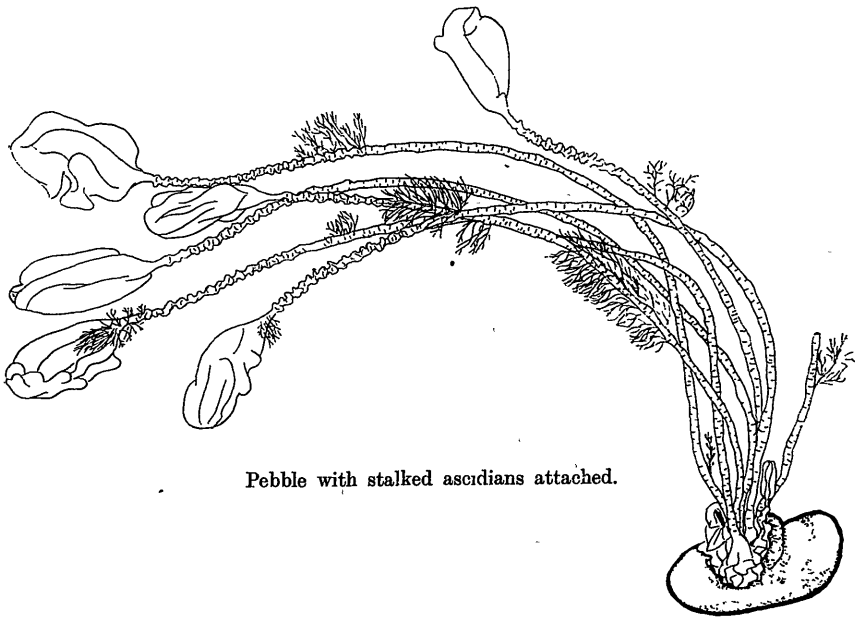


## Dispersal of Pebbles and Marine Organisms.

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IN February, 1923, I picked up on the beach at Riverton, on the south coast of New Zealand, a small smooth stone on which were growing a number of the stalked ascidian *Boltenia pachydermatina* Herdman. The ascidians with the stone had evidently been washed up on to the beach by the waves. This reminded me that several years previously the late Mr. Thomas Forrester, of Oamaru, had called my attention to the fact that smooth-surfaced stones with *Boltenias* attached were frequently washed up on the shores near Oamaru. In this case the pebbles were apparently river-worn stones brought down by the Waitaki River (the mouth of which is about fourteen miles north of Oamaru), which had afterwards been lying in the shallow water on the adjacent beach.



Pebble with stalked ascidians attached.

*Boltenia pachydermatina* is very common on the rocky shores of New Zealand, and it appears that its free-swimming larvae attach themselves to the stones lying near the mouth of the river or on the shore, and gradually grow until they are sufficiently buoyant to enable the stone to be floated away, either by the current of the river or by the wash of the waves. In this way it appears that stones may be transported to considerable distances and left in places where perhaps their presence might not easily be accounted for if these facts were unknown.

The stone from the Riverton beach is a rather flat one, probably beach-worn; it measures about 3 in. by 2½ in. by 1½ in., and weighs about ¼ lb.

In order to ascertain, if possible, how far the stone had travelled, I submitted it to Professor Speight, who has kindly examined it, and states that it is a somewhat fine-grained granite, similar in many respects to other granites found in Longwood Ranges, Southland (*e.g.*, near Orepuki), and that it may have drifted round the coast, as these granites are chiefly found on the western watershed of the range, or it may have come out of the Sounds area farther west.

On the stone there were growing about a dozen *Boltenias*, the stalks being about 12 in. to 15 in. long, some of the *Boltenias* being apparently mature, although much smaller in proportion to the length of the stalk than is often the case with those growing on fixed rocks. Others show younger stages with shorter stalks. Growing on the stalks of the *Boltenias* were tufts of hydroids and polyzoa of various species, and one or two small barnacles; at the base there is a small mussel, *Mytilus* sp., almost covered with a coralline, portions of which are also growing on the stalks of the *Boltenia*. It is evident, therefore, that various marine organisms, such as hydroids, cirripedes, &c., might be transported in this way along with *Boltenias* and the stone.

Mr. John Hardcastle, of Timaru, has written to me calling attention to the fact that about twelve years ago a series of heavy southerly seas caused the stranding along many miles of the shingly beach south of Timaru of a large quantity of stalked ascidians which had grown in bunches, usually to the number of twenty or more in each bunch. Among the bunches a small percentage brought ashore, entangled among their holdfasts, a small number of pebbles. In this case apparently the ascidians had been rooted on to a sea-bed composed of gravel.

Mr. C. D. Gilling also tells me of the frequent stranding of many ascidians on the shingly beach north of Timaru. He has sent me samples, many of which are attached to smooth river- or beach-worn pebbles, most of them, however, being much smaller than the one found at Riverton.

It is, of course, well known that seaweeds and other plants with portions of rock attached to them are frequently detached by the waves during storms and floated to distant parts.\* In these cases the portions of rock generally show fracture, and have rough and angular surfaces. The cases to which I am now calling attention are slightly different, since the pebbles are either river- or beach-worn, and, when the *Boltenias* have grown sufficiently, are floated away by the normal action of the river-current or by the waves, processes which are constantly going on.

The drawing illustrating this paper has been prepared by one of my students, Miss Beryl Parlane.

\* Thus Geikie in his *Text-book of Geology* says: "There occur in different parts of the Carboniferous system scattered pieces and even blocks of granite, gneiss, quartzite, or other durable material which he embedded, sometimes singly, sometimes in groups, in limestone, sandstone, and in coal. Various explanations have been proposed to account for these erratics, some writers having even suggested the action of drifting ice. The stones were most probably transported by floating plants. Seaweeds, like our living *Fucus*, with their rootlets wrapped round loose blocks might easily be torn up and drifted out to sea, so as to transport and drop their freight among corals and crinoids living on the bottom."—(*Text-book of Geology*, 4th ed. vol. 2, p. 1016.)

Similarly, Mr. E. J. Dunn says: "Seaweeds grow on pebbles at the bottom of the sea; as the plants become larger, or as more numerous bladder-like processes form on them, they become so buoyant as to lift the stone off the bottom, and then the tide or current conveys the seaweed with the attached pebble ashore." He gives a photograph of a pebble of volcanic ash 4 in. long, floated inshore and deposited on a sandy beach in Mercury Bay, North Island of New Zealand, by a seaweed (bladder-wrack) that grew upon it.—(*Pebbles*, p. 67, pl. 60, Melbourne, 1911.)