The Genera *Chromodoris* and *Felimida*

(Nudibranchia : Chromodorididae)

in Tropical West America: Distributional Data, Description of a New Species, and Scanning Electron Microscopic Studies of Radulae

BY

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(3 Text figures; 3 Plates)

INTRODUCTION

Tropical west America, or the Panamic province, consists of the eastern Pacific region between the warm- to cold-temperate Californian and Peruvian provinces. It extends along the American coastline from Bahía Magdalena, Baja California del Sur, Mexico, southward to Punta Aguja, Peru, with northward and westward extensions to include the Gulf of California and the Galápagos archipelago and other offshore islands (Keen, 1971).

The opisthobranch gastropod fauna in the Panamic province has been studied mainly from a small amount of material collected in the Gulf of California. Prior to 10 years ago, only 3 species of the extensive circumtropical nudibranch family Chromodorididae were known from the tropical eastern Pacific (Pruvot-Fol, 1951). Recent research in this region, however, has contributed 5 new species of *Chromodoris* and a new genus, *Felimida,* to the known representatives of this family.

Three species of Chromodorididae occur in the neighboring temperate Californian province. *Chromodoris macfarlandi* Cockerell, 1902, and *Hypselodoris porterae* (Cockerell, 1902) are recorded only from the Californian region; and *Hypselodoris californiensis* (Bergh, 1879) is recorded from both provinces. The occurrence of these species in the more northerly temperate waters is not an anomaly, but illustrates the faunistic relationships between these two provinces. Twenty-five % of the opisthobranch species occurring in the tropical west American province also occur in the temperate Californian province, and vice versa (Bertsch, 1973). Such overlapping of faunal elements is expected wherever zoogeographical provinces meet or are separated only by partial barriers (Darlington, 1957: 453). In the eastern Pacific, the Chromodorididae is a transitional family from the tropical region, contributing 3 species to the faunal complexity of the southern portion of the temperate Californian province.

This paper gathers together reported and new distributional data for the unicuspid Chromodorididae in tropical west America, discusses the taxonomy of the 2 "subspecies" of *Chromodoris banksi,* describes a new species of *Chromodoris* and its functional radular morphology based on scanning electron micrographs, and documents the deposition of the type material of *Felimida sphoni.*

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Table 1 lists the location of each collecting site reported in this paper.

Table 1

Latitude and Longitude of Collecting Localities

Pacific Coast of Baja California

Isla Cedros	28°07′ N; 115°11′ W
Puerto Rompiente	27°43′ N; 115°00′ W
Bahía Magdalena	24°38′ N; 112°09′ W

East Coast of Baja California

Puertecitos	30°21′ N; 114°38′ W
Bahía San Luis Gonzaga	29°49′ N; 114°25′ W
Puerto Refugio, Isla Angel de la Guarda	29°33′ N; 113°35′ W
Bahía de Los Angeles	28°53′ N; 113°30′ W
Isla Coyote	26°44′ N; 111°54′ W
Bahía Concepcion	26°43′ N; 111°54′ W
Isla Santa Catalina	25°42′ N; 110°49′ W
Isla Santa Cruz	25°14′ N; 110°44′ W
Isla Las Animas	25°06′ N; 110°33′ W
Isla San Jose	25°03′ N; 110°35′ W
Isla San Francisco	24°50′ N; 110°35′ W
Los Islotes	24°36′ N; 110°24′ W
Isla Espíritu Santo	24°27′ N; 110°19′ W
Bahía Las Cruces	24°13′ N; 110°05′ W
La Paz	24°11′ N; 110°23′ W
SW Isla Cerralvo	24°09′ N; 109°49′ W

West Coast of Mainland Mexico

Puerto Peñasco, Sonora	31°18′ N; 113°35′ W
Puerto Lobos, Sonora	30°16′ N; 112°51′ W
Isla San Pedro Nolasco	27°59′ N; 111°24′ W
Bahía San Carlos, Sonora	27°56′ N; 111°04′ W
Guaymas, Sonora	27°55′ N; 110°54′ W
Isla Venado	23°14′ N; 106°27′ W
Mazatlan, Sinaloa	23°11′ N; 106°26′ W
Santa Cruz, Nayarit	21°30′ N; 105°16′ W
Sayulita, Nayarit	21°15′ N; 105°15′ W
Tenacatita, Jalisco	19°17′ N; 104°54′ W
Bahía Santiago, Colima	19°07′ N; 104°22′ W
Puerto Angel, Oaxaca	15°40′ N; 96°29′ W

Central and South America

Bahía Jobo, Costa Rica	11°02′ N; 85°45′ W
Isla Tortugas, Costa Rica (Isla Alcatraz and Isla Tolinga	9°50′ N; 84°53′ W
Bahía Ballena, Costa Rica	9°45′ N; 85°00′ W
Quepos, Costa Rica	9°24′ N; 84°10′ W
Deale Beach, Ft. Kobbe Beach, Panama	8°48′ N; 79°55′ W
Cocos Island	5°33′ N; 86°59′ W
Academy Bay, Isla Santa Cruz, Galápagos Islands	0°45′ S; 90°15′ W
Punta Aguja, Peru	5°50′ S; 81°03′ W

NUDIBRANCHIA

Doridoida

Chromodorididae

Chromodoris banksi Farmer, 1963

Marcus & Marcus (1967) established the subspecies *Chromodoris banksi sonora* as distinct from *C. b. banksi* on the basis of the shape of the first inner lateral tooth. Lance (*in* Keen, 1971: 822) continued the separation, stating that *C. banksi sonora* should be raised to full specific status if the difference in radula proves consistent.

The innermost lateral tooth of *Chromodoris banksi sonora* possesses denticles (Marcus & Marcus, 1967: 175), and the description of *C. b. banksi* was illustrated by one innermost lateral tooth without any denticles. Farmer gave no written discussion of this pattern of denticulation to indicate whether his drawing showed a regular condition or merely a chance tooth that lacked denticles.

Examination of the holotype and paratype radula of *Chromodoris banksi banksi* (by Bertsch, with verification by Dustin Chivers and James T. Carlton of the California Academy of Sciences) revealed that the species named in 1963 by Farmer has denticles on the first lateral teeth. What Marcus & Marcus (1967) considered diagnostic

Explanation of Figures *1, 2*

Chromodoris ***marislae*** Bertsch, spec. nov.

Figure *1*: Five *Chromodoris* ***marislae*** in their natural habitat. alongside the egg mass of this species. Subtidal, near La Paz, Baja California del Sur, April 1972. Photograph by Edwin Janss

Figures 2a and 2b, paratype animal collected at Isla Las Animas; 80 mm total length

Figure 2a: Antero-lateral view of entire animal; photograph by Antonio J. Ferreira

Figure 2b: Close-up view of anterior dorsal portion of the animal; photograph by Hans Bertsch

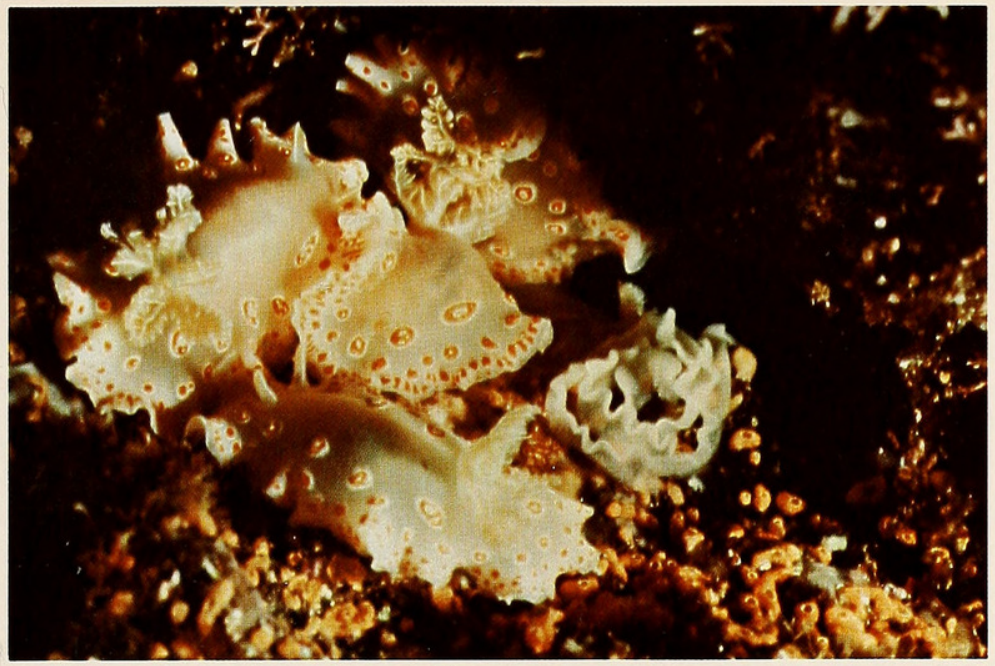

Figure *1*

Figure *2* a

Figure *2* b

for their subspecies *C. banksi sonora* is not unique to their material, but is actually typical of the original *C. banksi* material. A separation between the 2 subspecies becomes impossible on the basis of denticulations on the first lateral teeth. Other similarities are mentioned by MARCUS & MARCUS (*op. cit.*: 175), that the slight color differences are simply variations on a basic pattern (a common occurrence among nudibranchs), and that the radular formula, and the shape of the rachidian pseudo-tooth approximate their material with that named by Farmer. According to modern taxonomic practice, subspecies are local populations that have become genetically distinct, but not so much as to prevent interbreeding (MAYR, 1969: 41 - 43). In view of the evident continuity, the overlapping range, and the probability of a high rate of gene flow of the species population in question, erection of subspecific taxa is not warranted. Separate subspecies do not exist within *Chromodoris banksi,* and *C. banksi sonora* Marcus & Marcus, 1967, should be considered a synonym of *C. banksi (banksi)* Farmer,1963. The radula of *C. banksi* should be described as having a unique pattern of denticulation among the unicuspid chromodorids from the Panamic province. The inner lateral teeth have denticles, and the outer $\frac{1}{3}$ to $\frac{1}{4}$ of the half-row of teeth have no denticles.

The reported range of *Chromodoris banksi* is the northern half of the Gulf of California, from Puerto Peñasco (FARMER, 1967) to Bahía Concepcion (KEEN, 1971). It has also been found 3.8 km (2.3 miles) south of Puertecitos (type locality), at Bahía San Luis Gonzaga, Puerto Refugio (FARMER, 1963), Bahía San Carlos (Bertsch, Terrence Gosliner, and Gary Williams, December 1970, pers. observ.), and Isla San Pedro Nolasco (Ferreira, August 1972, pers. obser.). In September 1971, Ferreira collected one 30 mm long specimen from a depth of 10 m at Isla Las Animas in the southern Gulf of California, and in February 1972, he found 5 specimens while diving at Bahía Ballena and Islas Tortugas, Costa Rica. These new records establish *C. banksi* as occurring both intertidally and subtidally, and extend its range more than 3500 km (over 2200 miles) southeastward, toward the midpoint of the tropical west American province.

Chromodoris baumanni Bertsch, 1970

The range of *Chromodoris baumanni* is from Guaymas (BERTSCH, 1970) to Academy Bay in the Galápagos Islands (SPHON & MULLINER, 1972), with scattered intermediate occurrences in the Gulf of California at Isla San Francisco (type locality), SW Isla Cerralvo, Bahía Carisalito (4 km, $2\frac{1}{2}$ miles, N of Las Cruces), and along the southern Pacific coast of Mexico at Santa Cruz and Sayulita (BERTSCH, 1970, and in press; SPHON & MULLINER, 1972). Ferreira has collected *C. baumanni* at other subtidal localities in the Gulf of California (20 m, Bahía San Carlos, December 1970; 10 m, Isla Espíritu Santo, November 1970), and he has also collected 4 specimens at Bahía Ballena, Costa Rica (February 1972), establishing an important intermediate record between the Mexican and Galapagan localities. What was a seemingly disjunct distribution for *C. baumanni* is now continuous, and should even be considered as representative of the typical pattern for opisthobranchs presently reported from the Gulf of California and the Galápagos Islands. This pattern of distribution (Gulf of California, southern Mexico, Central-South America, and the Galápagos Islands) is seen in the majority of the 14 opisthobranch species reported from the Galápagos (SPHON & MULLINER, 1972). Of these species, 13 occur in the Gulf of California (the one exception is the little-known *Doris peruviana*). Nine of these species have also been reported from the Central or South American coast (KEEN, 1971; SPHON, 1971; Ferreira, pers. obser.; and this paper): *Aplysia juliana* Quoy & Gaimard, 1832; *Bulla punctulata* A. Adams *in* Sowerby, 1850; *Dolabrifera dolabrifera* (Rang, 1828); *Tylodina fungina* Gabb, 1865; *Umbraculum ovale* (Carpenter, 1856); *Pleurobranchus areolatus* Mörch, 1863; *Chromodoris baumanni* Bertsch, 1970; *C. sedna* (Marcus & Marcus, 1967); and *Hypselodoris agassizii* (Bergh, 1894). Two other species occur along the open Pacific coast of southern Mexico (KEEN, 1971): *Lobiger souverbii* Fischer, 1857, and *Spurilla chromosoma* Cockerell & Eliot, 1905. Such faunal associations between the Gulf of California, Central America, and the off-shore Cocos and Galápagos Islands have been accounted for by both normal and southward-shifted water currents that allow a fairly continuous faunal exchange between these areas (HERTLEIN, 1963; ABBOTT, 1966).

Chromodoris ***marislae*** Bertsch, spec. nov.

Material examined: 1) **Holotype.** One specimen (40 mm long) collected subtidally at the north end of Santa Catalina Island (25°42′ N; 110°49′ W), Gulf of California, on June 25, 1964, by Dustin Chivers and Richard Adcock. This specimen has been deposited as the holotype in the collections of the California Academy of Sciences, Department of Invertebrate Zoology, CASIZ no. 471. Three microscope slides of the radula and genitalia of this animal are in the CASIZ Type Slide Series, nos. 405, 406, and 407.

2) **Paratype:** One specimen (60 mm in length) collected from Los Islotes, subtidally in 30 m of water, crawling around in the open during the daytime, by Richard Adcock and Antonio J. Ferreira, July 16, 1971. The intact

whole animal has been deposited as a paratype at California Academy of Sciences, Department of Invertebrate Zoology, CASIZ Type Series, no. 472.

3) One specimen (80 mm long) collected subtidally, in 10 m of water, crawling on top of a rock, on the west side of Isla Las Animas, Gulf of California, on July 15, 1971, by Antonio J. Ferreira. The animal and its separately mounted radula have been deposited as a paratype specimen in the California Academy of Sciences, Department of Invertebrate Zoology, CASIZ Type Series, no. 473, and CASIZ Type Slide Series no. 411. The radula of this specimen is illustrated by the scanning electron micrographs (Figures *6* to *11*). Color photographs of this animal (Figures 2a and 2b) illustrate this paper.

4) Eleven specimens collected by Edwin Janss in the La Paz area, April 1972. The preserved material ranges from 24 to 42 mm in total length. Five of these specimens are deposited in the Los Angeles County Museum of Natural History, LACM no. 1618.

Description: The body color of the living animal (Figures *1* and *2*) is off-white, with 2 or 3 irregular rows of bright orange spots encircling the edge of the notum. The dots increase in size from the outer to the inner row, becoming both more irregular in shape and encircled or spotted by pure white markings. There is an additional row of large orange circlets beginning anterior to the rhinophores and continuing lengthwise along the animal's body just lateral to the mid-dorsal region. These ringlets vary in shape from circular to oval, and some may even be incompletely formed circles, open on one side. Each orange marking in this row is banded by a conspicuous pure white line, often with a few white specks on the orange coloration. This row contains the largest orange markings on the animal's body. The notum is covered by very low, closely placed tubercles. The distal portion of the rhinophores is a very light brown color, with a prominent median white longitudinal septum on both its anterior and posterior faces. Each rhinophore is perfoliated (18 - 28 leaves) and retractile into a low, smooth rim pocket.

The 7 or 8 bi- and tri-pinnate gills are light brown in color. Running along the center of each branching of the gills is a pure white ridge, slightly raised above the surrounding skin membrane.

The off-white colored foot has slight anterior corners and is bilabiate (Figure 3). A line of pure white completely encircles the edge of the foot. The free edge of the notum completely covers the foot.

The short oral tentacles are blunt and grooved laterally (Figure 3). The buccal armature on the jaw plates consists of numerous small rods and hooks (Figure 4).

The radular formula of the holotype is 59 × 59·1·59. The second paratype (illustrated by the scanning electron micrographs) has a radular formula of 62 × 40-53·1·40-53. The inconspicuous rachidian tooth is tipped with a slight, posteriorly directed hook (Figure 5). The lateral

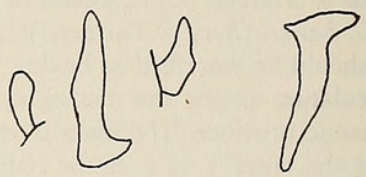

Figure 3

Chromodoris ***marislae:*** antero-ventral view of holotype, showing the slight anterior foot corners and the oral tentacles; drawing by Wesley M. Farmer

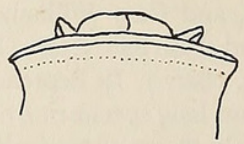

Figure 4

Chromodoris ***marislae:*** jaw plate of holotype; drawing by Wesley M. Farmer

Explanation of Figures *6* to *8*

Chromodoris ***marislae*** Bertsch, spec. nov.

Stereoscopic scanning electron micrographs (by Thomas L. Hayes and Hans Bertsch) of the radula of paratype specimen collected at Isla Las Animas. Micrographs reproduced laterally to each other are stereo pairs; resolution into a three-dimensional image can be facilitated by a two-lensed stereoscopic viewer. The exceptionally bright areas in Figures *6*, *9*, and *10* are charging artifacts of the scanning electron microscope, caused by reduced specimen collection or changes in collection efficiency because of distortion of the collection fields or both (Pawley, 1972). These charging artifacts are limited to changes in brightness, and have caused no distortion of the image shape, with the result that the informational content of the micrographs is still useful

Figure *6*: Rows of inner lateral teeth approximately ×50
Figure *7*: Inner lateral teeth; enlargement of bottom right center portion of Figure *6* approximately ×250
Figure *8*: Inner lateral tooth; enlargement of center area of Figure *7* approximately ×750

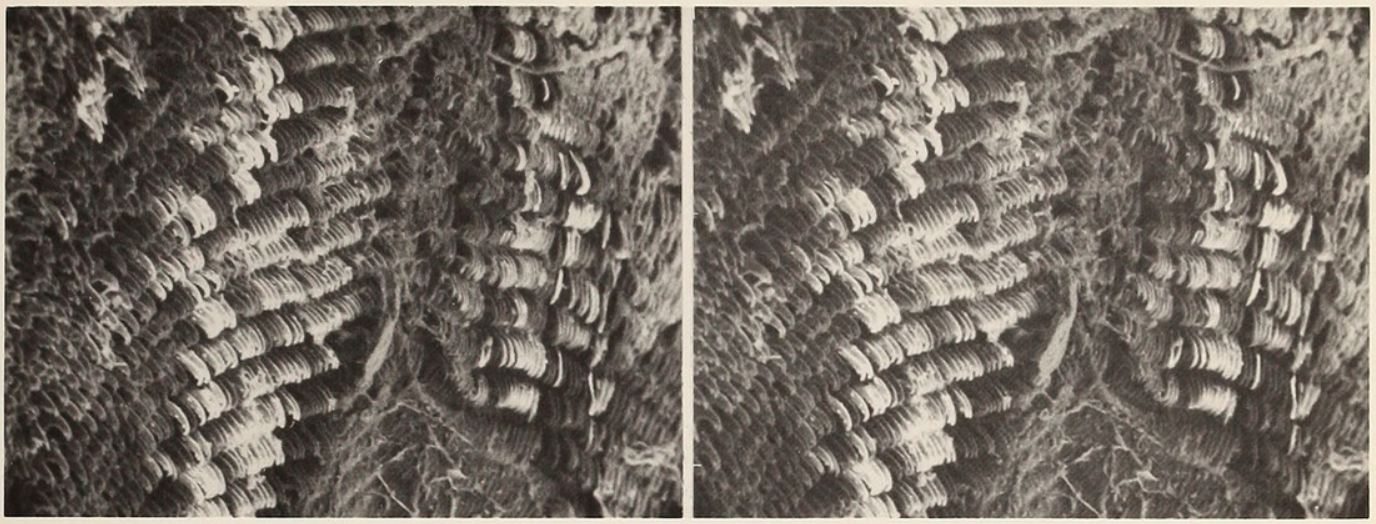

Figure *6*

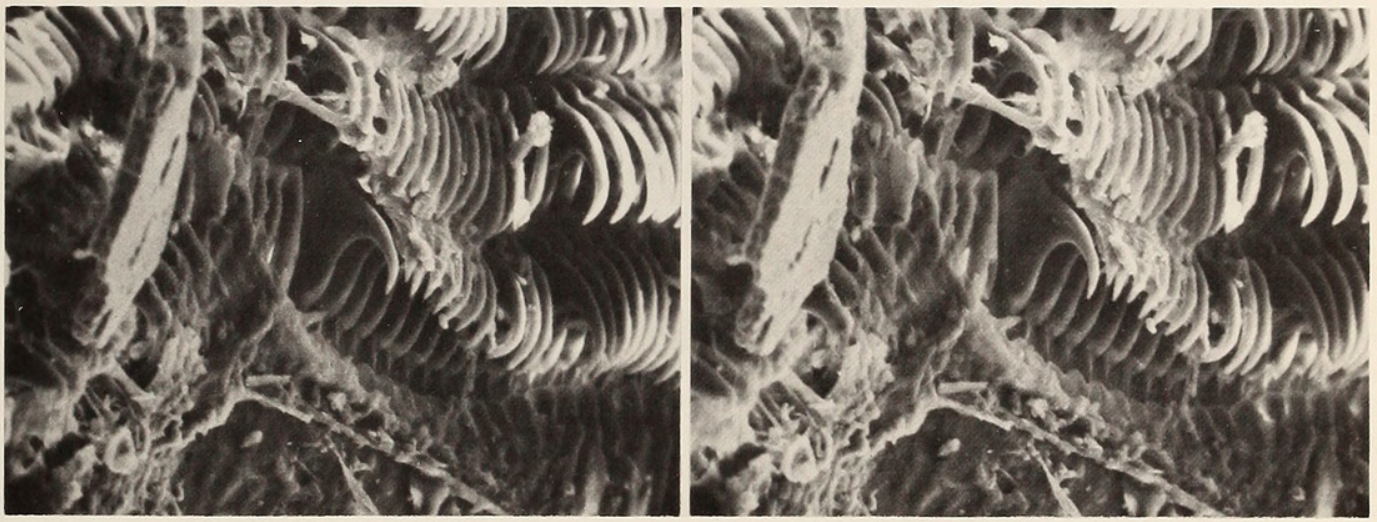

Figure *7*

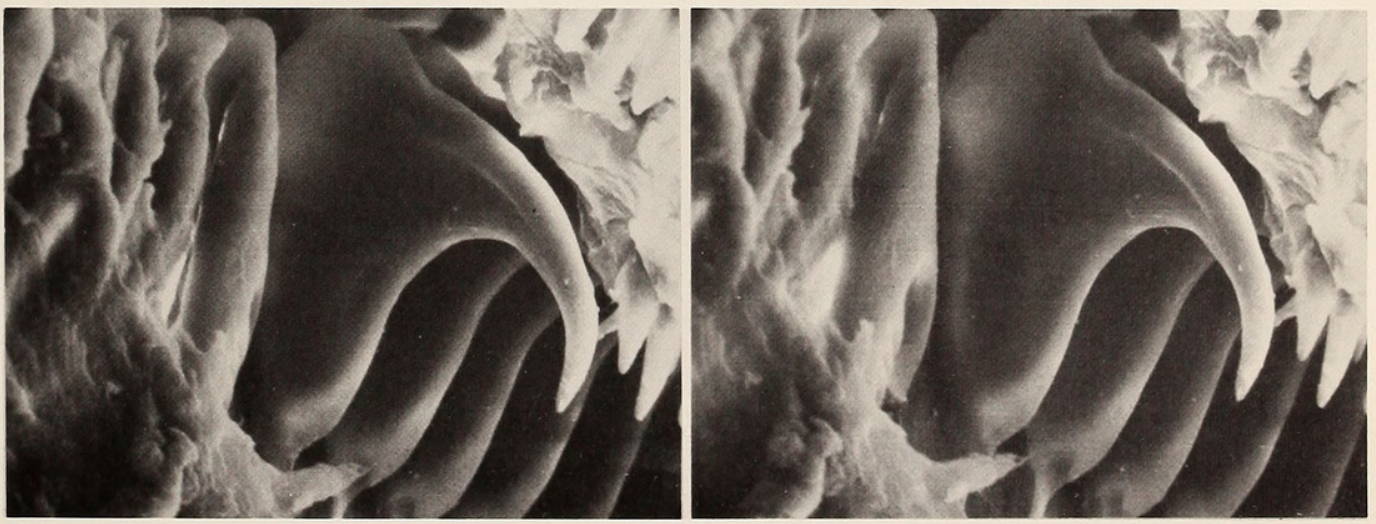

Figure *8*