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14. The washing procedures were: (1 and 2) 30 seconds vigorous agitation in metal-free water; (3) 60 seconds vigorous agitation in 1.0 percent hexadecyltrimethylammonium bromide, followed by rinse in metal-free water; (4) 60 seconds vigorous agitation in 0.1 percent hexadecyltrimethylammonium bromide, followed by rinse in metal-free water; (5) 30 seconds vigorous agitation in 0.05 percent hexadecyltrimethylammonium bromide and 0.05 percent *N*-(hydroxyethyl)ethylenediaminetriacetic acid, followed by rinse in metal-free water; (6) 30 seconds vigorous agitation in 0.05 percent hexadecyltrimethylammonium bromide and 0.05 percent diethylenetriaminepentaacetic acid followed by rinse in metal-free water.
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Free-Floating Mucus Webs: A Novel Feeding Adaptation for the Open Ocean

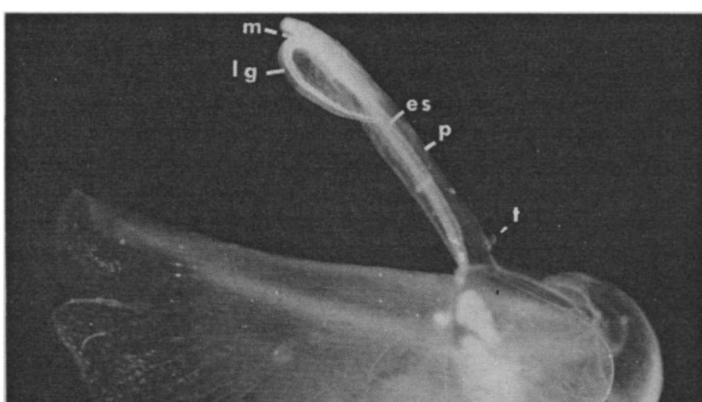
Abstract. *Observations by means of conventional scuba techniques have revealed that highly modified planktonic gastropods, in the order Thecosomata, utilize a free and unsupported mucus web for collecting food particles. Their delicate bodies, quick reactions, and apparent abundance suggest that traditional plankton-sampling methods may be inadequate to assess their importance in the blue-water plankton communities.*

Comparatively little information has been available on the biology of several important categories of planktonic organisms. Among these obscure groups are pseudothecosomatous pteropods, comprising a highly modified suborder of planktonic opisthobranch gastropods. Because of the extreme fragility and unknown swimming abilities of these organisms, previous expeditions have collected only a few badly damaged specimens (*1–3*).

During October and November 1971, as part of a diving research team from the University of California at Davis, I made field observations of the rare *Gleba cordata* (Forskål) and of *Corolla spectabilis* (Dall), two closely related species, in the surface waters of the Florida current 8 to 16 km west of Bimini, British West Indies, by using scuba. These data constitute the first observations of live members of the Pseudothecosomata. Furthermore, this is the first report of *Gleba* in the Florida current, and the first record of *Gleba* adults in any part of the tropical Atlantic (*1, 3*). Over 500 of these common, but patchily distributed, animals have been observed in the field. After making observations of their feeding habits, I collected some by hand and studied them in the laboratory.

As members of the family Cymbuliidae, *Gleba* and *Corolla* possess a characteristic jellylike, internal conch, seen intact in Figs. 1 and 2. This conch is so fragile that obtaining intact specimens is virtually impossible and taxonomists have been hampered in recognizing distinct variations (*1, 2*).

Gleba cordata feeds from a large, free-floating, and unsupported mucus web spread horizontally in the water



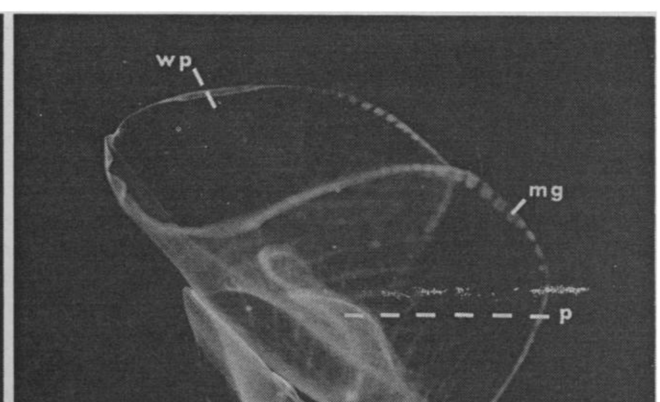


Fig. 1 (left). *Gleba cordata* as it appears while motionless in the water. The numerous mucus glands (*mg*) on the periphery of the wing plate (*wp*) are primarily responsible for the secretion of the web. The other abbreviations are: *con*, conch; *es*, esophagus; *lg*, lateral grooves; *m*, mouth; *p*, proboscis; *t*, tentacles; *vm*, visceral mass. Fig. 2 (right). *Corolla spectabilis* swimming toward the surface of a tank in the laboratory. The mucus glands (*mg*) are conspicuous on the periphery of the wing plate (*wp*). The pallial gland (*pg*) and the visceral mass (*vm*) are enclosed by the internal conch (*con*) below the fins and proboscis (*p*).

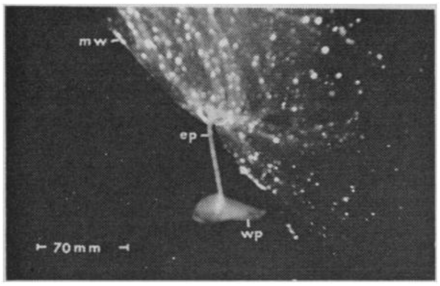


Fig. 3. *Gleba cordata* feeding from its delicate mucus web at a depth of 20 m in the Florida current. Only the tip of the extended proboscis (*ep*) touches the mucus web (*mw*) while the lateral grooves consolidate the particles entrapped in the mucus and move them toward the mouth. The wing plate is denoted *wp*.

(Fig. 3). When feeding, the animal is motionless below the web and assumes an inverted position with wings outstretched; an elongated proboscis supporting the mouth extends high above the body and maintains contact with the web. The animal and web sink slowly while feeding, the web either assuming a concave shape funneled toward the mouth or becoming convex and almost encircling the animal. Most webs measure 2 m in diameter.

The mucus web of *Corolla spectabilis* resembles that of *Gleba*. Also, *Corolla* assumes the same feeding position with the proboscis extended to touch the web floating high above the wings.

Large mucus glands, located along the periphery of the wing plate (Figs. 1 and 2), are contiguous with ciliary tracts that extend from the wings over the length of the proboscis and terminate distally in grooves surrounding the mouth (Fig. 1). The wing glands are primarily responsible for secretion of the web. The final strands of a freshly formed web are moved by cilia to the lateral grooves on the proboscis, so assuring contact during feeding between the mouth and the web.

A variety of phyto- and zooplankton, dominated by tintinnids and other protozoa less than 800 μm across, collect in the sinking webs of both species. Measurements on webs of *Gleba*, stained with azure A, reveal that most pores have areas less than 500 μm^2. The net can simply entrap many large particles, but smaller detritus and nannoplankton, observed to account for about 50 percent of the food, are evidently captured by adhesion to the mucus itself. Entangled particles are pulled toward the lateral grooves of the proboscis where they are consolidated into a fine mucus string by ciliary action. The string passes through the mouth into the esophagus and, although no radula is present, the food presumably moves through a muscular gizzard and is digested as in other ciliary-feeding pteropods (*4*).

Contrary to what Morton (*5*) suggests, *Gleba* and *Corolla* are exceedingly rapid swimmers. A feeding animal could sense my presence up to a meter away. The escape response first entails breaking the proboscis free of the web, whereupon several strokes of the fins flip the animal over so that the conch is dorsal and the retracted proboscis is aligned with the now ventral wing plate. Both species are capable of escape speeds of at least 45 cm/sec. Presumably, their high transparency, ability to sense turbulent motion, and swimming ability permit predator-avoidance when in the vulnerable feeding position.

Previous reports of mucus-web ciliary feeding have been limited to sessile organisms in which mucus traps attached to a substrate are periodically withdrawn and digested (*6*). The discovery that pteropods use an unsupported mucus web for filtering food particles from the open ocean adds a new mechanism to the array of feeding patterns already described for planktonic organisms.

Information such as this could only have been obtained by a diver making direct observations of live, undisturbed animals in their natural habitat. Traditional sampling programs have hidden the actual importance of many organisms which, although planktonic, can actively avoid nets. Consequently, population sizes as well as basic natural histories have been grossly misrepresented in the literature. *Gleba* and *Corolla* are only two examples of many previously obscure animals we have seen while diving in blue water.

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Adaptation in Retinal Rods of Axolotl: Intracellular Recordings

Abstract. *Intracellular recordings of the late receptor potential from rods of isolated axolotl retinas revealed the existence of a dark adaptation mechanism that is independent of rod pigment regeneration. Response amplitude of individual rods was measured as a function of intensity both before and at various times after exposure to bleaching illumination. The rod sensitivity increased by at least 3 to 4 log units during a period of 15 to 25 minutes following the bleach. During this time rod pigment regeneration was either too small to be measured or was nonexistent in our preparation.*

When a retina is exposed to either an increase or a decrease in illumination, large changes in visual sensitivity (adaptation) occur. The dark adaptation that follows photopigment bleaching has been found to consist of two parts: (i) the fast or "neural" component and (ii) the slow or photochemical component, which depends on the concentration of unbleached photopigment, regardless of whether or not regeneration of the visual pigment takes place (*1*). The fast component is independent of both bleaching and regeneration of the visual pigments and until recently was assumed to result from synaptic interactions at the bipolar cell level (*2*).

Due to technical difficulties, previous adaptation experiments have been limited almost exclusively to the investigation of extracellularly recorded mass potentials, unit responses proximal to the receptors (mainly from ganglion