THE OREGON SHORE ANEMONES (ANTHOZOA)

by

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A THESIS

submitted to

OREGON STATE COLLEGE

in partial fulfillment of
the requirements for the
degree of

MASTER OF SCIENCE

June 1949
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ACKNOWLEDGEMENTS

Expression of appreciation is due Dr. Ivan Pratt of the Zoology Department of Oregon State College for suggesting the topic of this thesis, for furnishing materials and facilities at both the Institute of Marine Biology and at Oregon State College, and for his criticism and guidance of the work throughout.

Professor Oskar Carlgren of the University of Lund has contributed generously by making available recent pertinent literature and by comparing and determining many species.

For invaluable aid in preparing the plates, critically reading and typing the manuscript, the writer is especially grateful to his wife, Bert.
THE OREGON SHORE ANEMONES (ANTHOZOA)

INTRODUCTION

Coelenterata of the class Anthozoa are a most variable group of animals. Many of the species are cosmopolitan and therefore live in a wide range of environments. This may tremendously affect their form and color. It was the changeable form and color that biologists of the past used to describe these animals. This use of superficial and variable characters and the incompleteness of many of the early descriptions led to an almost hopeless problem of synonymy. Much of the confusion may also be attributed to the relative isolation of the workers prior to about 1850 and to the fact that a good many descriptions were made from poorly preserved material.

The first effort to compile information on the anemones of a definite area was made by P.H. Gosse (1860) in his book, "A History of the British Sea Anemones and Corals". Following, T.A. Stephenson (1928 and 1935) published "The British Sea Anemones", a work which established sound characteristics for many of the larger taxonomic units. At about the same time R.F. Weill (1930 and 1934) proposed a
scheme of classification for all Cnidaria, based largely on type and distribution of the nematocysts. O.A. Carlgren has modified Weill's somewhat cumbersome scheme, and has applied this modification, along with other diagnostic characteristics, to anemone classification. This has formed a sounder basis for the establishment of phylogenetic relationships among the Anthozoa of the world.

In spite of Carlgren's contribution, the taxonomic status of the sea anemones of Oregon is still not very clear. First of all, there has been very little collecting done along the Oregon coast; consequently, there are very few marine zoological specimens from this region in the museums of the world where most taxonomic work is conducted. Secondly, many of the anemones that have been described from the Pacific Coast during the last century are today unknown to most marine biologists of this area. The reason is partly due to the fact that much of the literature is obscure and partly because there has been very little interest shown in the Anthozoa of this region for the past 50 years. Finally, there are probably a considerable number of species occurring in Oregon that are new to science, some of which are not distinguished from the forms already described.

The purpose of this thesis is to bring together information on the Oregon anemones and to determine valid
nomenclature for the forms found here. Through such investigation new species are easily detected and can then be properly treated. During this study notes were taken on all phases of the life histories which became apparent during the observation of the anemones. These facts are incorporated in the text wherever they are applicable.

The immediate value of this study will be to furnish a local source of information on a rather obvious group of shore animals which to date have not been known to those who frequent the Oregon beaches.

METHODS AND MATERIALS

**Collection.** This thesis is intended to cover only the anemones in tidal waters. Because of this restriction most specimens were collected on the shores at low tide. The largest number of anemones was taken in the vicinity of the Oregon Institute of Marine Biology at Charleston, Oregon. Collections were also made at Cape Blanco and Brookings, to the south, and at Newport and Astoria, to the north.

A great majority of Oregon shore anemones have a strong base and are capable of clinging tenaciously to rocks, shells, and piling. These delicate animals must be handled carefully if they are to be moved to aquaria or anesthetized and killed in anywhere near a normal state of
expansion. The best tool found for removing them from objects, without rupturing their bases, was a putty knife or stiff spatula. Many excellent and undamaged specimens were obtained by carefully inserting the sharp, broad end of the knife under the edge of the base and scraping the rock, wood or shell from the base of the anemone rather than prying the anemone from the substrate.

It was possible to collect one genus of Oregon anemone (Halcampa) by digging in the pockets of broken shell and coarse sand found between rocks. This genus does not have an adherent base. Larval Peachia were found attached parasitically to small medusae in the bay waters of Coos Bay and were collected with coarse plankton nets.

Transporting specimens to the laboratory is a problem that can be fairly successfully met in either of two ways. (1) Shipment over a period of several days can be accomplished by placing a few healthy anemones of the same kind in a clean glass container with ample water and air space and after allowing them to become firmly attached to the walls. (2) Specimens wrapped in clean pieces of cloth soaked in sea water (certain species of algae, such as Ulva, Irriophyous or Laminaria, will do) and then further wrapped in clean burlap also soaked in sea water will transport with equal safety if the package is kept soaked with sea water.
Anesthetization. The anesthetization of sea anemones prior to preservation is a very important factor in obtaining satisfactory results. Reagents found to give good results are chlorotone, magnesium sulfate, and cocaine hydrochloride, although the latter is less effective on large anemones. The anemones are first allowed to become fully expanded in clean, fresh sea water, and then a few crystals of chlorotone are added. When using magnesium sulfate, it has been found to be less disturbing to the anemone if the crystals are tied in several thicknesses of gauze and then the bag suspended in the container so that it just touches the water. Cocaine and menthol will work at times, but the two previously mentioned chemicals give better results and are more readily obtained.

Fixation and staining. When the animals are completely anesthetized they will show no further response to tactile stimulation, and fixation can then be accomplished. For histological purposes the following fixatives are a few of many that will give good results.

Bouin's picric-formol-acetic is a general, fast-penetrating fixative, especially good for larger anemones. It is also an excellent fluid in which to store specimens. It keeps them firm, but not hard, and preserves a great deal of natural color although masking it with picric acid. This yellow picrate can be removed by repeated washings
with 30 to 50 per cent alcohol to which has been added sodium or lithium carbonate. The natural colors of the anemone will appear for a short time when the last of the yellow disappears and before the colors fade in the alcohol. Through careful handling specimens may be examined for color and returned to Bouin's several times by following this procedure. The best stains to follow Bouin fixation are Harris' or Heidenhain's hematoxylin.

Zenker's sublimate and bichromate is another excellent fixative, especially good when material is to be stained with safranin and fast green or with Cajal's micro-indigo-carmine. Heidenhain's Susa and various sublimate solutions, both hot and cold, have proved satisfactory the few times they were used. The use of formaldehyde on anemones quickly removes all color and does not give satisfactory fixation for histological analysis. Other techniques on fixing and staining may be found in Bolles Lee's "The Microtomists Vade Mecum".

The fixatives were applied by filling the coelenteron as quickly as possible with a syringe, the anemone still being in the vessel in which it was anesthetized. The injected specimen was then removed from the water and placed in a large container of fixative.

After fixation the material to be sectioned was washed, dehydrated in dioxan, cleared in cedar-wood oil
and embedded in paraffin. Most of the sections for this study were cut at 10\(\mu\) and stained with Harris' or Heidenhain's hematoxylin.

**Nematocysts.** The nematocysts require special treatment for careful study. Small bits of fresh tissue from the various organs or regions of the anemone, in which nematocysts are to be studied, were placed on a clean slide with a drop of methylene blue (acid fuchsin for spirocysts) and teased apart with needles. Further maceration may be obtained after the coverslip is added by gently rubbing the top of the cover with the handle of the needle. Methylene blue is generally made up in a one per cent aqueous solution to which is added a little liquid soap. Aqueous acid fuchsin is best for the study of spirocysts at a strength also of about one per cent.

Good optics are essential in studying nematocysts. Most observation is possible with the high-dry objective of a good compound microscope, but the fine details of the armament can only be discerned under oil immersion.

**Plates.** The plates of this thesis are all photographs of living animals. The color plates were prepared from Kodaslides by the Eastman Dye-transfer process. The drawings were prepared by carefully inking over photographs of the tissues and then bleaching out the photographs. This procedure allows for greater clarity of detail and for the
elimination of extraneous adjacent tissues present in the photographs.

DATA

The discussion which is included with the data will be limited in so far as the writer has not had the opportunity to study forms other than those found in Oregon. For this reason diagnoses other than those for species, in most cases, will be largely from Carlgren (1948). Diagnoses of families, which are the largest taxonomic units considered here, are given as an orientation aid to the reader. Local genera follow under assigned families, and in turn a detailed description of the species is given.

Family Haloclavidae Verrill 1899

Tentacles usually less than 48 in number. Acontia absent. At least 6 pairs of perfect mesenteries (except Oractis which has 8). A single strong ventral siphonoglyph. No sphincter or rarely a diffuse one (e.g. Oractis).

Genus Peachia Gosse 1855

Tentacles without special batteries of nematocysts. Six pairs perfect mesenteries and 4 pairs imperfect. No sphincter. One siphonoglyph, rarely completely separated from the actinopharynx, but sometimes elongated to form a
conchula. The larvae live parasitically on medusae.

*P. quinquecapitata* McMurrich 1913

**Synonyms.** *Bicidium aequoreae* McMurrich 1913. *Bicidium aequoreae* has since been recognized as the larva of *P. quinquecapitata*. For further synonymy see Stephenson (1935), Carlgren (1948).

**Distribution.** In Oregon this species has been taken in the larval form from Coos Bay near Charleston. In the course of this study adult Peachia were not found. It is expected that they occur mostly subtidally. On the Pacific Coast the species is known from Departure Bay, Vancouver Island and Friday Harbor, Washington.

**Habitat.** Only the larval form (Figure 1) has been encountered in Oregon. The many larvae taken in Coos Bay were attached to the subumbrellar surfaces of the hydroid medusae, *Phialidium gregarium*.

**Size.** Length 5 to 10 mm. Width at crown 2 to 3 mm.

**Cnidom.** Permanent preparations of the nematocysts were unfavorable for critical study and the cnidom has not been determined for this species.

**Tentacles.** Twelve; medium length; blunt; without aerospheres. Color cream with several reddish-brown V-shaped bands.

**Disc.** Broad; marked by the insertions of the perfect
Fig. 1 Larva, *Peachia quinquecapitata*

Fig. 2 Siphonoglyph, *Peachia quinquecapitata*

Fig. 3 Mesenteries, *P. quinquecapitata*
mesenteries. Color cream to white, marked with brown near base of tentacles.

**Column.** Cone-shaped in younger larvae, becoming more cylindrical in older individuals; indistinctly divisible into regions; with minute adherent areas. Insertions of mesenteries visible through column wall. Color cream to white.

**Base.** A physa; capable of inflation; perforated with numerous cinclides. Color white.

**Mesenteries.** (See Figure 3). Ten pairs; 6 pairs perfect. Perfect mesenteries with diffuse retractors. Imperfect mesenteries with retractors close to column wall. There was no indication of fertile mesenteries in the larvae.

**Siphonoglyph.** (See Figure 2). A single, deep siphonoglyph. The oral end occasionally elevated at the corners of the mouth to form a lobed conchula. The conchula was not evident in living larvae.

**Family Halcampidae Andres 1883**

Body cylindrical, commonly elongate. Acontia absent. Sphincter mesogloeaal, single or double.

**Genus Halcampa Gosse 1858**

Column indistinctly divisible into physa, scapus and
capitulum. Scapus with tenaculi. Mesenteries more numerous than tentacles. Tentacles 8 to 12. Sphincter single, weak, close to tentacles.

**H. duodecimoirrata** (Sars 1861)

**Synonyms.** *Edwardsia duodecimoirrata* Sars 1851. *Halcampa duodecimoirrata* Carlgren 1893. For further synonymy see Gosse (1860), Stephenson (1935), Carlgren (1948).

**Distribution.** In Oregon this species has been repeatedly taken from the coast near Coos Bay. On the Pacific Coast the species is known from Pysht, Washington to Southern California.

**Habitat.** The adults are found buried in sand and finely broken shell in tide pools among the rocks. Generally the animals are completely covered, but on cloudy days the disc and tentacles are frequently visible. They are often found in association with *Leptosynapta* with which they may be confused. The larva is parasitic on medusae.

**Size.** Length 6 to 8 cm. Width at crown 5 to 10 mm.

**Tentacles.** (See Plate V). Ten; medium length; capitate; without acrospheres. Two tentacles are larger and of different color and borne at right angles to the directive radius. Color may be transparent purple-brown at base, becoming opaque white at the tip, or marked with several V-shaped bands of reddish-brown flecked with cream.
The odd tentacles may be entirely an opaque white or mostly white with brown bands at the tips on specimens with marked tentacles.

**Disc.** (See Plate V). Broad; marked by the insertions of the mesenteries. Color cream to white; may be marked with brown. Area between the two odd tentacles marked by conspicuous diamond-shaped patches of brown flecked with cream.

**Column.** (See Plate I). Capable of extreme elongation; indistinctly divisible into regions; with tenaculi. During contraction one or more bulges may form in the column. Insertions of mesenteries visible through column wall. Color white, blending to a brownish-purple at the margin.

**Base.** A phylls; capable of inflation; perforated with numerous cinclides. Color white.

**Mesenteries.** (See Figure 5). Eight to 12 pairs perfect; 2 pairs directives. A second more or less complete cycle of imperfect mesenteries present. Perfect mesenteries fertile; with filaments and strong circumscript, reniform retractors.

**Sphincter.** Weak; difficult to distinguish from mesogloea of column.

**Siphonoglyph.** (See Figure 4). Two; shallow; three-lobed.

**Reproduction.** Dioecious. The specimens examined
Fig. 4 Siphonoglyph, *Halcampa duodecimcirrata*

Fig. 5 Mesentery, *Halcampa duodecimcirrata*
were all females and contained large ova (Figure 5). The
time of collection was July and August.

Family Actiniidae (Gosse 1858)

Tentacles arranged in cycles, never more than one
tentacle communicating with each endo- and exocoel. Column
sometimes with vesicles which, however, never have macro-
basic amastigophore. With or without acrorhagi, the acro-
rhagi always having atrichs. Mesenteries never divisible
into macro- and microcnemes. Sphincter usually endodermal
but sometimes absent.

Genus Anthopleura Duchassaing and Michelotti 1860

Acrorhagi containing atrichs present in older speci-
mens. Sometimes atrichs present in other parts of column.
Column without vesicles but with numerous adhesive verru-
cae. Sphincter more or less circumscribed.

A. xanthogrammica (Brandt 1835)

Synonyms. Actinia xanthogrammica Brandt 1835.
Anthopleura xanthogrammica McMurrich 1891. For further
synonomy see Gosse (1860), Stephenson (1935), Carlgren
(1948).

Distribution. This anemone is found abundantly along
the entire Oregon Coast. Its range is known to extend
from Japan to Southern California.

**Habitat.** Occurs from upper littoral to sub-littoral on rocky shores; is also present in bays on piling.

**Size.** Length to 15 cm. Width at crown to 20 cm.

**Chidom.** (See Figure 6). Tentacles: spirocysts 25 to 28 x 2.5 to 3 μ; basitrichs 20 to 22 x 2 μ. Actinopharynx: basitrichs 30 x 2.5 to 3 μ. Filaments: basitrichs 17 to 20 x 2.5 μ.

Atrichs in the column as described by Carlgren (1948) were not found.

**Tentacles.** Hexamerously to irregularly arranged; of medium length; acuminate. Copper green to white in color.

**Disc.** Simple, with broad area between mouth and base of tentacles. Insertions of mesenteries faintly visible. Copper green to white in color.

**Column.** With numerous adhesive verrucae arranged irregularly, becoming more prominent distally. No acrorhagi were present in the specimens examined. Color ranges from deep green to pale brown.

Carlgren (1948 and personal correspondence) states he has found acrorhagi in Pacific Coast material. The live specimens that were examined during the course of this study did not have acrorhagi although the specimen in Plate VII shows very clearly on the margin what could be acrorhagi or pseudo-acrorhagi. Torrey (1906) grouped
Fig. 6 Onidom, *Anthopleura xanthogrammica*

Fig. 7 Sphincter, *Anthopleura xanthogrammica*

Fig. 8 Mesenteries, *A. xanthogrammica*
A. *xanthogrammica* with several other Pacific Coast anemones under the genus *Bunodactis*. He believed the four species of anemones that he grouped together could either have or not have acrorhagi. Until it is known that Brandt's species *xanthogrammica* has acrorhagi and atrichs it should be referred to Carlgren's genus *Bunodactis*.

**Base.** Pedal disc well developed and capable of extreme adhesion to rocks. Color white.

**Mesenteries.** (See Figure 8). Numerous perfect mesenteries, most of which are fertile. Retractors of perfect mesenteries circumscript-diffuse. Parietobasilar muscle strong.

**Sphincter.** (See Figure 7). Strong; circumscript; pinnulate.

**Siphonoglyph.** Two; strong. Color green to white, as in the actinopharynx.

**Reproduction.** Dioecious. Many small specimens (12- to 24-tentacle stages) were found in *Mytilus* beds on the open coast.

**Genus Bunodactis Verrill 1899**

Column with verrucae; these well developed, sometimes compound in the distal part; acrorhagi absent; rarely with pseudo-acrorhagi. Sphincter more or less circumscribed to restricted, rarely weak. More mesenteries at base than at
the margin.

**B. elegantissima** (Brandt 1835)

**Synonyms.** *Actinia elegantissima* Brandt 1835. For further synonymy see Gosse (1860), Stephenson (1935), Carlgren (1948).

*Actinia elegantissima* as described by Brandt (1835) probably refers to Gosse's *Tealia orassicornis* and not to the anemone considered here (See Plates II and VI). Ver- rill (1869) associates *Urticina (Tealia) orassicornis* with Brandt's *A. elegantissima*. Dana's (1849) description of *Actinia artemisia* in all probability refers to the anemone in Plates II and VI. Carlgren (1948) calls this form *Anthopleura xanthogrammica*. The species mentioned in this paragraph should probably belong to the following genera in this order: *elegantissima* Brandt (1835) to Gosse's genus *Tealia*; *xanthogrammica* Brandt (1835) to Carlgren's genus *Bunodactis*; *artemisia* Dana (1849) to Carlgren's genus *Anthopleura*; Carlgren's *Evaetis artemisia* is most likely a species not yet properly described but perhaps belonging to the genus *Bunodactis*. With further investigation all except Brandt's *Actinia elegantissima* will probably be found to have acrorhagi and atrichs which will then place them in the genus *Anthopleura*.

**Distribution.** In Oregon this species is abundant
along the entire coast. It occurs from Sitka, Alaska, to Southern California.

**Habitat.** This anemone is almost always found in colonies on the rocks or piling of the open coast or bays. It occurs primarily in the upper littoral regions.

**Size.** Length 5 to 8 cm. Width at crown 8 to 9 cm.

**Cnidom.** (See Figure 9). Tentacles: spirocysts 27 x 4 μ; basitrichs 14 to 22 x 2 to 3 μ. Acrorhagi: atrichs 40 to 75 x 3 to 4 μ; basitrichs 18 x 2.5 μ; spirocysts 13 x 2.5 μ. Column: basitrichs 16 to 18 x 2.5 μ; atrichs 75 x 4 μ. Actinopharynx: basitrichs 22 x 2.5 μ. Filaments: basitrichs 25 to 40 x 3 to 4 μ; microbasic p-mastigophors 22 to 25 x 4 to 5 μ.

The presence of atrichs in the acrorhagi and column should place this species in Carlgren's (1948) genus Anthopleura; however, he seems to have confused the species *elegantissima* and *xanthogrammica*.

**Tentacles.** (See Plates II and VI). Medium length; simple; hexamerously arranged; acuminate. Color, olivaceous at base becoming white to pink at tip. Frequently the tentacles are marked with white spots and bands on the adoral side.

**Disc.** (See Plate VI). Simple; with broad area between mouth and base of tentacles. Insertions of mesenteries distinct. Color, olive-green; insertions of
Fig. 9 Cnidom, *Bunodactis elegantissima*

Fig. 10 Sphincter, *Bunodactis elegantissima*

Fig. 11 Mesentery, *B. elegantissima*
mesenteries usually darker green.

**Column.** (See Plate II). With numerous adhesive verrucae arranged in longitudinal rows; becoming more prominent distally. Shell and gravel usually adhering to verrucae. Acrorhagi always present in older specimens; inconspicuous to prominent. Color, white at base becoming a yellow or yellow-green at the margin. Acrorhagi white.

The presence of acrorhagi refers this species to Carlgren's (1948) genus Anthopleura.

**Base.** Pedal disc well developed and capable of extreme adhesion to rocks. Color white.

**Mesenteries.** (See Figure 11). Numerous perfect mesenteries, most of which are fertile. Retractors of perfect mesenteries circumscribed-diffuse. Basilar muscle strong.

**Sphinctor.** (See Figure 10). Strong; circumscribed.

**Siphonoglyph.** Two; strong. Color, white to olivaceous, as in the actinopharynx.

**Reproduction.** Dioecious. Probably viviparous. Sections of gonad with ciliated larvae have been prepared on one occasion.

**Genus Evactis Verrill 1869a**

Acorhagi absent. Column with adhesive verrucae; rarely with pseudoacrorhagi; with cinclides. Outer tentacles longer than the inner ones. Sphinctor circumscribed, more
or less unequal bipinnate.

**Evaotis artemisia** (Dana 1849)

**Synonyms.** *Actinia artemisia* Dana 1849. *Evaotis artemisia* Verrill 1869a. For further synonomy see Carl-gren (1948).

The description and figures given by Dana (1849) suggest the anemone described in this thesis as *Bunodactis elegantissima* (See Plate II and VI) and not the anemone considered here (See Plate X).

**Distribution.** This anemone is found along the entire coast of Oregon. It is known from Alaska to Northern California.

**Habitat.** Occurs from upper littoral to sub-littoral on the open coast and in bays. This anemone is almost always found firmly attached in holes in rock with only the tentacles protruding. It attains a much larger size in the bays.

**Size.** Length 4 to 8 cm. Width at crown 5 to 6 cm.

**Cnidom.** (See Figure 12). Tentacles: spirocysts 18 to 20 x 2.5 µ; basitrichs 18 x 2.5 µ. Column: basitrichs 19 to 20 x 2.5 µ. Actinopharynx: basitrichs 25 to 30 x 2.5 µ. Filaments: basitrichs 25 to 40 x 2.5 to 4 µ; micro-basic p-mastigophors 25 x 4.5 µ.

**Tentacles.** (See Plate X). Medium length; simple;
hexamerously arranged; acuminate. Very little difference in length between the outer and inner cycles. Color, extremely variable ranging from almost transparent to translucent white, to pink, to rose, to orange, to deep wine-red, to almost black. These base colors are uniform for the individual and may be clear or covered on the adoral side with an imperfect overtone of olive-brown which produces striking markings of spots, bands or bars. The more vivid colors are usually clear. Carlgren (1948) states that the outer tentacles are longer than the inner. This has not been found to be true of the Oregon forms.

Disc. Simple, with broad area between mouth and base of tentacles. Color, olive to sepia with a whitish checkerboard pattern around the mouth and a white patch at the base of the inner cycle of tentacles.

Column. (See Plate X). Frequently elongate; with numerous adhesive verrucae arranged in longitudinal rows; more prominent distally. Broken shell usually adhering to the verrucae on the margin. No acrorhagi or pseudoacrorhagi present in specimens examined. Color, white at base becoming gray or brownish on the exposed margins.

Base. Strong. Color, white.

Mesenteries. (See Figure 14). Most mesenteries perfect and fertile. Two pairs of directives. Retractors circumscrip-diffuse; parietobasilar and basilar muscles
Fig. 12 Cnidom, *Evactis artemisia*

Fig. 13 Sphincter, *E. artemisia*

Fig. 14 Mesentery, *E. artemisia*
Sphincter. (See Figure 13). Circumscribed; strong.

Siphonoglyph. Two; strong. Color, white, except for a patch of bright phosphorescent-green at the corners of the mouth. This green patch seems to be constant for the species.

Reproduction. Dioecious. Viviparous. Many specimens were observed to shed sperm and ciliated larvae while in captivity. On several occasions ciliated larvae were also taken from the gonad.

Genus Epiactis Verrill 1869a


Epiactis prolifera Verrill 1869a

Synonyma. See Carlgren (1948).

Distribution. Common along the entire Oregon coast. This anemone is known to occur from British Columbia to Southern California.

Habitat. Attached firmly to rocks on the open coast. Occurs from upper littoral to sub-littoral.

Size. Length 1 to 3 cm. Width at crown 2 to 5 cm.

Chidom. (See Figure 15). Tentacles: spirocysts 35
to 40 x 4 \mu; basitrichs 32 x 2.5 to 3 \mu. Column: basitrichs 20 to 25 x 2.5 \mu; spirocysts 35 x 4 \mu. Actinopharynx: basitrichs 18 x 2.5 to 3 \mu; microbasic p-mastigophors 22 x 5 \mu; spirocysts 35 x 4 \mu. Filaments: microbasic p-mastigophors 18 x 5 \mu; basitrichs 18 to 32 x 2.5 to 3 \mu; spirocysts 35 x 4 \mu.

**Tentacles.** Short; simple; hexameroously arranged; acuminate. Color, translucent shades of dull green or pink with a white mark at the base of the inner tentacles.

**Disc.** Simple; with broad area between mouth and base of tentacles. Area about mouth elevated in expansion. Color, translucent dull green to bright pink with white lines marking the insertions of the primary mesenteries.

**Column.** Smooth; margin and fosse distinct; commonly with brood pits and young on limbus. Color, dull green to bright pink to dull, deep red marked with vertical red lines on limbus and margin. In the bright pink form vertical white lines extend the full length of the column.

**Base.** Strong; very broad. Color, the same as the column but without markings.

**Mesenteries.** (See Figures 17 and 18). At least 12 pairs perfect. All stronger mesenteries fertile. Retractors diffuse to circumscrip. Figures 17 and 18 represent mesenteries from two color phases, figure 17 being the green phase and figure 18, the red phase.
Fig. 15 Cnidom, *Epiactis prolifera*

Fig. 16 Sphincter, *Epiactis prolifera*

Mesenteries, *E. prolifera*
Fig. 17 (green) Fig. 18 (red)
**Sphincter.** (See Figure 16). Circumscribed; very strong.

**Siphonoglyph.** Two. Color, same as column and actinopharynx.

**Reproduction.** Dioecious. Oviparous. Young firmly attached in brood pits on limbus.

*Epiactis* sp. (probably a new species)

Herein described are two anemones very much alike in color and morphology but occurring in two decidedly different habitats. They are treated here as one species. The writer's realization of this anemone as a new species has been confirmed by Carlgren (personal correspondence).

**Distribution.** Fairly common on the Oregon coast from Astoria to Brookings.

**Habitat.** The southern form occurs intertidally on rocks of the open coast. The northern form occurs subtidally on rocks and epizoically on Pecten and Cancer.

**Size.** Length 3 to 4 cm. Width at crown 4 to 6 cm.

**Tentacles.** (See Plate XI). Short; simple; hexamerously arranged; acuminate. Color, translucent brick or earth red, unmarked except for a diffuse white patch at the base.

**Disc.** (See Plate XI). Simple, with broad area between mouth and base of tentacles. Area about mouth
Fig. 19 Sphincter, *Epiactis* sp. from Cape Blanco

Fig. 20 Mesentery, Blanco *Epiactis* sp.

Fig. 21 Sphincter, *Epiactis* sp. from Astoria

Fig. 22 Mesentery, Astoria *Epiactis* sp.
elevated in extension. Color, translucent brick or earth red with a white triangular patch at the base of the tentacles, becoming diffuse upon the tentacle. Insertions of mesenteries faintly visible.

**Column.** Smooth; margin and fosse distinct; without brood pits. Color, brick or earth red, becoming deeper on the limbus, which is marked with vertical light lines.

**Base.** Strong. Color, same as column.

**Mesenteries.** (See Figures 20 and 22). At least 12 pairs perfect. All stronger mesenteries fertile. Retractors strong, circumscribed-diffuse. Parietobasilar muscle strong.

**Sphincter.** (See Figures 19 and 21). Circumscribed; very strong.

**Siphonoglyph.** Two.

**Reproduction.** Dioecious. Viviparous. Rather large ciliated larvae carried in the coelenteron.

**Genus Tealia Gosse 1858**

Column with adhesive verrucae. Acrorhagi and pseudacrothagi absent. Fosse well developed. Sphincter strong, circumscribed. Numerous perfect mesenteries, usually the older pairs sterile.
Tealia felina (Linne 1767)

Synonyms. Actinia felina Linne 1767. Tealia felina Faurot 1895. For further synonymy see Gosse (1860), Stephenson (1935).

Distribution. Three varieties of the species, *T. felina*, as recognized by Stephenson (1935), are common on the Oregon Coast. The three varieties are known to occur from Alaska to Northern California. The species is boreal.

Habitat. Occurs from upper littoral to sub-littoral on the rocks of the open coast and bays.

Size. Length 8 to 15 cm. Width at crown 10 to 20 cm.

Gnidom. (See Figures 23 and 26). Tentacles: basitrichs 20 to 75 x 2.5 to 6 μ; spirocysts 25 to 35 x 2.5 to 3 μ. Column: basitrichs 17 to 20 x 2.5 μ; spirocysts 25 to 30 x 2.5 to 3 μ. Actinopharynx: basitrichs 50 to 75 x 5 to 6 μ; microbasic p-mastigophors 26 to 30 x 3 to 6 μ. Filaments: basitrichs 25 to 50 x 2.5 to 6 μ; microbasic p-mastigophors 26 to 30 x 5 to 6 μ.

Tentacles. Short; cylindrical; stout; acuminate to blunt.

Disc. Simple, with broad area between mouth and tentacles. Area about mouth elevated in expanded state.

Column. With adhesive verrucae, these sometimes weak. Acrorhagi and pseudoacrorhagi absent. Fosse well developed.

Base. Strong; capable of extreme adhesion to rocks.
Mesenteries. (See Figures 25, 28, 30). Numerous perfect mesenteries, older pairs usually sterile. Retractors strong, diffuse to circumscript, some band-like. Parietobasilar and basilar muscles strong.

Sphincter. (See Figures 24, 27, 29). Circumscript; strong.

Siphonoglyph. Two; strong.

Reproduction. Dioecious. Viviparous. Ciliated larvae were observed in two varieties, T.f. crassicornis and T.f. ooriacea. Specimens of T.f. lofotensis examined were sterile.

T. f. crassicornis

This anemone (See Plate VIII; Figures 23, 24, 25) is perhaps the most common variety of Tealia felina found on the Oregon coast. The outstanding characteristics of this anemone are its smooth, debris-free column and its coloration. The color of the column is grass-green, but many specimens exhibit irregular patches of bright red over the green. The color of the tentacles is usually a translucent pale green at the base becoming white at the tips, and with a rose colored band about the middle. The disc is green with rather broad bands of red marking the insertions of the mesenteries.
**T. f. coriacea**

*T. f. coriacea* (See Plate IX; Figures 26, 27, 28) is about as common as *T. f. crassicornis* in Oregon, but is more difficult to find because of its habit of living buried in gravel and shell under rocks. The column has well developed verrucae, especially on the margin, and is usually covered with adhering bits of shell and gravel. The color of the column is a uniform plum-red. The tentacles are smaller and thinner than those of the other two varieties but of about the same color and markings as those of *T. f. crassicornis*. The oral disc is the same color as the column or sepia with insertions of mesenteries faintly visible, and with a diffuse white patch at the base of the tentacles.

**T. f. lofotensis**

*T. f. lofotensis* (See Plate III; Figures 29, 30) is a common deep water form in Oregon but rarely occurs intertidally. The column is covered with numerous weak verrucae which are rarely adhesive. The color of this anemone is very variable; it occasionally resembles *T. f. coriacea*. The column may be colored white, straw-yellow, plum-red or a vivid scarlet, and the markings may be white or scarlet spots. The tentacles are larger than those of the
Fig. 23  Cnidom, *Tealia felina crassicornis*

Fig. 24  Sphincter, *T. f. crassicornis*

Fig. 25  Mesentery, *T. f. crassicornis*
Fig. 26 Cnidom, *Tealia felina coriacea*

Fig. 27 Sphincter, *T.f. coriacea*

Fig. 28 Mesentery, *T.f. coriacea*
Fig. 29 Sphincter, *Tealia felina lofotensis*

Fig. 30 Mesenteries, *Tealia felina lofotensis*
preceding two varieties. The color of the tentacles is the same as the column and unmarked. The oral disc is usually a deep sepia with mesenterial insertions faintly visible. The actinopharynx is the same color as the column. In the scarlet form the siphonoglyphs are pure white.

Family Metridiidae (Carlgren 1893)

Acontia present, with microbasic b-mastigophores and microbasic amastigophores, the latter sometimes rare or absent in adults. Sphincter mesogloea1. Mesenteries not divisible into macro- and microconemes.

Genus Metridium Oken 1815

Metridiidae with well developed base. Column divided into a distinct scapus and capitulum. Scapus with numerous cinolideae. Sphincter mesogloea1; found in the uppermost part of the scapus. Tentacles short and numerous. Oral disc deeply lobed in adults. Perfect mesenteries variable in number, typically 6 pairs but often more; the six primary pairs usually sterile. Retractors diffuse. Acontia well developed.

Metridium senile (Linneus 1767)

Synonyma. Actinia senilis Linneus 1767. Metridium
senile McMurrich 1911. For further synonymy see Gosse (1860), Stephenson (1935).

M. s. dianthus Oken 1815


Distribution. Common on Oregon coast. The species and probably the variety are boreal and circumpolar.

Habitat. Occurs subtidally and rarely intertidally; found attached to rocks and piling of the open coast and larger bays.

Size. Length 20 to 35 cm. Width at crown 8 to 12 cm.

Cnidom. Not adequately determined by writer.

Tentacles. (See Plate XII). Very numerous; short; slender; acuminate. Color, same general color as column.

Disc. Deeply lobed in older specimens; usually completely concealed by the numerous tentacles. Color, same as column.

Column. (See Plate XII). Column smooth; pillar-like in extension; distinctly divided into scapus and capitulum. Scapus with numerous cinclides. Color, white, pink, orange or sepia.

Base. Strong. Color, same as column.

Mesenteries. (See Figure 32). Variable in number; typically 6 pairs perfect but often more; the 6 primary pairs usually sterile. Retractors, circumscribed-diffuse,
band-like. Basilar muscle weak.

**Acontia.** Typical; freely emitted.

**Sphincter.** (See Figure 31). Mesogloeaal; in the uppermost part of the scapus; strong.

**Siphonoglyph.** Variable in number; usually one or two.

**Reproduction.** Sexual; dioecious; oviparous. Asexual by basal laceration, longitudinal fission.

M. s. fimbriatum Verrill 1865.

Unfortunately a good photograph of the anemone is not available for the thesis.

This form has been identified by Carlgren (personal correspondence) as M. s. fimbriatum. The writer is in agreement with Carlgren as to the genus and species but definitely opposes calling it var. fimbriatum. Verrill's (1865 and 1869) original descriptions of M. fimbriatum do not agree with the form considered here, but rather definitely suggest the anemone described in this thesis as Diadumene sp. (Plate XIII). Verrill's type specimens will have to be checked before such a correction can be made. However, in the event the writer's interpretation is correct, the Diadumene sp. in this thesis will become Diadumene fimbriatum, and the anemone whose description follows will probably become a new species of the genus Metridium.
Distribution. Found along the entire Oregon Coast. Uncommon. Known from Alaska to Northern California.

Habitat. Lower littoral to sub-littoral on the open coast. Occurs firmly attached in holes or to undersurfaces of rocks. The writer has never found this anemone in the bays.

Size. Length 5 to 15 mm. Width at crown 2 to 8 mm.

Cnidom. (See Figure 33). Tentacles: spirocysts 33 x 4 μ; microbasic amastigophors 14 x 4 μ; microbasic b-mastigophors 24 x 2.5 μ. Column: spirocysts 30 x 3.5 μ; basitrichs 12 to 77 x 2 to 3 μ. Acentaia: microbasic b-mastigophors 55 to 75 x 6 to 6.5 μ; microbasic amastigophors 67 x 6 μ.

Tentacles. About 80 or 90; medium length; slender; acuminate; fully retractile. Color, white to cream.

Disc. Simple; with a wide area between mouth and inner tentacles. Color, same as column but with a white flaky area around the mouth.

Column. Smooth; distinctly divided into scapus and capitulum; with numerous cinolides; barrel-shaped. Color, salmon-orange.

Base. Strong. Color, same as column.

Mesenteries. (See Figure 35). Six pairs perfect and usually sterile. Retractors restricted; circumscrip-diffuse.
Fig. 31 Sphinoter, *Metridium senile dianthus*

Fig. 32 Mesenteries, *Metridium senile dianthus*
Fig. 33 Cnidom, *M. senile fimbriatum*

Fig. 34 Sphincter, *M. s. fimbriatum*

Fig. 35 Mesentery, *M. s. fimbriatum*
Acontia. Typical; freely emitted.

Sphincter. (See Figure 34). Mesogloosal; in the uppermost part of the scapus; weak.

Siphonoglyph. Usually two.


Family Diadumenidae Stephenson 1920a

Acontia present, with basitrichs and microbasico p-mastigophors. No distinct sphincter. Some or all of the inner tentacles typically forming catch-tentacles provided with atrichs and holotrichs; sometimes, apparently, these special nematocysts are lacking in individuals of a species which does possess them.

Genus Diadumene Stephenson 1920a

Column smooth, divisible into scapus and capitulum. Basal disc well developed. Scapus with numerous cinclides. Margin of capitulum tentaculate. No distinct sphincter. Tentacles long; numerous; imperfectly retractile. Some or all inner tentacles thicker, forming catch-tentacles containing atrichs and holotrichs. Siphonoglyph and directives variable in number. Mesenteries, six or more pairs perfect; perfect and stronger imperfect ones fertile. Retractors circumscript-diffuse. Parietobasilar and basilar
muscles weak. Acontia well developed.

**Diadumene sp. (probably a new species)**

This anemone (See Plate XIII) in all probability is the same form described by Verrill (1865 and 1869) as *Metridium fimbriatum*. During the course of studying the Oregon anemones it was noticed that this species possessed catch-tentacles containing large atricha and holotrichs. At about the same time Mr. Cadet Hand, working on the shore anemones of California, also observed catch-tentacles in this species from California.

The presence of catch-tentacles containing atricha and holotrichs is not yet known to be constant for the family Diadumenidae, but if it proves to be so this anemone will belong to the genus Diadumene. However, the placing of this form in Diadumene is questionable as it has both a mesogloelal and endodermal sphincter.

**Distribution.** Found along the entire Oregon Coast. The form is known from Alaska to Southern California.

**Habitat.** Occurs intertidally and sub-tidally; in colonies firmly attached to rocks and piling in bays. The writer has never found this anemone on the open coast.

**Size.** Length 2 to 6 cm. Width at crown 2 to 4 cm.

**Chidom.** (See Figure 36). Outer tentacles: spirocysts 22 x 3 μ; basitrichs 17 to 18 x 2 μ; microbasic
amastigophors 22 x 3 μ. Catch-tentacles: atrichs 27 x 7 μ; spirocysts 14 x 3 μ; basitrichs 18 x 2.5 μ; microbasic amastigophors 19 to 20 x 3 μ. Column: microbasic p-mastigophors 20 to 62 x 2.5 to 3 μ; basitrichs 12 to 17 x 2.5 μ; microbasic amastigophors 12 to 25 x 2.5 to 4 μ; spirocysts 20 x 2.5 μ; atrichs 14 x 7 μ. Actinopharynx: microbasic p-mastigophors 20 x 2.5 to 3 μ; spirocysts 20 x 2.5 μ.

Acontia: basitrichs 30 to 57 x 3 to 5 μ; microbasic amastigophors 25 x 5 μ; microbasic p-mastigophors 12.5 x 2.5 μ.

**Tentacles.** Numerous; short (except for the catch-tentacles); acuminate. Color, white, orange or sepia.

**Disc.** Lobed in older specimens; area between mouth and tentacles narrow. Color, white, orange or sepia; sometimes with white flecks around mouth of colored forms.

**Column.** (See Plate XIII). Column smooth; divided into scapus and capitulum. Scapus with numerous oinclides. Margin of capitulum tentaculate. Color, white, orange or sepia.

**Base.** Strong. Color, same as column.

**Mesentaries.** (See Figure 33). Typically 6 pairs perfect, which may be fertile; arrangement irregular in specimens which have undergone asexual reproduction. Directives vary from 1 to 5. Retractors circumscrip-t-diffuse. Basilar muscle weak.
Fig. 36 Cnidom, *Diadumene* sp.

Fig. 37 Sphincter, *Diadumene* sp.  Fig. 38 Mesentery, *D*. sp.
**Acontia.** Typical; freely emitted. Filaments strong.

**Sphincter.** (See Figure 37). Apparently two. One mesogloeaal, weak; the second endodermal, circumscrip-diffuse.

**Siphonoglyph.** One to five present.

**Reproduction.** Sexual, dioecious, oviparous. Asexual, basal fragmentation and longitudinal fission.

**Family Aiptasiomorphidae Carlgren 1948**

Acontia present, with basitrichs and microbasic p-mas-tigophors. Sphincter, endodermal, weak or absent. Ten-tacles never with atrichs, holotrichs and macrobasic amas-tigophors.

**Genus Aiptasiomorpha Stephenson 1920**

Column divided into scapus and capitulum. With a distinct pedal disc. Margin of capitulum tentaculate. Cinolidees present. Sphincter, endodermal, weak or absent. Typically six pairs of perfect mesenteries which may be fertile. Number and arrangement of mesenteries very variable in forms with asexual reproduction. Siphonoglyph and pairs of directives varying from 1 to 5, and the number of pairsof perfect mesenteries at least from 5 to 12. Retractors more or less restricted.
**Aiptasiomorpha luciae** (Verrill 1899)

**Synonyms.** Sagartia luciae Verrill 1899. Aiptasiomorpha luciae Carlgren 1948. For further synonymy see Stephenson (1935).

**Distribution.** Found along the entire Oregon Coast. The species is known to occur from Japan and Alaska to Southern California.

**Habitat.** This anemone occurs abundantly on rocks, broken shell, piling and oysters in the larger bays of Oregon. The writer has never found this species on the open coast, although it may occur there.

**Size.** Length 1 to 3 cm. Width at crown 5 to 10 mm.

**Cnidom.** (See Figure 39). Tentacles: spirocysts 12 x 4 to 5 μ; microbasic p-mastigophores 20 to 22 x 2.5 to 3 μ; basitrichs 16 x 2.5 to 3 μ. Column: microbasic p-mastigophores 12.5 to 14 x 2.5 μ; basitrichs 14 x 2.5 μ. Acontia: microbasic amastigophore 12 to 35 x 3 to 5 μ; microbasic p-mastigophores 20 to 40 x 2 to 6 μ; basitrichs 11 to 17 x 2 μ; spirocysts 15 x 2.5 μ.

**Tentacles.** Long; slender; smooth; about 30 in number. Color, opaque white at base becoming translucent to clear at tip; some marked with white flecks on the adoral surface.

**Disc.** Simple; broad. Color, greenish; some with opaque white bands marking the inter-mesenterial areas.
Fig. 39 Cnidom, *Aiptasiomorpha luciae*

Fig. 40 Mesenteries, *Aiptasiomorpha luciae*
Column. (See Plate IV). Column smooth, divided into scapus and capitulum. Margin of capitulum tentaculate. Scapus with cinolides. Color of capitulum clear; scapus a dirty green to almost black, usually with 8 vertical bright orange stripes.


Mesenteries. (See Figure 40). Typically 6 pairs perfect which may be fertile. Retractors weak, diffuse.

Acontia. Typical; not abundant; reluctantly emitted. Filaments conspicuous in section.

Siphonoglyph. Varying from 1 to 5.

Sphincter. Absent.

Reproduction. Asexual, usually by basal laceration. May also be sexual.

SUMMARY

Literature published during the last 20 or 30 years on the marine fauna of the Pacific Coast has been consistently vague in regard to the group of animals known as the Anthozoa (sea anemones). Three probable reasons for this omission are: first, a general lack of interest in the group; second, biologists of the Pacific Coast are unfamiliar with these rather prominent animals because accurate identification of them requires lengthy histo-
logical examination; third, the literature of the Anthozoa is widespread and relatively unavailable.

As a contribution to an available and accurate source of information on the Oregon sea anemones, the present study is offered.

Collecting and investigation extended over a period of three years. Most of the collections were made in the vicinity of Coos Bay, but others were from Astoria, Tillamook, Newport, Cape Blanco and Brookings. Because of more favorable tides during the summer months, the most extensive collections were necessarily made then. The resulting list of anemones found on the Oregon beaches, although still incomplete, includes eleven species, at least two, and possibly four, of which are new.

Haloclavidae
   Pechia quinquescapitata

Haloampidae
   Haloampa duodecimcirata

Actiniidae
   Anthopleura xanthogrammica
   Bunodactis elegantissima
   Eucallis artemisia
   Epiactis prolifera
   Epiactis sp. (new)
   Tealia felina (3 varieties)

Metridiidae
   Metridium senile (2 varieties)

Diadumenidae
   Diadumene sp. (new)

Aiptasiomorphidae
   Aiptasio morpha luciae
The problem is only partially solved, for during this study several shore species that should occur on Oregon beaches were not found.

The subtidal forms are almost completely unknown for Oregon. The writer has had several opportunities to see, but not to examine, some of these deep water forms and is of the opinion that many will be found to be new to science.
BIBLIOGRAPHY


Bibliography continued


APPENDIX
EXPLANATION OF PLATES

Plate I  Haloampa duodecimoirrata, side view
Plate II  Bunodactis elegantissima, side view
Plate III  Tealia felina lofotensis, side view
Plate IV  Aiptasionomorpha luciae, side view
Plate V  Haloampa duodecimoirrata, oral view
Plate VI  Bunodactis elegantissima, oral view
Plate VII  Anthopleura xanthogrammica, side view
Plate VIII  Tealia felina crassicornis, side view
Plate IX  Tealia felina coriacea, side view
Plate X  Eucrustis artemisia, side view
Plate XI  Epiactis sp., from Cape Blanco, oral view
Plate XII  Metridium senile dianthus, side view
Plate XIII  Diadumene sp., side view