On the Previously Undescribed Aggregate Form of the Pelagic Tunicate *Ritteriella picteti* (Apstein) (1904)[1]

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DURING MARCH, APRIL, AND MAY, 1949, over 400 specimens of *Ritteriella picteti* were taken off the west coast of the United States and Baja California in the net hauls taken by the Scripps Institution of Oceanography in conjunction with the California Cooperative Research Program. This is its first reported occurrence in the eastern Pacific Ocean and in large numbers. In this material the solitary form and the undescribed aggregate form are both represented. The original recognition of the aggregate form was based on specimens that contained embryos of the solitary form which were mature enough to possess their characteristic diagnostic features. Five individuals of the aggregate generation have been deposited in the United States National Museum, under number 11170.

I wish to express my appreciation to Dr. Martin Johnson for his valuable assistance in the preparation of this manuscript.

In the past *Ritteriella picteti* has been considered a rare species by all workers on the Thaliacea. Apstein (1904: 655) described the species from a single specimen taken off Amboina, Dutch East Indies. He again found the species in the Tiefsee Expedition material (1906*a:* 252), listing two specimens, but appears to have confused it with *R. amboinensis*, so the number may be higher. From the Deutsche-Südpolar Expedition, Apstein (1906*b:* 168) reported three specimens of *R. picteti*. Ritter (1906: 1–5) took one specimen from Sugura Bay, Japan, which he described as a new species, *Cyclosalpa retracta*. Ihle (1910: 43–46) reported two specimens from the Siboga collections, and Sewell (1926) reported two specimens from the Indian Ocean collections he examined. Komai (1932: 64–69) and Thompson (1948: 124–126) each reported one specimen from their collections. Thus more than 13 specimens, all of the solitary form, were reported in nearly 50 years of investigation. Thompson (1948: 125) suggested that he may have found the aggregate form of the species, but from his description it appears that he must have been looking at a very young individual or at another species.

Ritteriella picteti (Apstein) (1904)

Cyclosalpa retracta Ritter, 1906
Salpa amboinensis Apstein, 1906*a*
[non] *S. amboinensis* Apstein, 1904
Salpa picteti Apstein, 1906*a*
Salpa picteti Apstein, 1906*b*
Salpa retracta Ihle, 1910
Salpa picteti Ihle, 1910
Salpa picteti Ihle, 1912
Salpa (*Ritteria*) *picteti* Metcalf, 1918
Salpa (*Ritteria*) *retracta* Metcalf, 1918
Salpa (*Ritteriella*) *picteti* Metcalf, 1919
Salpa (*Ritteriella*) *retracta* Metcalf, 1919
Salpa (*Ritteria*) *picteti* Sewell, 1926.
Salpa (*Ritteriella*) *picteti* Komai, 1932.
Ritteriella picteti Ihle, 1935
Ritteriella picteti Thompson, 1948

DESCRIPTION OF AGGREGATE FORM

Body: (Fig. 1) The body is ovoid, with anterior and posterior processes which are usually short. In dorsal view *R. picteti* is quite similar in appearance to *R. amboinensis*, *Salpa maxima*, and *S. fusiformis*. The atrial opening is dorsally placed. The test is soft, often collecting debris from the sample, thus making the details of the animals difficult to see. The mature specimens examined have ranged in size from 9 to 35 millimeters, excluding the processes.

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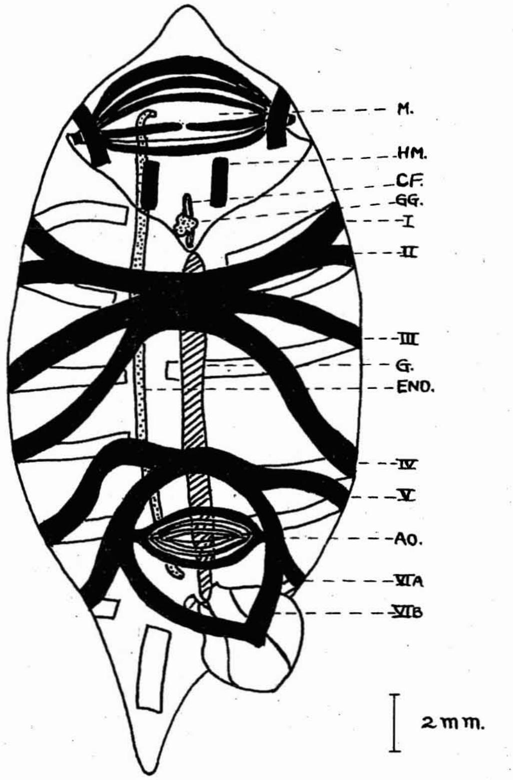

FIG. 1. *Ritteriella picteti*, aggregate form. AO, atrial opening; CF, dorsal tubercle; END, endostyle; G, gill; GG, ganglion; HM, dorsal horizontal muscle; M, mouth; I–VI, body muscles.

Muscles: The body muscles (Figs. 1, 2) may be asymetrically arranged. There are usually six body muscles on each side of the animal although specimens have been found with seven on one side (Fig. 2). Body muscles I and II are joined over the dorsal half of their course, separating laterally, whereas III and IV are joined dorsally over a short portion of their course and contact the bundle formed by muscles I and II in the same general area. Muscles V and VI are also in contact over the dorsal portion of their course. Laterally, muscles IV and V may approach closely. Muscle VI has an anterior branch in front of the gut and a posterior branch which joins its mate from the opposite side over the gut nucleus. There is a broad, independent muscle running along the base of the posterior process. The atrial muscles resemble those of *R. amboinensis*. There are four delicate sphincters attached laterally to a delicate retractor muscle. This muscle then attaches to a heavier retractor which receives the attachment of the heavy basal sphincter. The retractor finally attaches to muscle VI just before the sixth muscle divides. The oral musculature (Fig. 3) includes a single oral retractor laterally on each side and three sphincters on both the upper and lower lips. The sphincters of the upper lip include a wide muscle which is discontinuous medially, U_1, a narrow muscle, U_2, and a wide muscle, U_3. The sphincters of the

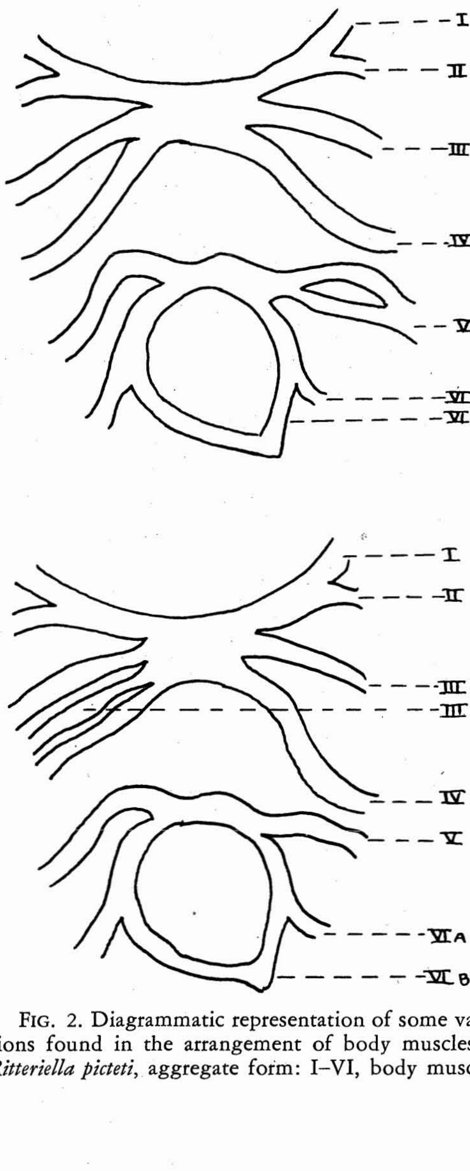

FIG. 2. Diagrammatic representation of some variations found in the arrangement of body muscles of *Ritteriella picteti*, aggregate form: I–VI, body muscles.

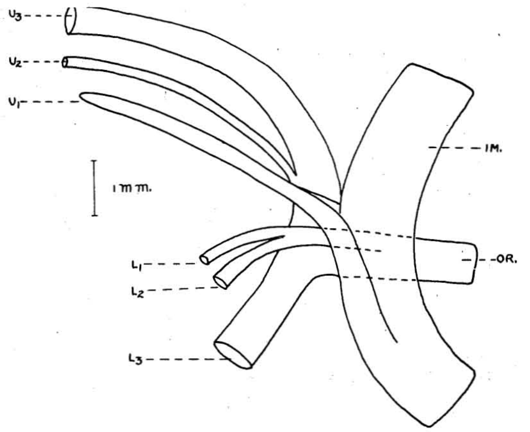

FIG. 3. *Ritteriella picteti*, aggregate from, oral musculature. IM, intermediate muscle; L_1 etc., oral sphincter muscles of the lower lip; OR, oral retractor; U_1 etc., oral sphincter muscles of the upper lip.

lower lip are made up of a narrow muscle, L_1, a wider muscle, L_2, and a wide muscle, L_3. The oral retractor passes internally to the broad intermediate muscle which is discontinuous both dorsally and ventrally. The horizontal muscles are independent and run from the region just behind the last dorsal oral sphincter to about the region between the ends of the first body muscles.

Internal Structure: The gut forms a compact nucleus in which the course of the intestine cannot be clearly traced without dissection. The oesophageal opening, at the base of the gill, is wide and slightly flared. The anal opening is situated on the anterior left side of the gut nucleus. The dorsal tubercle is of typical form, elongate and slightly curved in dorsal view. The dorsal ganglion is much like that figured by Metcalf (1918) for *R. amboinensis*. The endostyle is rather straight, sharply hooked at the anterior end and slightly hooked at the posterior end. It extends from a point below the lower lip to the area posterior to the bifurcation of muscle IV. There is one embryo placed laterally in the area between muscles V and VI.

COMPARISON WITH OTHER SPECIES

In comparing this species with *R. amboinensis*, the other member of the genus, one finds the two very similar. There are certain characteristics, however, that show striking differences; the body muscle bands in *R. picteti* are wider and composed of more fibers. Two typical individuals are compared in the table below.

The large number of fibers in muscle VI of *R. picteti* before its division might indicate that there are in reality two muscles involved and that the posterior branch might be numbered VII. It is felt however that, because of the long-established convention in numbering muscles, the normal order should be maintained even though the muscle might be subdivided. Although the number of muscle fibers is not constant from specimen to specimen, the greater width of muscle bands and greater number of fibers in the specimens of *R. picteti* examined has been a constant feature. This variation in muscle-band width was also observed to a lesser extent in the solitary forms examined. The cross banding on the gill bars of *R. picteti* appears to be more closely spaced than that on the gill bars of *R. amboinensis*. The oral musculature of the two species is quite different, *R. picteti* having three oral sphincters on each lip whereas *R. amboinensis* has only two.

The greatest difficulty encountered has not been in the differentiation of the two *Ritteriella* species but in the differentiation of *R. picteti* from the aggregate form of *Salpa fusiformis*. If the muscle banding is distinct there

TABLE 1
COMPARISON OF THE SPECIES OF RITTERIELLA

BODY MUSCLE	*R. picteti*		*R. amboinensis*	
	Fibers	Width in millimeters	Fibers	Width in millimeters
I	16	0.75	4	0.1
II	16	0.50	5	0.1
III	19	0.50	5	0.1
IV	18	0.50	6	0.1
V	17	0.50	6	0.1
VI	24	0.50	6	0.1
Total length of animal....	11 mm.		9 mm.	

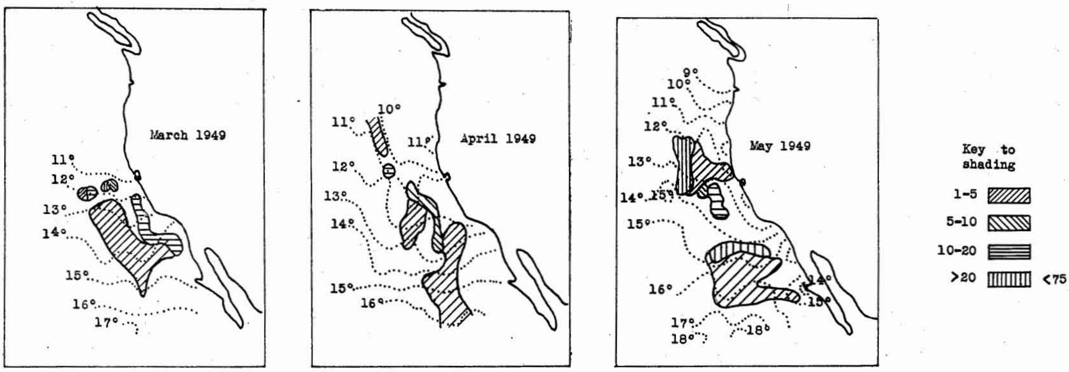

FIG. 4. Charts showing the distribution and approximate numbers of *Ritteriella picteti*, per 1,000 cubic meters of water filtered. Isotherms in degrees centigrade.

is no problem, but in specimens in which the muscles are not easily seen separation of the species is complicated. The best solution to the problem yet found is staining the muscles. For the purpose of this "identification staining," Rose Bengal has been found very useful although not suitable for permanent preparations. A stock solution of 0.1 per cent Rose Bengal may be added to a mixture of sea water and formalin in various amounts to give the intensity of staining desired, with no salt reaction. The main objection to the method is that the stain washes out very easily.

The distribution of *R. picteti* during the period covered by this paper is shown in Figure 4; it can be seen that the occurrence of the species is variable. The patchiness seen is typical of distributions of "salps" and especially true of those which do not occur in large numbers and are not extremely common. This form appears to be much more tolerant of cold water than its relative *R. amboinensis*. It has been taken in water with a temperature as low as 10 degrees at a depth of 10 meters. In the area examined, the lower limit of their range appears to be in the vicinity of this 10-degree isotherm.

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