon:

1. *For sizing fabrics.* A solution of alginate of sodium imparts to goods a thick clothy elastic feeling without the stiffness imparted by starch. (Many other advantages are pointed out which are chiefly of interest to weavers and dyers.)

2. *As an Article of Food.* Algin [alginic acid?] contains carbon 44.39, hydrogen 5.47, nitrogen 3.77, oxygen 46.37 per cent, or about the same amount of nitrogen as Dutch cheese. It has a slight pleasant marine taste, easily overcome if objected to, and may form a useful addition to the kitchen for thickening soups and puddings.

3. *For Pharmaceutical Purposes.* It appears especially applicable for replacing gum arabic in the manufacture of jujubes and lozenges. To make it into jelly requires the addition of gelose or gelatin or the admixture of lemon juice.

It will also be useful for making emulsions of oils (cod-liver oil, etc.), as an excipient for pills, for the fining of spirits [and the manufacture of empty capsules].

4. *For Boiler Incrustations.* The addition of 1 pound of algin to every 1,000 gallons of water in the boiler has been found to produce a calcium deposit of so favorable a condition that it may be blown off with ease. It has been very favorably reported upon.

5. *For Boiler Covering.* Seaweed charcoal mixed with algin has been used advantageously for this purpose under the name of "carbon cement."

The author sums up the results of his investigations and the benefits to be derived from the practical application of the products described in the following manner:

1. The only way to effectually utilize seaweed is to import it in the raw state.

2. By following the wet process, the additional cost is fully made up by the greatly increased amount of iodine and salts obtained from the water solution, leaving two-thirds of the plant for further treatment.

3. That by extracting from this the algin and the cellulose we utilize the whole plant and obtain two new products of considerable commercial importance.

4. That the process is extremely simple, and requires no extravagant plant, nor do operations on the large scale present any serious practical difficulties.

5. That the new substance, algin, has very remarkable properties, which may find many applications not yet known, when it can be put on the market.

6. That the demand for such a substance in fixing and mordanting fabrics alone is enormous.

Our annual export of textile manufactures and yarns is valued at £40,000,000, or more than half the value of our total exports; and a large portion of this requires some dressing material to fit it for the market. We import about £200,000 worth of gum arabic, a good deal of which is used for this purpose; and the war in the Soudan is raising its price and making it scarce.

7. That the supply of raw material is almost unlimited. Seaweed damaged by rain is equally available for the manufacture of algin.

Adulterated Fruit-Jam.

F. A. ADAMS has made an interesting report on English commercial fruit-jams, of which he has analyzed a number. There being no guide or reliable process previously known or agreed upon, the author had to evolve a method of his own, and in order to start from correct premises, prepared a series of pure jams himself.

The constituents to be determined chemically were: glucose, cane-sugar, other soluble matters, ash, and moisture.

The sugar in one hundred parts of dried jam amounted from 74.77 to 96.98 per cent, and it was found that most of this is *inverted*. In this lies the chief distinction of the different jams experimented on; for while in the author's home-made jam not more than about 6.71 per cent of *uninverted* sugar could be found, in the commercial varieties a good deal of it remains uninverted.

The principal ingredient of adulterated jam is apple pulp, which is easily recognized by the behavior of the cells of the pulp towards tincture of iodine. While it is next to impossible to actually identify the peculiar cells of the blackberry, raspberry, etc., etc., under the microscope, and the identity of these jams can be deduced more safely from other considerations, *apple* jams may be rendered evident, under the microscope, by the fact that its cells—to the exclusion of all other cells—are stained a characteristic pinkish purple or greenish color. In the raw apple this color does not necessarily occur when treated with iodine, but always occurs after boiling the apple pulp with dilute acid; but the natural acid of the fruit is usually sufficient by itself gradually to determine the reaction.—*The Analyst.*

Paraldehyde Elixir for Insomnia.

YVON recommends the following formula:

	Gm.	
Paraldehyde	10	= 160 min.
Alcohol, 90%	40	14 fl. dm.
Tinct. Vanilla	2	½ " "
Water	30	1 fl. oz.
Syrup	60	1½ " "

Dose: 1 to 2 teaspoonfuls.