teonina tubulata (= *Saccammina sphaerica*), *Pyrgo williamsoni*, *Trochammina intermedia* (= *T. ochracea*), *Uvigerina angulosa* (= *Trifarina angulosa*), and *Webbinella hemisphaerica* (= *Hemisphaerammina bradyi*), were collected in large quantities from the cliff habitat. The variation in the foraminiferal abundances between cliffs and mud may be attributed to their displacement from a favorable into an unfavorable habitat.

Many foraminifera found off the Antarctic Peninsula have been encountered by workers who have studied foraminifera off South America. Lena (1966) noticed that the littoral foraminiferal fauna off the tip of South America is Subantarctic in nature but biogeographically belongs to the Argentinean province. Such studies must be noted because of the relatively close proximity of South America to the Antarctic Peninsula. Since the Early Tertiary the Scotia Arc has served as a connection between these two continents (Adie, 1963) and as a migration route for benthic organisms (Dell, 1972). Out of 69 species encountered by Lena, 15 occurred in the Arthur Harbor area. These included *Cassidulina* (= *Globocassidulina*) *crassa*, *Cassidulinoides parkerianus*, *Cornuspira* (= *Cyclogyra*) *involvens*, *Epistominella* (= *Pseudoparrella*) *exigua*, *Fissurina earlandi*, *F. laevigata*, *Hemisphaerammina bradyi*, *Hippocrepinella alba*, *Nodosaria calomorpha*, *Ovammina* sp., *Patellina corrugata*, *Pullenia subcarinata*, *Quinqueloculina seminulum*, *Saccammina decorata*, and *Spiroplectammina biformis*.

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Intertidal region and molluscan fauna of Seymour Island, Antarctic Peninsula

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During the 1974-1975 austral summer a joint geological field party from Instituto Antártico Argentino and Ohio State University spent 5 weeks studying the Late Cretaceous to Early Tertiary stratigraphy and paleontology of the north end of Seymour Island (Elliot *et al.*, 1975). Much time was spent examining outcrops exposed along the sea cliffs. During low tides I observed and collected molluscs from the intertidal region. This brief note describes the intertidal zone and its molluscan fauna along the north coasts of Seymour Island.

Seymour Island is southeast of the north end of the Antarctic Peninsula (figure 1). Ice conditions are unpredictable because of the island's location on the edge of the Weddell Sea. During the 1974-1975 spring and summer the prevailing southeast winds drove the sea ice northward along the east coast of the Peninsula. Most of the ice passes along the east coast of Seymour Island with lesser amounts of pack ice passing to the west through Admiralty Sound. Shallow depths

in waters around Seymour Island cause all large icebergs to be grounded well offshore. Strong longshore currents flow northward along the east coast. These currents swing to the northwest as they pass Cape Wiman at the north tip of the island. Sand and silt eroded from the sea cliffs are transported by these currents along the shore and are eventually deposited in a large spit at Larsen Cove, near the northern tip of the island (figure 2).

The intertidal region of Seymour Island is unique for the Antarctic. It varies from narrow boulder beaches to broad mudflats and sand spits. The type of beach and intertidal zone depends on the degree of exposure to storms and on the movement of ice and currents from the Weddell Sea. The lithology of rocks from the sea cliffs has special importance. The rocks generally consist of loosely consolidated sandstones and silty clays with local conglomeratic lenses and interbedded horizons with resistant concretions. The loosely consolidated nature of the rocks leads to exceptionally rapid erosion of the sea cliffs.

The intertidal region of Seymour Island may be divided into two basic types. On the exposed east coast, the beaches are narrow and consist of boulders and sand. On the protected west side of the island, north of Bodman Point, the intertidal region is characterized by broad mudflats (figure 3).

Exposed coast. The intertidal region along the exposed coastal areas varies from coarse, rocky beaches to narrow, sandy beaches backed by wave-eroded cliffs. The height of the cliffs along the east coast varies from 0 to 100 meters. The swash zone extending to the base of the sea cliff is generally composed of very coarse gravels that extend to the mid low-tide zone. The sediment of the intertidal region below the mid low-tide zone depends on the lithology of the sea cliffs.

Beaches along regions where concretions are common in the cliffs are quite rocky (figure 4). In contrast, in areas where concretions are rare the beaches are generally sandy with minor amounts of small pebbles (figure 5). Ice erosion along the east coast appears to be minimal. No microrelief features (i.e., ice-push ridges) associated with active ice movement were observed. During the summer, brash ice drifts with the longshore currents and is grounded quietly at low tide. The passive movement of the brash ice can be attributed largely to the damping effect of large icebergs grounding offshore.

Protected coast. In contrast, the west coast of Seymour Island north of Bodman Point is characterized by a broad, shallow, protected bay

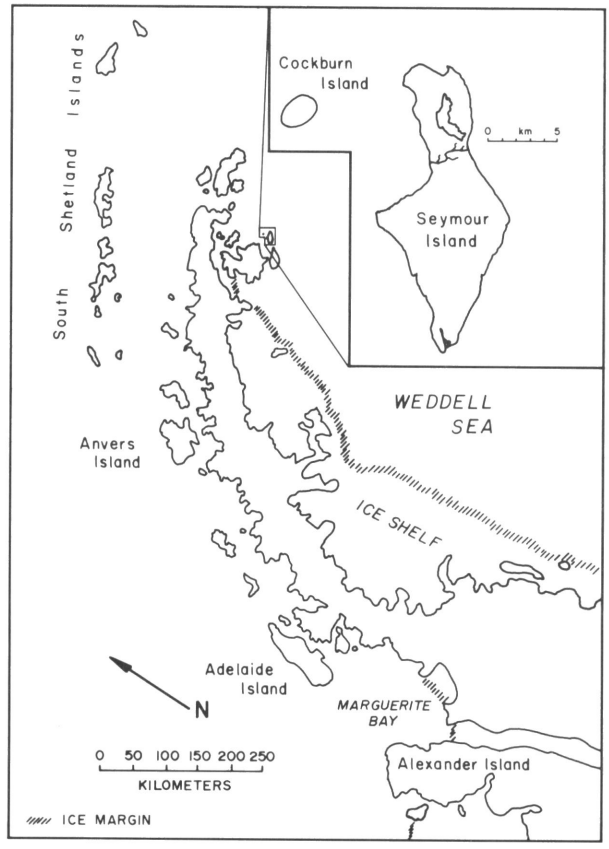

Figure 1. Location maps for Seymour Island area.

with extensive mudflats (figure 6). Strong currents that flow through Admiralty Sound are kept well offshore by Bodman Point. Almost all the sand and mud carried by the streams of Cross Valley and derived from the sea cliffs is deposited on the immediate beach of this bay and forms a broad mudflat 300 to 400 meters in width. There is no evidence of any ice abrasion anywhere in the bay, except for a shallow kettle-like depression

Figure 2. Large sand spit on the east side of Larsen Cove.

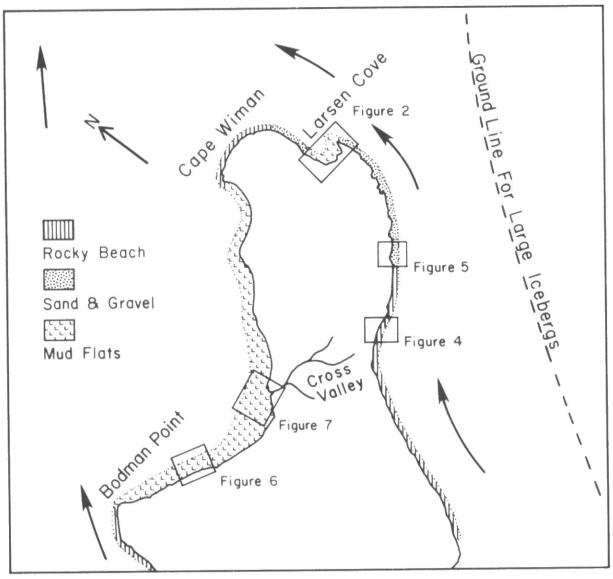

Figure 3. Distribution of intertidal along the northeast coast of Seymour Island.

along the beach where brash ice has been stranded (figure 7). The only relief on the mudflats consists of shallow and meandering tidal channels and of low rock mounds. These mounds appear to be erosional remnants of concretionary horizons that have survived, whereas the loosely consolidated sediments have been removed by erosion. The shore along Larsen Cove near the northeast tip of the island is also characterized by broad and protected mudflats.

Intertidal molluscan fauna. The intertidal fauna of Seymour Island is unusual for Antarctica. The macrofauna is characterized by four species of mollusks *(Yoldia eightsi, Laternula ellipitica, Patinigera polaris,* and *Amauropsis aureolutea)* along with large numbers of species of amphipods, isopods, and annelids. The large isopod *Serolis,* previously recorded only from the sublittoral zone of Antarctica, is also an important element of the intertidal fauna. Red and green algae occur as large masses on the mudflats and in amongst the boulders on rocky beaches. Diatom colonies typically cover rocky surfaces with slimy, fur-like growth.

Two species of mollusks *(Yoldia eightsi* and *Amauropsis aureolutea)* appear to be restricted to the protected mudflats north of Bodman Point. Neither of these species of mollusks has been reported before from the intertidal zone, although this may be because little is known about the distribution and ecology of most Antarctic mollusks. Powell's survey (1960) of antarctic and subantarctic mollusks lists both species as being sublittoral. DeLaca and Lipps (1976) reported that *Y. eightsi* is a common member of the subtidal, soft, muddy substrate fauna from Anvers Island. Its occurrence on the intertidal mudflats of Seymour Island indicates that both species range into the intertidal region provided that the proper substrate is present.

Numerous disarticulated valves of the fragile bivalve *Laternula ellipitica* were found as beach wash on both exposed and protected coasts. Because no live individuals of *L. ellipitica* were taken, it is not known whether this species actually lives in the intertidal region. Studies around Anvers Island indicate that the motion of grounded ice frequently dislodges *L. ellipitica* (Kauffman, 1974). Once this feeble, burrowing bivalve is removed from the soft muddy substrate it generally falls prey to predators (Lipps, per-

Figure 4. Rock beach on exposed east coast of Seymour Island.

Figure 5. Sand and gravel beach on exposed east coast.

sonal communication). Although the beach-washed valves on Seymour Island may represent individuals from a subtidal population, *L. ellipitica*—as in the case of *Y. eightsi*—may actually range into the intertidal region.

The large limpet *Patinigera polaris* was only observed on the boulder beaches of the exposed east coast. Many individuals were found on the sides and beneath large boulders. *P. polaris* appears to be restricted to the most rocky part of the beach, and it was never observed in areas where sand occurred in significant amounts between the rocks. Migration of *P. polaris* into deeper water would appear to be impossible because of the sand and mud; during the winter freeze, therefore, its survival depends on its ability to migrate into cracks and crevices in loose boulders. Frequent grounding of tabular icebergs close to shore tends to dampen any storm-generated waves; as a result, movement of loose boulders on the beach appears to be minimal even during storms.

Summary. This brief survey suggests that the distribution of many shallow-water invertebrates, for example *Yoldia eightsi* and *Amauropsis aureolutea,* depends on the occurrence of a suitable substrate. The extensive intertidal mudflats along the west coast of Seymour Island offer a unique opportunity for the study of the distribution and ecology of shallow-water marine invertebrates of Antarctica.

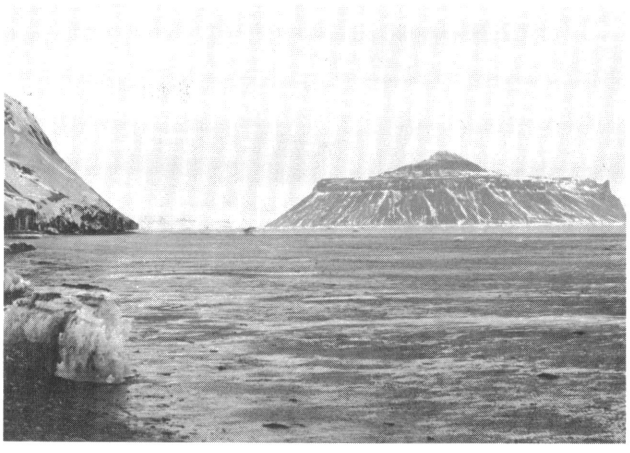

Figure 6. Broad mudflat just north of Bodman Point at low tide.

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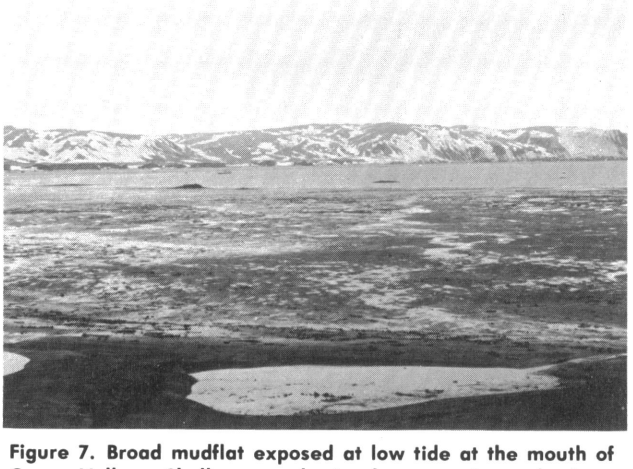

Figure 7. Broad mudflat exposed at low tide at the mouth of Cross Valley. Shallow ponds in foreground result from melting of stranded brash ice. Dark mounds on the mudflat are resistant erosional remnants.