THE AGAR SEAWEEDS IN NEW ZEALAND

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New Zealand has three red seaweeds that are found in sufficient quantities to be commercially important for agar production. They are Pterocladia lucida, P. pinnata (previously called P. capillacea) and Gracilaria secundata.

Agar is a polysaccharide colloid or jelly that is used in many food products and particularly in culturing bacteria and other micro-organisms. The seaweed is steam cooked under pressure for some time and then the straw coloured liquid produced is drawn off and allowed to cool to a firm jelly. This jelly is then cut into strips which are washed repeatedly in clean water. The jelly will not dissolve in water at ordinary temperatures and many of the impurities are washed away. It is further purified by quickly freezing and then allowing it to thaw. During the thawing, the water falls away from the jelly taking the impurities with it. The strips are dried in a warm air current and ground into a powder for packing.

For use, the agar powder is dissolved in boiling water to make a jelly again. As this jelly will not melt until it reaches a temperature of about 95°C, and will not reset until it cools to about 42°C, there is a range of about 50°C when agar can be used in either a liquid or a solid state. It can also be sterilised at very high temperatures without losing its gelling properties. These features make it possible to grow most bacteria and micro-organisms in culture. All the nutrients required by the bacteria are made up with agar into a jelly and the bacteria will grow over the surface or through this jelly, which always remains firm. If gelatine is used instead of agar, it quickly becomes a liquid as the bacteria begin to digest the protein of the gelatine.

As agar can be cooked to very high temperatures it is used as aspic in meat canning. The jelly found with sheeps' tongues is agar. Agar is also used as an emulsifier in pharmaceuticals and sometimes to make special photographic films.

Pterocladia lucida, the coarse agar weed, and P. pinnata, the fine one, both illustrated on the cover, have been used for agar production in New Zealand for about 35 years. Both species are dark red but in drift weed where they are bleached they may be pinkish or green, eventually becoming white. The fronds are fern-shaped and usually flat with well defined flattened mid lines, with side branches coming off both sides for most of their length. The reproductive organs are usually found at the slightly wider tips of the ultimate branches. Both species have a rather tough texture and they dry crisp and harsh. Other similar seaweeds disintegrate on drying or become softer or more brittle. Both species are found in quantity around the North Island in suitably rocky places, and also at Kaikoura in the South Island. Occasional records of these seaweeds have come from Nelson and Jackson's Bay, South Westland, but they are not available there in commercial quantities. P. lucida is the larger of the two and is most commonly found in the drift on beaches. It grows on rocks at the lowest tide level and subtidally down to 80 feet deep off Cape Brett where the water is very clear. It is apparent from

the quantity that sometimes comes ashore after a storm, that there must be larger beds of weed at some depth off shore, particularly on the Wairarapa and southern Hawkes Bay coasts. The second species is now called Pterocladia pinnata in the Flora written by Professor Chapman, but for years it was known as P. capillacea. It grows on rocks and in pools, sometimes in sandy areas, at the lowtide mark. It prefers to grow, in any quantity, in the northern areas of New Zealand and commonly forms a complete fringe around the edges of deeper rock pools.

The collection for sale of seaweed growing on rocks is now regulated by licences issued by the Ministry of Agriculture and Fisheries. Drift weed however, can still be collected and sold without a licence. Licensing is needed to keep watch on the harvesting of the weed and to prevent the beds being destroyed by over collecting. Most of the weed used in agar production in New Zealand is P. lucida which has been picked up from the drift by people living on the coast, often retired couples. Some collectors have devised special collecting sticks to prevent them from continual bending to pick up the weed. The Wairarapa coast up to Hawkes Bay, the Bay of Plenty, Hokianga and Kaikoura seem to be the most important collecting places. The wet weed is usually washed in fresh water and then dried in the sun on wire frames, being turned occasionally as the limey tube worms and other seaweeds are removed during cleaning. The weed dries easily in the sun and it will not deteriorate if it is wet by rain. Once dry, it is baled like hay or wool and sent to the factory. Davis Gelatine (N.Z.) Ltd at Woolston, Christchurch began agar production in 1943 and in recent months, a new factory belonging to Coast Biologicals Ltd has been opened in Opotiki, Bay of Plenty.

Our agar story, however, all began back in 1939 with World War II when it became apparent that the agar supplies usually obtained from Japan would no longer be available. Dr. Lucy B. Moore did the first botanical studies. She found out what likely agar species were here in New Zealand and she then visited many areas on the coast all over New Zealand to find and assess the weed. Several species were considered; some were too small and too contaminated by sand and other marine organisms to be processed without much hand picking and washing. Others yielded little agar for the quantity of weed available. The best seaweed for quantity, size and quality of agar content turned out to be Pterocladia lucida. In the winter of 1941, the first large scale trials of extraction were carried out in Wellington using weed that had been collected by children from native schools in the Bay of Plenty. The industry was licensed in the early days to prevent excessive competition that might cause the destruction of the agar resources. The collection of agar weed in New Zealand is not easy. The weed is often found in remote areas far from good transport, or there are few collectors in the area to take advantage of the drift weed. The current high price of 80 cents a kilo of cleaned dried weed indicates the renewed demand for this seaweed and agar generally. However it must be remembered that at least 5 kilos of wet weed must be carried off the beach, dried and cleaned to give the collector one kilo of final weed.

The third weed, as mentioned earlier, is Gracilaria secundata. This grows on the tidal mudflats of Barry's Bay in Akaroa Harbour and of the Avon-Heathcote Estuary. It forms brownish hair-like masses when left lying as the tide goes out. During the 1940's Gracilaria was used for agar at Botany Bay, in Australia, but this has now ceased. The agar from Gracilaria makes a weaker jelly than that from Pterocladia

but it can still be used in meat canning. There are large beds of Gracilaria in the Manukau Harbour, Auckland. The growth of the weed up there seems to be promoted by the sewage outfall that flows into the area, and the warmer temperatures in Auckland seem to allow a longer growing period. A pilot scheme is being financed by the Auckland Regional Authority and Davis Gelatine (N.Z.) Ltd to see if this Gracilaria can be cultured in concrete tanks using the sewage effluent diluted with seawater. Initial experiments in Auckland and similar ones being done in America indicate that there is every possibility that we might yet see a seaweed farm to produce agar weed established here in New Zealand.

As Gracilaria grows on soft mud sometimes 2-3 feet deep, it is not likely to be collected by hand. Some way of harvesting the weed from a boat or floating platform needs to be devised. If the weed is cut off the surface of the mud, small fragments will be left to regenerate vegetatively. This will be more reliable than waiting for chance spore regeneration. It is also possible that Gracilaria will be grown in culture. In America long shallow concrete raceways have been built to grow the weed in continuously flowing water. This method seems to speed up the growth rate. It has been found that all the nitrogen and most of the phosphorus present in sewage effluent can be reclaimed by the seaweeds and almost pure seawater is released finally from the culture system.

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SEDGES (CYPERACEAE) OF BANKS PENINSULA, INCLUDING (KAITORETE) ELLESMERE SPIT, LYTTELTON HILLS & NORTH TO NEW BRIGHTON

(A Provisional List)

M.J.A. Simpson & E. Edgar

Sedges tend to be the cinderellas of the plant world, often overlooked and unrecorded although many are attractive plants both in form and colour. Those of Banks Peninsula have not been listed since Laing (1919, 1924) wrote his accounts of the vegetation of Banks Peninsula. He listed 18 species of Carex and 4 of Uncinia. Since then a number of new species have been recognised in the genera Carex, Scirpus and Uncinia, some records of J.B. Armstrong have been confirmed and a good many new records have been added to the list of species. As will be noted, some are known from solitary specimens, others have not been collected or recorded for many years and, apart from the more common species, little is known of their ecology. The distribution of plants on Banks Peninsula is always of interest, as is the occurrence there of species not known in localities nearby. It is sometimes difficult to find uncinias here in fruit, especially the finer leaved forest dwellers e.g. U. silvestris, and positive identification is therefore difficult.

In this list species which are known from one or only a few collections are noted and the locality and herbarium number are given. Any additions to these localities would be welcomed, as would records for species which have not recently been collected.