RITTERELLA RUBRA AND *DISTAPLIA SMITHI:* TWO NEW COLONIAL ASCIDIANS FROM THE WEST COAST OF NORTH AMERICA

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INTRODUCTION

Collections of ascidians from the low intertidal regions of the rocky shores of central California have repeatedly included two highly distinctive colonial forms which could not be placed in any known species. They are described here as new species in the genera *Ritterella* and *Distaplia*.

Ritterella rubra n. sp.

Description: Colony bright scarlet red in life, fading to orange in preservation. Individual heads capitate, joined at the base by stolons (Fig. 1 A). Smallest heads about 3 mm in diameter, largest about 14 mm. Exposed surface of the colonies clean and free of debris; stalks and stolons encrusted with bits of shell and sand (Fig. 1 A). Each head may contain from 6 to 70 zooids not arranged in systems (Fig. 1 A). Branchial and atrial apertures visible on surface of colony but most of the zooids obscured by pigment cells in test (Fig. 1 A).

Zooids vary in length from 5 mm to 15 mm although variation within a single head is small. Length of thorax and abdomen combined between 2.5 mm and 5 mm. Length of postabdomen from shorter than the combined length of the thorax and abdomen to more than twice as long. Variations similar in those with and without gonads.

Mantle musculature not well developed. Anesthetized, preserved specimens show little severe distortion of the thorax although the number of gill slits may be difficult to count.

Thorax with both atrial and branchial siphons well developed. Each aperture six-lobed (Fig. 1 B). Two orders of tentacles with 6 in each, a third order of twelve may be present. Number of rows of gill slits from 10 to 13 with from 11 to 15 gill slits per row when viewed laterally (Fig. 1 B). Counts made from within the pharynx on dissected specimens show 16 to 20 per row. One well developed curved languet lies between adjacent rows dorsally.

Oesophagus short, curving to enter stomach dorsally (Fig. 1 B). Stomach round to ovate, covered with areolations and with a dorsal

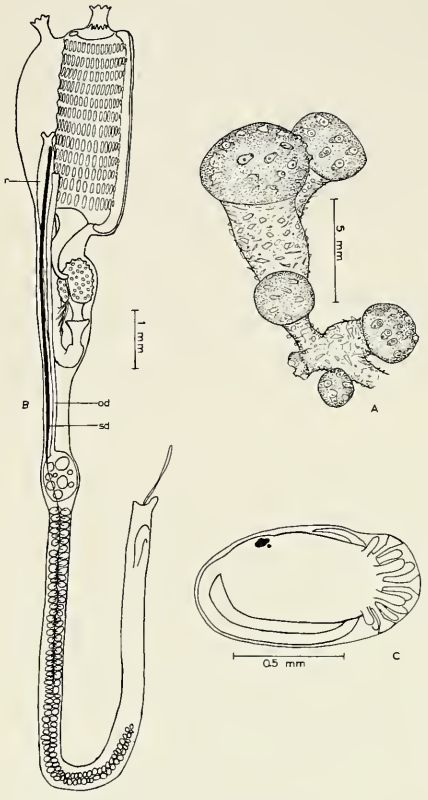


Figure 1. Ritterella rubra, n. sp. A. Portion of colony showing several capitate lobes; drawn from life. B. Mature zooid, removed from test; composite drawing. C. Tadpole larva.

raphe (Fig. 1 B). Intestine with pronounced valve anterior to loop (Fig. 1 B). No marked twist to gut which ends in a two-lipped anus at the level of the 5th row of gill slits from the posterior end of the pharynx (Fig. 1 B). Pyloric gland on the ascending loop of intestine with duct entering stomach postero-dorsally (Fig. 1 B).

Reproductive organs well developed in specimens taken May through July; lacking in those taken in November. Ovary lies some distance behind gut loop (Fig. 1 B). Numerous testes lobes lie in a double row in the postabdomen behind the ovary; a few lobes may lie anterior to the ovary. Sperm duct runs from testes lobes through postabdomen and abdomen along the hind gut to terminate near the anus (Fig. 1 B). Oviduct follows a similar course.

Larvae in different stages of development present in the atrium. Internal structure of larva obscured by large quantities of yolk. Body of

larva about 0.8 mm. in length. Three adhesive papillae in a row anteriorly and about three rows of 4 ampullae. Otolith and ocellus present (Fig. 1 C).

Diagnosis: Colony composed of bright red capitate heads joined by basal stolons. Zooids not arranged in systems. Individual zooids with well developed six-lobed branchial and atrial siphons opening on the surface. Stomach ovate, with areolations, into which the oesophagus enters dorsally.

Material examined: Carmel Cove, Monterey County, California. Several collections from under rocky ledges in low intertidal. Pescadero Point, Monterey County, California. Several collections from under rocky ledges in low intertidal. Point Pinos, Monterey County, California. One collection from under rock in low intertidal.

Holotype: U. S. National Museum number 11951. May 29, 1949. Carmel Cove, Monterey County, California. Under rocky ledge. Zone 4. D. P. Abbott, collector.

Paratypes: U. S. National Museum number 11952. November 28, 1947. Pescadero Point, Monterey County, California. On rocks in cave, Zone 4. D. P. Abbott, collector. California Academy of Sciences Number 228. July 3, 1947. West shore of Point Pinos, Pacific Grove, Monterey County, California. Under rock in Zone 4. Unprotected rocky shore. V. House and W. Fox, collectors. Los Angeles County Museum Number 1164. November 28, 1947. Pescadero Point, Monterey County, California. On rocks in cave, Zone 4. D. P. Abbott, collector.

Discussion: The genus *Ritterella* was set up by Harant (1931) for *R. aequali-siphonis,* a species which had been described originally by Ritter and Forsyth (1917) as *Amaroucium aequali-siphonis.* Harant's definition of the genus included: a well developed postabdomen, atrial and branchial siphons 6 lobed, both siphons opening on the surface, no systems present and a stomach which is not smooth.

Harant (1931) also set up a new subfamily Pseudodistominae within the family Polyclinidae for those Polyclinids with lobed siphons placed at the same level and without a cloacal languet:

> "Polyclinidés à siphons semblables ordinnairement lobés placés au même niveau, dépourvus de languette cloacale." (Harant, 1931, p. 22)

He placed 4 genera in the subfamily separated as follows:

1. Stomach smooth; numerous rows of stigmata;
   — Oesophageal-intestinal length two times longer than the pharynx; a placenta . . . . . *Placentela* Redikorzev

— Oesophageal-intestinal length much shorter than the pharynx; no placenta ..... *Homeodistoma* Redikorzev

2. Stomach not smooth;
— 3 rows of stigmata; testes lobes divided in two by their entry into the sperm duct ..... *Pseudodistoma* Michaelsen
— more than 4 rows of stigmata; testes lobes not having this character ..... *Ritterella* Harant

Considerable confusion and discussion has developed over these genera largely because later workers were unaware of Harant's paper.

Oka (1933) set up a new genus, *Sigillinaria,* in which the type species was *S. clavata.* Definition of the genus was brief: body divided into thorax, abdomen and postabdomen and the two body apertures open to the outside. This description was equivalent to that of Harant's whole subfamily Pseudodistominae.

Using Oka's generic definition, Van Name (1945) placed what had been described as *Amaroucium aequali-siphonis* and *Distoma pulchra* in the genus *Sigillinaria* as *S. aequali-siphonis* and *S. pulchra.* Both species have stomachs with longitudinal plications.

Kott (1957) refers to the type species, *S. clavata,* in order to include the presence of a smooth stomach in the generic description. She concludes that if this is done *Placentela* and *Sigillinaria* ". . . cover the same range of characters and therefore the latter name must be replaced by *Placentela,* which has priority. . . . The definition of *Ritterella* may be conveniently expanded to include species with more than 3 rows of stigmata and with a longitudinally folded stomach." (Kott, 1957, p. 100). This results further in the species designated by Van Name as *S. aequali-siphonis* and *S. pulchra* (formerly *Amaroucium aequali-siphonis* or *Ritterella aequali-siphonis* and *Distoma pulchra)* being placed in the genus *Ritterella,* an arrangement which brings *R. aequali-siphonis* back to the genus set up for it by Harant in 1931.

Millar (1960) describing a new species, *R. vestita,* concludes that *Ritterella* and *Sigillinaria* are synonyms.

Careful study of the original descriptions of *Sigillinaria clavata* Oka (1933) and *Placentela crystallina* Redikorzev (1913) and of specimens of what appear to be *Placentela* lacking the diagnostic placenta has led to the tentative conclusion that these could well be members of the same genus. A final decision would depend on study of the type specimens. If this proves correct, then *Sigillinaria* would be synonymous with *Placentela,* the latter having priority as noted by Kott (1957).

In view of the existing confusion, the present investigators have

decided that for the present, Harant's (1931) subfamily and generic distinctions are most dependable and workable and therefore have placed this new species in the genus *Ritterella* as defined by Harant. Other species in the genus have a stomach with longitudinal plications but this character need not limit the genus at this time.

The specific name refers to the characteristic color of the living colony.

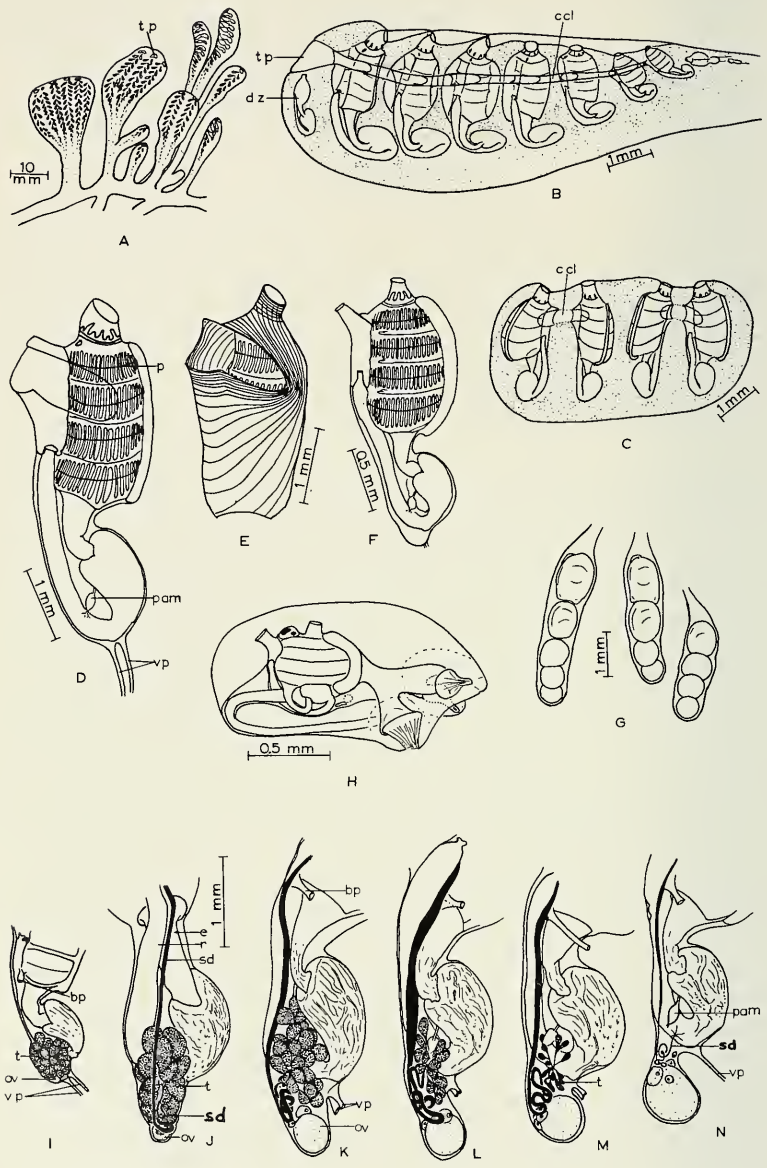
Distaplia smithi, n. sp.

Description: Colony composed of up to 100 or more club-shaped or paddle-shaped lobes, borne on slender stalks up to 5 cm long arising from a basal mat of stolons (Fig. 2 A). Smaller lobes narrow, gray to whitish, translucent, and free of encrustation; larger lobes with distinctly flattened, rectangular or fan-shaped heads, up to 2 cm across. Older heads, stalks, and stolons opaque, often pigmented orange-brown, and sometimes encrusted with foreign matter.

Zooids with oral apertures opening on one flattened side of each head, and with bodies oriented approximately at right angles to the main axis of the head and stalk (Fig. 2 B, C). Zooids arranged in systems, each consisting of two rows of individuals and between them a straight, tubular common cloacal canal running parallel to the main axis of the head and terminating distally in a pore (Fig. 2 B). One to 8 systems present per head; where more than one occurs the common cloacal canals lie parallel to one another or diverge slightly distally, and open separately to the outside. Zooids on the two sides of each system are alternately placed, and oriented with atrial apertures angling both inward, toward the common cloacal canal, and distally, toward the tip of the lobe (Fig. 2 A). In each system zooids show a gradation in age, the oldest ones lying near the common cloacal pore and new individuals entering the system at the proximal tip of the canal (Fig. 2 A, B).

Zooids generally characteristic of the genus *Distaplia*. Mature individuals 4-5 mm long, with a thorax slightly longer than the abdomen. Oral siphon with margin smooth or slightly undulating, not lobed. Atrial aperture in juvenile zooids round, smooth-edged, and borne on a tubular siphon (Fig. 2 F); aperture in adults enlarged, forming an asymmetrical gap in the mantle on the side facing the canal into which it empties, and bearing an extended atrial languet on the opposite side (Fig. 2 D). Mantle musculature delicate (Fig. 2 E). Fully grown zooids usually with 12 tentacles, of two sizes alternately arranged (Fig. 2 D).

Pharynx with 4 rows of stigmata, each row with 15-23 stigmata; variation in number of stigmata per row usually not greater than 1-3 between different rows in the same individual. Parastigmatic transverse vessels always present in zooids which have developed to the feeding



stage. Stomach pear-shaped, tapering posteriorly, the wall bearing fine longitudinal or irregular sculpturing (Fig. 2 I-N); pyloric valve poorly developed. Intestinal loop compact, rectum rising dorsal to, and slightly to the left of, the esophagus. Commonly two vascular processes, separate or joined, extend into the test from the posterior border of the abdomen. In flattened heads the larger zooids may have the abdomen bent at right angles to the thorax (Fig. 2 B).

Gonad lying on the right side of the abdomen, anteriorly nearly filling the intestinal loop, posteriorly extending up to 1 mm beyond the loop when fully enlarged. Gonad hermaphroditic consisting of an anterior cluster of testes and a posterior ovary, both male and female elements always visible in stained material. However, gonad development is somewhat protandrous (Fig. 2 I-N), thus some young zooids appear almost wholly male (Fig. 2 I), and some old zooids may appear very largely female (Fig. 2 N). Common sperm duct tortuously coiled as it leaves the gonad, then extending straight anteriorly along the right side of the hind gut to terminate near the anus. Oviduct enters the brood pouch, which arises postero-dorsally on the right of the thorax (Fig. 2 I, K-N). Detached brood pouches containing 1-5 developing larvae (Fig. 2 G), some isolated larvae free of brood pouches, and even a few metamorphosed larvae are found lying in the tunic below mature zooids with regressed gonads. Larvae are equipped with both ocellus and otolith (Fig. 2 H), and are apparently liberated by dissolution of tunic.

Diagnosis: Colony formed of clusters of paddle-shaped lobes, usually expanded and flattened distally, with all zooids opening on one flat surface. Zooids borne in double rows along straight, tubular common cloacal canals; up to 8 systems in a single lobe, each with its own canal and terminal pore. Zooids of the *Distaplia* type, with oral aperture smooth, atrial aperture large and asymmetrical in mature zooids, 4

Figure 2. Distaplia smithi, n. sp. A. Portion of a colony showing lobes and arrangement of zooids in systems. B. Lontitudinal section through a system, showing zooids arranged along common cloacal canal. C. Cross section through a head bearing two systems, showing common cloacal canals. D. Fully grown zooid, gonads not developed. E. Thorax of mature zooid, showing mantle musculature. F. Immature zooid. G. Brood pouches, removed from test. H. Tadpole larva. I-N. Abdomens, seen from right side, showing gonads in various stages of development. I. Immature zooid, gonad largely male, no sperm in sperm duct. J. Testes fully enlarged, some sperm in common sperm duct; ovary still small. K. Ovary enlarged, testes declining in size, sperm duct enlarged. L. Ovary enlarged, testes shrunken, common sperm duct gorged with sperm. M. Ovary enlarged, testes very small, sperm duct still containing considerable sperm. N. Ovary enlarged, testes fully regressed; some sperm still stored in sperm duct, but gonad appears almost wholly female.

rows of stigmata, parastigmatic vessels, and hermaphroditic gonads. Developing embryos borne in a brood pouch, and equipped with ocellus and statolith.

Material examined: Knoles Head (mainland West of Cordova), Prince William Sound, Alaska. Intertidal. June 4, 1965. Stoner B. Haven, collector. Ucluelet, Vancouver Island, B. C., Canada. Intertidal. May 31, 1965. Ivan Goodbody, collector. Victoria, Vancouver Island, B. C., Canada. W. Gordon Fields, collector. Otter Rock, Oregon. Washed on beach by a storm. February, 1956. Dale Snow, collector. Shell Beach, Sonoma County, California. In small caves and on sides of intertidal channels. June 26, 1956. Cadet Hand, collector. Dillon Beach, Marin County, California. Low intertidal rocks out from Second Sled Road. Numerous collections. Moss Beach, San Mateo County, California. Low intertidal. No further data. Asilomar State Park, Pacific Grove, Monterey County, California. Low intertidal rocks. Several collections. Pescadero Point, Pebble Beach, Monterey County, California. Low intertidal channels and caves. Many collections. Carmel Mission Point, Carmel Bay, Monterey County, California. Low intertidal channels and among *Phyllospadix*. Many collections.

Holotype: U.S. National Museum number 11953. May 24, 1959. Carmel Point, Monterey County, California. Under ledge, on rocks. D. P. Abbott, collector.

Paratypes: U. S. National Museum number 11954. April 14, 1956. Carmel, Monterey County, California. D. P. Abbott, collector. California Academy of Sciences number 229. March 23, 1952. Pescadero Point, Monterey County, California. D. P. Abbott, collector Los Angeles County Museum number 1165. April 14, 1956. Carmel, Monterey County, California. D. P. Abbott, collector.

Discussion: D. smithi is highly distinctive among the colonial ascidians of the rocky shores of North America, and there is little chance of mistaking it for any other species. It resembles some of the published illustrations of species of *Sycozoa* in the form of the colony and the organization of the systems. It seems highly likely that this is the "*Sycozoa (Colella)* sp." which Huntsman (1912, p. 115) reported he and others had found "in quantity" at Ucluelet, B. C., in 1909; it is certainly the "*Distaplia* sp." in dichotomy 24 in the Key to the Littoral Ascidians of the Central California Coast (Abbott, p. 307, in Light, Smith et al, 1954); and it looks very much like the species shown in figure 36A (a photo credited to D. P. Wilson) in Forest, (1957).

The species is locally abundant in many areas, growing most profusely in the low intertidal zone under rocky ledges, in cave-like spaces below large rocks, and along the sides of deep rocky channels, in

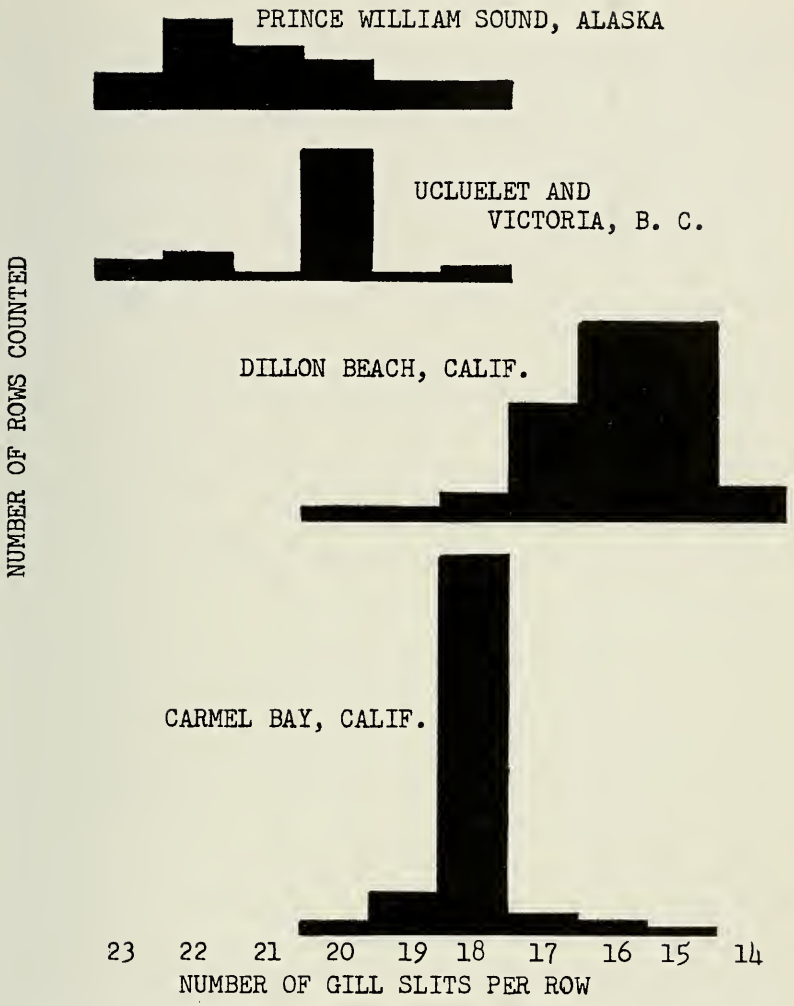


Figure 3. Distaplia smithi, n. sp. Number of gill slits per row in specimens taken at different localities.

regions where it is always well shaded, and protected from direct wave action but subjected to pronounced currents of fresh cold water. The lobes of the colony swing freely in moving water, and it appears that there is constant erosion at the tips of the lobes, resulting in loss of old zooids and test distally as new individuals are added to the systems from the stalk, proximally.

Colonies from the northern and southern ends of the known geo-

graphic range are quite similar, though the northern colonies tend to be smaller and have shorter stalks; further, the number of stigmata per row tends to be higher in the northern latitudes (Fig. 3).

The species is named in honor of Professor Ralph I. Smith, Department of Zoology, University of California at Berkeley, under whom both of the authors obtained doctorates in researches on ascidians.

D. smithi clearly possesses the characteristics of the Holozoinae as defined by Berrill (1950), including the presence of a brood pouch. The species had been assigned to the genus *Distaplia,* after some initial hesitation, on the basis of its parastigmatic vessels, a finely plicated stomach wall, hermaphroditic gonad, and presence of both ocellus and otolith in the tadpole larva. The question of the separateness of the genera *Distaplia, Holozoa,* and *Sycozoa* has been discussed by Van Name (1945), Brewin (1953), and Millar (1960), among others. Brewin (1953) has united *Holozoa* with *Distaplia,* under the latter name (as nomen conservandum), and has separated the species *D. fasmeriana* into a separate genus *Hypsistozoa.* Millar (1960) concurs with the demise of *Holozoa,* and presents additional evidence that *Distaplia* and *Sycozoa* are doubtfully distinct. At present there are many species which need careful reinvestigation, including some species with rather anomolous constellations of characters (e. g., *D. australensis* Brewin, and *D. mikropnoa* Sluiter, which while hermaphroditic, lack parastigmatic vessels and *S. anomala* Millar, which has both unisexual and hermaphroditic zooids (Millar, 1960). Determination of the conditions of sexuality in a species, especially where a fair degree of protandry occurs, may require the examination of more and better material than is sometimes available to investigators, and it is safe to say that if only certain colonies of *D. smithi* had been seen, the present investigators might have reported only males, or only females, or only hermaphrodites. Millar (1960) has pointed out the confusion that might result from uniting *Distaplia* and *Sycozoa* at the present time, and the writers feel revision of the genera should only follow a careful reinvestigation of many species.

Summary

Two new species of colonial ascidians from the Central California coast, *Ritterella rubra* and *Distaplia smithi* are described and taxonomic problems related to the genus *Ritterella* and to the three genera, *Distaplia, Holozoa* and *Sycozoa* are reviewed.

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Abbreviations of labels used on drawings

b p	brood pouch
c cl	common cloacal canal
d z	degenerating zooid
e	esophagus
o d	oviduct
ov	ovary
p	parastigmatic vessel
p am	pyloric ampulla
r	rectum
s d	sperm duct
t p	terminal pore of common cloacal canal
v p	vascular process