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The Templeton Crocker Expedition. XII. Sergestidae (Crustacea Decapoda) from the Lower Californian Region, with Descriptions of Two New Species and Some Remarks on the Organs of Pesta in *Sergestes*.¹

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(Text-figures 1-12).

[Note: This is the twelfth of a series of papers dealing with the specimens collected on the Twenty-fourth or Templeton Crocker Expedition of the Department of Tropical Research of the New York Zoological Society; William Beebe, Director. For data on dredges, localities, dates, etc., concerning the capture of specimens treated in this paper, refer to the present volume of *Zoologica*, No. 2, pp. 33 to 46.]

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INTRODUCTION.

Of the six sergestids included in the present collection, two appear to be undescribed species; while two others, named forms which seem to be limited to the American Pacific, have never been completely diagnosed. I am deeply indebted to Dr. Beebe for the privilege of examining this material.

¹Contribution No. 545, Department of Tropical Research, New York Zoological Society. Figures from camera lucida drawings by the author.

A list of sergestids recorded from the American Pacific but not included in the present collection is presented below:

1. *Sergestes inous* Faxon, 1893 and 1895; Hansen, 1919 (cf. Hansen, 1903, p. 69; and Illig, 1927, pp. 292-297). *S. profundus* Bate, 1888, p. 429, part (cf. Hansen, 1903, p. 69)?
2. *Sergestes edwardsii* Kroyer; Faxon, 1895, part (cf. p. 321 below. *S. oculatus* Kr., Faxon, 1895. *S. orientalis* Hansen, Cecchini, 1928?).
3. *Sergestes longispinus* Bate (the mastigopus of *S. cornutus* Kr. according to Hansen, 1922), Faxon, 1895.
4. *Sergestes longicollus* Bate, 1888, p. 422, part; Hansen, 1922, p. 92.
5. *Acetes binghami* Burkenroad, 1934.
6. *Lucifer orientalis* Hansen, Cecchini, 1928; Boone, 1930.

Sergestes H. M. Edwards.

In previous considerations of the genus, one set of structures of very considerable systematic importance has been neglected, namely the internal cephalothoracic organs briefly noted by Pesta, 1918 (quoted by Hansen, 1922, p. 21), in *S. corniculum*, *S. arcticus* and *S. vigilax*. As Pesta observes, the form of these structures [which may be termed the *organs of Pesta*] suggests for them a luminescent function; but whether this is actually the case I am unable to say inasmuch as varied manipulations of several living specimens of different species of *Sergestes* which possess the organs were not effective in inducing the production of light. If the organs are indeed luminescent, they seem to be the only ones known among crustacea which have been developed from endodermal tissue (cf. Dahlgren, 1916, p. 821: "They [rods of the photophores of euphausiids] thus stand, as one factor, in the evidence that these light cells . . . have, in common with most other light-cells, an ectodermal origin.")

The organs of Pesta seem from the study of dissections to be modified areas of the surface of the gastric gland (which is in almost all of the species of *Sergestes* a structure of relatively enormous size); these modified areas total altogether perhaps a tenth or twentieth of the bulk of the gland. The modified portions of the gland consist of groups of about 8 to 30 or more ventrally directed tubules, the terminal portions of which are constructed of a dense layer of columnar tissue bright Antwerp blue in color in the living animal. The dorsal, or more proximal, portions of the modified tubules are white and are more loosely constructed than the terminal parts, and merge (in the case of groups of modified tubules not pinched off from the body of the gastric gland) with tubules of more ordinary type, although tissue connected with the modified tubules seems to differ from that of the mass of the gastric gland by an increased density of granulation and in other ways. That part of the tunic of the gastric gland which covers the dorsal parts of the areas of modified tubules bears a dense layer of carmine chromatophores, and similar pigment surrounds the necks of the distal parts of the modified tubules themselves and lies between these tubules and the ordinary ones, so that each of the modified areas has in life the appearance of a fringe, cluster or spherule of blue (opaque yellow or white in preserved material) ellipsoidal bodies covered dorsally with a carmine cap and lying more or less near to or embedded in the translucent gastric gland.

The modified areas always include a pair at the anterior end of the gastric gland and almost completely separated from it, which seem the most highly developed of the organs. In addition to these there are always some modified tubules at the posterior end of the gland, variously organized as an undivided lateral and posterior fringe, a single posterior organ, a pair of posterolateral organs with or without an additional posteromedian area,

or even two posterolateral pairs plus an unpaired posteromedian one. The posterior organs also vary considerably from species to species in degree of consolidation. Finally, there may be an unpaired anteromedian area, and also a small pair of organs lying in the middle of the sides of the gastric gland. The modified areas or organs of Pesta of the anterior pair lie just above the dorsal wall of the branchial chamber, behind the dorsal end of the base of the mandible; and their ventrally directed uncapped surfaces are exposed to the exterior through the doubled but transparent integument overlying them. The organs at the posterior end of the gland are in part plainly exposed through the gap in the lateral musculature just above the branchial area of the thirteenth somite. The posteromedian, anteromedian, paired midlateral and anterior pair of posterolateral (when the posterolateral areas are subdivided) organs are however, when present, more or less invisible from the exterior (and were indeed overlooked by Pesta, who mentions only two pairs in *S. corniculum* which actually possesses ten distinct organs). The anteromedian area in particular, dorsally and posteriorly hooded by its pigment layer, faces through a layer of muscle into the densely pigmented posterior wall of the foregut.

Organs of Pesta appear to be present in all members of the genus other than the *S. mollis*, *S. tenuiremus*, *S. robustus* and *S. challengerii* super-species of Hansen's "Group I." In available specimens of these latter four groups (which include altogether about half, or sixteen species of the genus), no portion of the gastric gland seems to be conspicuously modified. In compensation, however, numerous small complex photophores occur in the dermal layer of *S. challengerii* and related forms; and in *S. robustus* and its close relatives there are numerous small simple subcuticular bodies (Illig, 1914, p. 354²; Hansen, 1919, p. 10; Sund, 1920, pp. 11, 15, 18; Hansen, 1922, p. 21; and below, p. 324) the appearance of which suggests a luminous function particularly in fresh-caught material where (*S. crassus* Sund taken in the Straits of Florida during a recent expedition of the Bingham Oceanographic Foundation) these bodies appear as lenticular transparent structures invested on their inner sides by a layer of vermilion pigment. Surficial and presumably ectodermal or mesodermal photophores of these types, which have no structural relation at all to the endodermal organs of Pesta, seem to be absent in all of the species in which the latter occur.

As regards the systematic significance of the organs of Pesta, aside from their value as specific or superspecific diagnostics (which is in practice reduced by the fact that their elucidation requires a certain amount of damage to the specimen) their greatest interest lies in the possibility that their presence or absence marks the genus off into two natural groups the members of which seem in many other features as well to display more resemblance to one another than they do to the members of the other group. Without detailing the evidence or venturing at this time to modify Hansen's system, it may be stated that the distribution of certain characters among the species equipped with the organs of Pesta suggests that enlargement of the third maxillipedes may possibly have occurred independently in two different stocks, so that the form of these appendages may perhaps not be so significant of degree of relationship as Hansen's method of subdivision of the genus implies.

A more extensive consideration of the matters introduced above may be deferred until an exhaustive review of *Sergestes* has been completed. As will be shown on a subsequent page, the characters heretofore relied upon for separation of *Sergestes* from *Petalidium* are not diagnostic, and the major as well as the minor features of relationship within the subfamily therefore seem to be in need of further study.

² Illig finds these bodies present in *S. robustus* Smith and in "*S. kroyeri* Bate." It is believed by Hansen, 1922, p. 91, that by *S. kroyeri* Illig refers to the *S. tenuiremus* Kr. of Hansen; however, no such rows of glandular patches seem to occur on the appendages of *S. tenuiremus*, and it would therefore appear that Illig refers, in part at least, to some other species.

Sergestes pestifer, sp. nov.

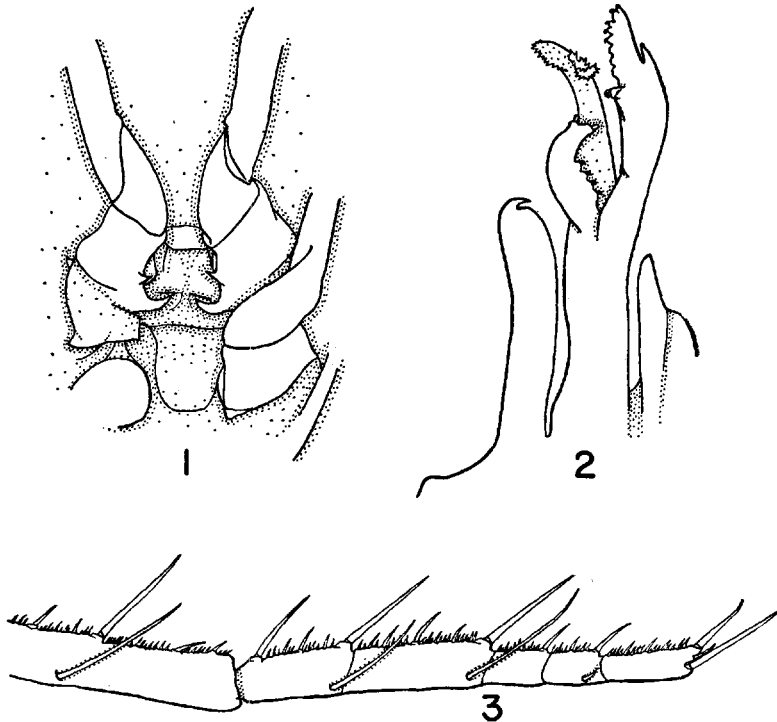
Text-figures 1-3.

Type: Holotype, Cat. No. 361,031, Department of Tropical Research, New York Zoological Society. Taken at Station 165 T-3; 20° 36' N. Lat., 115° 07' W. Long., 145 miles N. of Clarion Island, eastern Pacific; meter net at 500 fathoms; May 17, 1936. Paratype: Cat. No. 361,030, Station 130 T-1, 25° 17' N. Lat., 113° 25' W. Long., 68 m. WNW. of Cape San Lazaro, Lower California; meter net at 400 fathoms; March 28, 1936.

Range: Eastern Pacific off Lower California, the Cocos, and the Galápagos Islands. Midwater at levels of 400-600 fathoms or less, in depths of 500-2,000 fathoms.

Material: Two specimens were taken in the Pacific off Lower California in depths of 400-600 fathoms, as follows: Station 130: T-1 (1 ♂); Station 165: T-3 (1 ♀). Cat. Nos. 361,030, 361,031. Three males and three females from the collection of the Department of Tropical Research taken at *Arc-turus* stations 74 and 86 have also been examined.

Dimensions and Sexual Condition: Female, adult, with ripening ovaries, of carapace 9.5 mm., total length 28 mm. Male, adult, of carapace 7 mm., total length 22 mm.



Text-figures 1-3.

Sergestes pestifer, sp. nov. 1. Thelycum; adult ♀, TYPE, D. T. R. 361,030, x 18. 2. Petasma (left endopod, anterior view of distal part); adult ♂ TYPE, D. T. R. 361,031, x 37. 3. Third maxillipede (of the left side, median view of dactyl and distal part of propodus); as in 1, x 18.

Diagnosis: Organs of Pesta present, consisting of only five areas (a highly developed anterior pair almost completely isolated from the gastric gland; a well-developed ovoid posterior pair distinctly set off from the gland; and a small and less well differentiated posteromedian area). Supra-orbital and hepatic spines present; telson with only a single pair of dorso-lateral spinules, and with a terminal point. Distal article of antennular peduncle relatively long and slender in both sexes, although shorter than the basal segment. Third maxillipedes very long and basally much swollen; propodus much longer than dactyl and these two distal segments with many spines on one margin, a few only on the other; dactyl divided into five subsegments of which the inner margin of the ante-penultimate bears in males eight, in females eleven or twelve spines of all sizes. Ischium of the first and second legs with a spine on its outer margin; carpus of the first legs much shorter than the propodus; chelae of the second and third legs with fixed finger conspicuously shorter than the mobile one and palm with a longitudinal series of long setae; the two distal segments of the fifth legs setose on both margins. Ciliated portion of the external margin of the exopod of the uropods about one and one-half times as long as the unciliated part, and not separated from it by a tooth or spinule. Neck of the capitulum of the petasma long; processus uncinatus not reduced and with distal hook; processus ventralis not reduced and armed, in addition to a row of simple spinules, with one to three large stellate spines; lobus armatus curved medially and not extending to more than three-fifths the length of processus ventralis, its median margin armed with several hooked spinules; lobus terminalis bearing a small slender lobus internus closely applied to its median edge, and with the distal third of its lateral edge armed with a row of hooked spinules. The posteroproximal corner of the precoxa of the third legs of the females bears a conspicuous laterally directed spur; the coxa is armed on its posteromedian edge with two teeth, the distal of which is, although much smaller than the proximal, decidedly produced, so that the margin of the coxa proximal to it appears concave.

Remarks: *Sergestes pestifer* is very closely related to the *S. sargassi* Ortmann of Hansen, 1922, p. 148, and is distinguished from it only in a few minute but apparently rather constantly different details. In adults of *S. sargassi*, according to figures by Hansen and by Sund, 1920, p. 26, (sub *S. henseni* Ortmann) which are in agreement with North Atlantic specimens in the Bingham Oceanographic Collection, the inner margin of the antepenultimate subjoint of the dactyl of the third maxillipedes bears only four or five spines. Lobus armatus of the petasma reaches to two-thirds or more the length of processus ventralis; the latter bears five or more large stellate spinules; lobus terminalis is armed only with a single spinule at the tip, and lobus internus is relatively larger than in *S. pestifer* and divergent from lobus terminalis. The distal of the two pairs of projections arming the posteromedian edge of the coxa of the third legs of the female usually appears more like a sharp angle than a produced tooth, and the margin of the coxa proximal to it is more or less straight so that the portion of the margin lying between the tips of the two teeth often appears >-shaped rather than ⊃-shaped as in *S. pestifer*; the degree of development of the distal tooth in *S. sargassi* seems however to be somewhat variable. It may be noted that the supraorbital spines seem sometimes to be absent in *S. sargassi*.

The precise synonymy and the specific relationships of the *S. sargassi* group of species are in a state of some confusion, and it is particularly difficult to interpret the descriptions of Illig, 1927, of *S. pectinatus* Sund, *S. henseni* Ortmann, and *S. nudus* Illig (a form which as described for the second time, from adults, would seem to combine characters of the *S. edwardsii* with those of the *S. sargassi* superspecies in a very peculiar fashion). However, *S. pestifer* appears to be quite distinct from any of the material figured by Illig under these names. It seems possible that

the mastigopus of 7.8 mm. from north of the Galápagos, recorded as *Sergestes sargassi* Ortmann by Cecchini, 1928, p. 38, refers to *S. pestifer*.

No attention seems heretofore to have been bestowed upon the great resemblance in critical features of the *S. sargassi* to the *S. corniculum* superspecies, which is particularly marked as regards the peculiar form of the second and third chelae, as well as in the unique combination of various other characters. These two superspecies seem, indeed, to be distinguished from one another only as regards the form of the third maxillipedes, among characters of more than specific significance. In the present incomplete state of the resurvey of the genus, it appears possible that the *S. sargassi* superspecies and the *S. vigilax*, *S. edwardsi* superspecies may respectively be linked by way of the *S. corniculum* and the *S. atlanticus* to the *S. arcticus* superspecies, which last seems the nearest of all these forms to the group of superspecies which lacks the organs of Pesta.

Sergestes halia Faxon.

Text-figures 4, 5.

Sergestes halia, Faxon, 1893, p. 217.

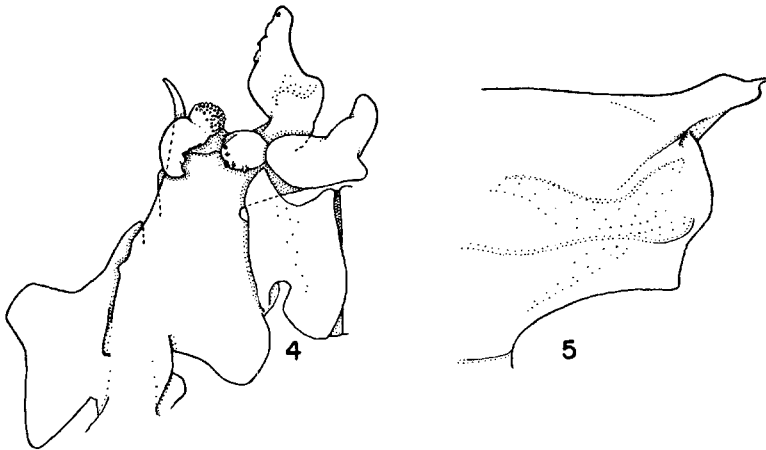
Sergestes edwardsi Kr., part, Faxon, 1895, p. 212.

Sergestes halia, Hansen, 1896, pp. 950, 960, 962.

Range: Gulf of Panama; off southeastern and southwestern Lower California. Midwater at levels above 300-500 fathoms.

Material: A total of 9 specimens (two being males) was taken off the southwest (Station 134) and the southeast (Stations 156, 158 and 159) coasts of Lower California, in 235 to 550 fathoms, as follows: Station 134: T-3 (1 ♂, 1 ♀); Station 156: D-2 (1 juvenile); Station 158: T-4 (2 ♀); Station 159: T-1 (2 ♀), T-2 (1 ♂), T-3 (1 ♀). Cat. Nos. 361,032, 361,033, 361,034, 361,035, 361,036, 361,037.

Dimensions and Sexual Condition: Females ranging in carapace length from 9.5 mm. to 15 mm., total length 25.5 mm. to 39 mm. Ripening ovaries are present in all of carapace 11 mm. or more. Males, adult, of carapace length 10 mm., total 28 mm. The juvenile specimen has a carapace length of 5.5 mm.



Text-figures 4 & 5.

Sergestes halia Faxon. 4. Petasma (left endopod, anterior view); adult ♂, D. T. R. 361,032, x 26. 5. Carapace (lateral view of anterior part); as in 4, x 13.

Remarks: In 1895 Faxon concluded that his *S. halia*, described in 1893, represented "large and mature individuals of *S. edwardsi*," especially as Kroyer had recorded a variety of that species with rostrum larger than the typical. Faxon therefore identified his three specimens of *S. halia* with other smaller individuals taken by the *Albatross* which he referred to *S. edwardsi* Kr. In 1896, Hansen pointed out (p. 947) that Kroyer's "variety" of *S. edwardsi* is a species (*S. diapontius* Bate, to which, indeed, Illig, 1914, p. 365, suggests that Faxon's species may refer) related to *S. vigilax* and quite distinct from the type; and he proposed (p. 963) to revive *S. halia*, as a valid species closely related to *S. armatus* Kr. of the *S. vigilax* group.

The present material of *S. halia* seems to differ from *S. armatus* (according to Atlantic specimens of the latter in the Bingham Oceanographic Collection and to the figures by Hansen, 1922) most conspicuously as regards the form of the anteroinferior corner of the carapace, which is almost rectangular in *S. halia* instead of gently rounded as in *S. armatus* and related forms. The anterior part of the ventral margin of the carapace is naked, not setose as in *S. armatus*. The fairly conspicuous tubercle of the distomedian edge of the ocular peduncle of *S. armatus* is hardly indicated in *S. halia*. The third maxillipede, uropodal exopod, thelycum of the female, and various other features of *S. halia* seem to differ only very slightly from these structures in *S. armatus*. The petasma of *S. halia* presents a few minute but characteristic differences from *S. armatus*; thus, the distal part of lobus internus of the capitulum of the petasma extends much higher than does lobus connectens in large specimens of *S. halia*, and lobus terminalis is mitten-shaped instead of finger-like; both of these features are indicated in somewhat exaggerated form in Faxon's Plate LI, figure le (sub "*S. edwardsii*"). Of other petasmal differences, the armature of lobus terminalis is more extensive in *S. halia* and is placed upon the latero- instead of medio-distal edge; and lobus connectens bears only six or eight spinules upon its anterior face which are more or less concentrated toward the lateral side, instead of a dozen distributed over the entire anterior face.

The juvenile specimen of the present collection, perhaps better termed a late mastigopus, has eyes of a pale chocolate color, and a rostrum stretched out into a long slender tip, nearly one-third as long as the carapace; otherwise it nearly resembles the adults.

Hansen, 1922, p. 188, remarks that "Les données de Faxon (1895) sur l'occurrence de *S. edwardsi* dans le Pacifique tropical oriental doivent être tenues pour extrêmement douteuses, surtout parce que le grand spécimen figuré par lui . . . doit appartenir à une espèce très différente mais encore inconnue." However, although the large specimens are indeed of another species, it seems probable that the smaller of the specimens recorded by Faxon as *S. edwardsii* are actually referable to this name inasmuch as, in sorting the *Arcturus* Sergestidae, a quantity of material which seems to pertain to *S. edwardsi* has been encountered.

***Sergestes similis* Hansen.**

Sergestes similis, Hansen, 1903, p. 60; Illig, 1927, p. 310.

Sergestes atlanticus H. M. E., Bate, 1888, p. 320, part.

Sergestes atlanticus Rathbun, 1904, p. 145, part.

Sergestes similis, Schmitt, 1921, p. 19.

? *Sergestes articus*, Cecchini, 1928, p. 33.

? *S. nasidentatus*, Bate, 1888, p. 398; Hansen, 1896, p. 957; 1903, p. 62.

Range: Pacific off western North America, including Gulf of California. South Atlantic off southwest Africa; Pacific off Japan. Midwater above 145-500 fathoms.

Material: A single specimen was taken in the Gulf of California off Tiburon Island, in 500 fathoms, as follows: *Station* 148: T-4 (1 ♀). *Cat.* No. 361,038.

Dimensions and Sexual Condition: The specimen is a juvenile female of carapace 6.1 mm., total length about 21.6 mm.

Remarks: As regards shape of rostrum and relative size of branchiae, the present specimen agrees very well with the Japanese type as described by Hansen, 1903. The anterodorsal margin of the carapace, below the post-orbital ridge, is however nearly vertical and slightly concave, much as in *S. arcticus* Kr.; a difference from the type perhaps due to the smaller size of the present individual. The genital structures are quite undeveloped.

According to Schmitt, 1921, the "*Sergestes atlanticus*" 40 to 52 mm. in length from Pacific America recorded by Rathbun, 1904, are referable to *S. similis*. Rathbun (p. 145) has synonymized with her "*S. atlanticus*" the *S. pacificus* described by Stimpson, 1860, p. 45, from an individual "1.25 poll." in length taken in the western North Pacific. Hansen, 1922, pp. 52-53, who has evidently overlooked Rathbun's record of the lengths of her specimens, tentatively accepts her determination and synonymy, remarking that "Stimpson . . . établit *S. pacificus* sur des spécimens . . . mesurant 1.25 inches, soit environ 33 mm.; les plus grands spécimens de *S. atlanticus* me paraissent être un peu plus petits, mais je ne puis trouver aucune différence réelle entre la très brève description de Stimpson et *S. atlanticus* . . . Les spécimens nommés par M. Rathbun . . . appartiennent certainement à la forme décrite par Stimpson." However, it seems to me improbable that *S. pacificus* was identical with the specimens described by Rathbun, and very possible that it does not refer to *S. atlanticus* either. Stimpson's description seems to exclude adult forms of all of the known species of *Sergestes* except *S. atlanticus* H. M. E. and *S. cornutus* Kroyer, since the third maxillipede of *S. pacificus* is not indicated to be enlarged; the lateral margin of the uropodal exopod is stated to bear a small tooth beyond its middle; and the third segment of the antennular peduncle is stated to be much longer than the second. It seems unlikely that the "dente praeorbitali" of Stimpson's description ("Carapax minus elongatus, rostro brevissimo conico resimo, et spina vel dente praeorbitali armatus; spina hepatica quam in *S. Frisii* magis posterior") refers to anything but a post-terminal rostral tooth (compare his description of *S. macrophthalmus*, "carapax spina hepatica et spina supra-orbitalis armatus . . . Rostrum brevissimum, resimium, apice antrorsum flexum;" and that of *Sergia remipes*, "carapax valde elongatus . . .; spine hepatica nulla. Rostrum minutum spiniforme, acutum, curvatum, dorso dente vel spina armatum."); this feature, then, would exclude *S. atlanticus*. The remaining species, *S. cornutus*, has been recorded by Hansen, 1922, p. 53, from a locality very near that where *S. pacificus* was taken. If Stimpson's unit of measurement, "poll.," is intended to mean *inch*, his specimen of *S. pacificus* would be much larger than any of *S. cornutus* (a species still smaller than *S. atlanticus*) heretofore recorded; it seems possible, however, that for *inch* Stimpson would have used the common equivalent *uncia*, a twelfth part; whereas *pollex* is an alternative form of *digitus*, the one-hundredth part of an "org." or fathom (a term also employed by Stimpson) and the sixteenth part of a foot. In this case, Stimpson's "poll." would be equivalent to 18.5 mm. instead of 25.4 mm., and the specimen of *S. pacificus* would have a length of about 23 mm. instead of 32 mm., a size not too far in excess of that which *S. cornutus* sometimes attains. It seems of interest to note that Faxon (1895, p. 214) records "*Sergestes longispinus* Bate," a name which according to Hansen is referable to the mastigopus of *S. cornutus*, from the eastern Pacific.

It is possible that *Sergestes longicaudatus* Stimpson, 1860, p. 46, a late mastigopus or juvenile "0.75 poll." in length (14 mm. or 19 mm., depending on whether by "poll." Stimpson means a twelfth or a sixteenth of a foot)

taken in the middle North Pacific, may refer to *S. similis*, but as its description might also apply to several other members of Hansen's "Group I" no decision can at present be reached.

It seems possible that the "*S. arcticus* Kroyer" recorded by Cecchini, 1928, p. 33, from off the coast of Chile may refer to the present species rather than to *S. arcticus*, but no description of the branchiae of these two juvenile males is offered. Cecchini's figure of the petasma of a specimen 25 mm. in length indicates the general form to be similar to that in *S. arcticus*. The genitalia of adults of *S. similis* from the eastern or western north Pacific have never been described.

***Sergestes phorcus* Faxon.**

Text-figures 6, 7.

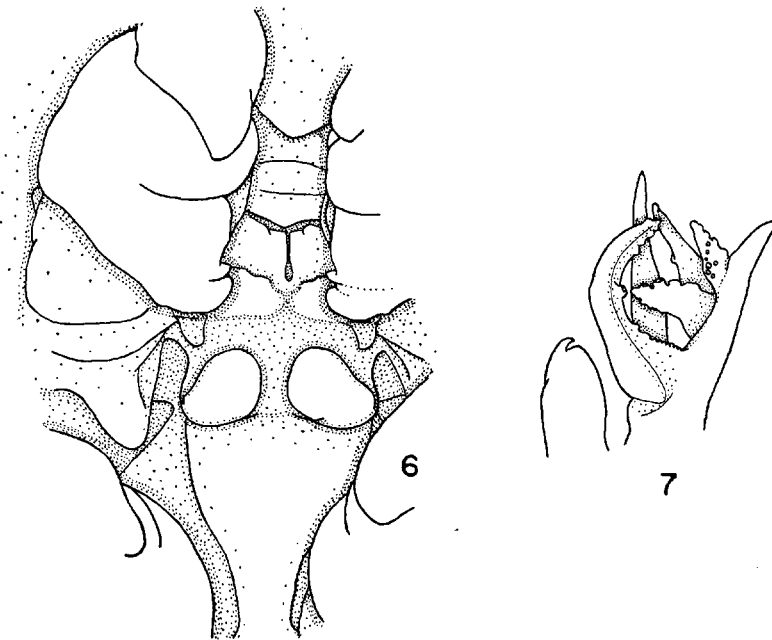
Sergestes phorcus, Faxon, 1893, p. 217.

Sergestes bisulcatus W. M., Faxon, 1895, p. 210.

Sergestes phorcus, Hansen, 1919, p. 5, part; Sund, 1920, p. 16; Hansen, 1922, p. 97; Boone, 1930, p. 121.

Range: Eastern Pacific off Galápagos Islands and Lower California; Gulf of Panama; Gulf of California. Midwater at levels above 242-550 fathoms in depths of 242-2,000 fathoms.

Material: A total of 4 specimens was taken in the Pacific off Lower California (Stations 134 and 165) and in the Gulf of California (Stations 139 and 148) in 300 to 550 fathoms, as follows: Station 134: T-3 (1 ♂



Text-figures 6 & 7.

Sergestes phorcus Faxon. **6.** Thelycum; adult ♀, D. T. R. 361,040, x 15. **7.** Petasma (left endopod, anterior view of distal part); adult ♂, D. T. R. 361,041, x 15.

juvenile); Station 139: T-4 (1 ♂); Station 148: T-6 (1 ♂ juvenile); Station 165: T-3 (1 ♀). Cat. Nos. 361,039, 361,040, 361,041, 361,042.

Dimensions and Sexual Condition: Female, adult with ripening ovaries, carapace 25 mm., total length 74 mm. Male adult, total length 57 mm.; juveniles, total length 29 mm.

Remarks: *Sergestes phorcus* is very closely related to *S. grandis* Sund, from which it seems to differ principally as regards petasma and thelycum. Differences in petasma have been fully described by Hansen, 1922, p. 97. The thelycum differs from that of *S. grandis* as figured by Hansen, 1922, plate V, fig. 3n, in that there is a sharply-cut transverse ridge, interrupted in the midline, just in advance of the posterior margin of the base of the third legs; and in that the portion of the twelfth sternite lying behind the level of the third legs bears a pair of subtriangular elevations which are quite well defined. The posteromedian corner of the coxa of the third legs of the female of *S. phorcus* bears a pair of blunt projections instead of a single tooth as in *S. grandis*.

In the present large female opaque patches similar to those which occur in other species of the *S. robustus* group and which are believed to be luminous organs are perceptible in considerable number. There is a row of ten of these patches along the inner margin of the antennal scale; two or three on the distal part of the exopod of the uropod, one at the base of the ischium in all five legs, one or two at the distal end of the ischium of the second and third legs, a row of seven in the merus of the first leg, of ten in the same joint of the third leg, and one patch in the base of the merus of the fourth leg.³ There appear also to be less readily distinguished patches of the same sort on other parts of the body, as on the ventral surface of the sixth pleonic somite, on the sides of the pleon, between the pleopods, and on the precoxae of the pereionic legs. The patches are less numerous and less well-defined in the smaller specimens, but appear to occur in all.

***Petalidium* Bate.**

Petalidium, Bate, 1881, p. 194; Hansen, 1922, p. 189.

Petalidium has in the past been considered to differ from *Sergestes* mainly in the smaller number and lesser degree of ramification of its gills and in the bifurcation of the processus ventralis of its petasma. However, in a Pacific American species described below which must undoubtedly be considered congeneric with *Petalidium foliaceum* Bate and *P. obesum* (Kroyer), the number of gills is the same as in *Sergestes*. The gills of the ventral series (the anterior arthrobranchs, after Burkenroad, 1937, p. 510), although with fewer rami and lamellae in the new *Petalidium* than in the least developed species of *Sergestes*, are yet considerably more richly branched in the new species than in the two species of *Petalidium* which have been previously described. The petasma of the new species is, most unfortunately, unknown; but it may be observed that in view of the slight but distinct subdivision of processus ventralis in *Sergestes mollis* Smith, described by Hansen himself (1922, p. 78), it is doubtful whether this feature can be considered as a clear generic distinction.

Although it seems best for the present to retain the accepted generic grouping (thus, Gurney, 1924, p. 95, finds the larvae of the two genera to differ), a re-evaluation of the relationship of *Petalidium* to *Sergestes* is undoubtedly required. Characters by which *Petalidium* may be distinguished from the *Sergestes mollis* superspecies are detailed on p. 327 below.

³ The occurrence of these patches on the legs of species of the *S. robustus* group, which has not been previously reported in print, was pointed out to me by Dr. F. A. Chace, Jr., of the Museum of Comparative Zoology.

***Petalidium suspiriosum*, sp. nov.**

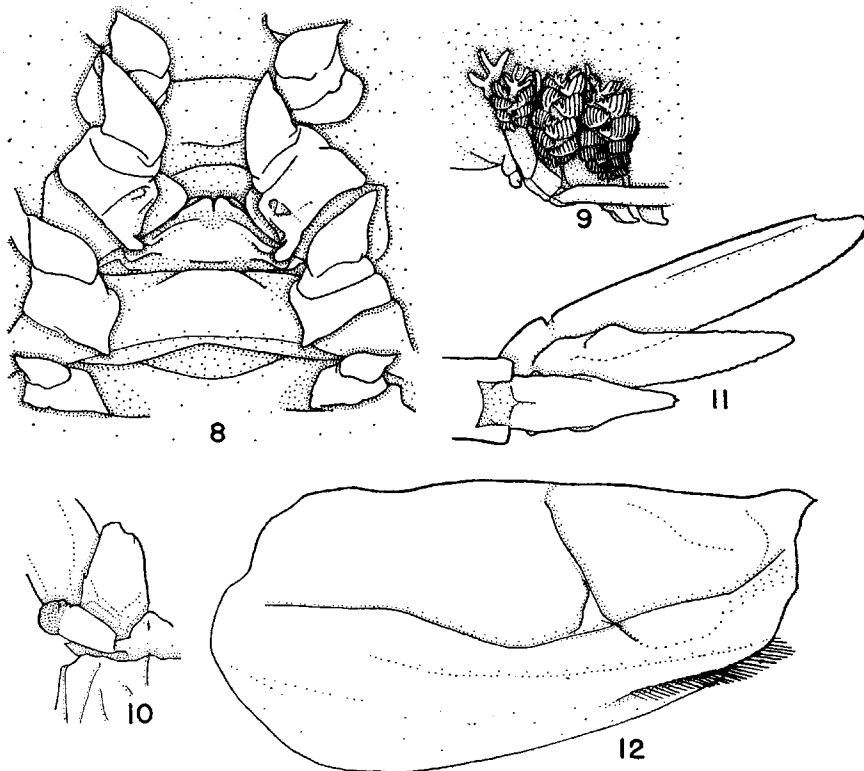
Text-figures 1-6.

Range: Definitely known only from the type locality in the eastern Pacific off Mexico, midwater at a level above 500 fathoms. Possibly off San Diego, California, depth 417 fathoms ("*Sergestes* sp. indet.," Rathbun, 1904, p. 146).

Material: A total of two specimens, both females, was taken 145 miles north of Clarion Island, Revillagigedo Islands, in 500 fathoms, as follows: Station 165: T-3 (2 ♀). Cat. No. 361,043.

Dimensions and Sexual Condition: Larger female apparently adult but with undeveloped ovaries, carapace 12 mm., total length 36.5 mm. Subadult female, carapace 8 mm., total length 26 mm.

Diagnosis: A podobranch and an arthrobranchial lamella are present on the eighth somite. An anterior arthrobranch, of up to thirteen rami placed alternately along the petiole, each of which may bear up to as many as twelve lamellae; and a lamella representing the posterior arthrobranch are present on somites IX, X, XI, and XII. A well developed anterior arthro-



Text-figures 8-12.

Petalidium suspiriosum, sp. nov. 8. Thelycum; adult ♀, TYPE, D. T. R. 361,043, x 13. 9. Branchiae (of somites XI-XIII); as in 8, x 6. 10. Eye (of left side, dorsal view); as in 8, x 6. 11. Telson and uropod (of left side, dorsal view); as in 8, x 6. 12. Carapace (lateral view); as in 8, x 6.

branch consisting of nine rami bearing up to six lamellae each, and a small posterior arthrobranch of three rami of several lamellae each, are present on XIII.

The cervical sulcus is very distinct and is continued across the dorsum of the carapace although not here accompanied by the sharp carina marginal to it on the sides of the carapace. The cardiaco-branchial carina (and its anterior continuation, the antennal carina) is well developed. A minute hepatic spine is present. The postorbital carina is very weak and is unarmed. The rostrum is very short and fairly high with a pointed tip. It bears a rudimentary dorsal tooth in the smaller specimen. The telson narrows abruptly to a small terminal spine flanked by a pair of fixed lateral teeth. The integument is membranous, smooth and shining, without reticulated pattern save that produced by subcuticular tissues in the antennal scales and uropods.

The cornea of the eyes is about one and one-half times wider than long; there is a well-developed tubercle at the base of the cornea on the inner side of the peduncle, and a minute projection further proximally. The distal segments of the antennular peduncles, the tips of the antennal scales, the third maxillipedes, and the legs except the fourth pair in the larger specimen, are all missing. The exopod of the uropod is a little less than five times as long as wide; the ciliated part of its external margin is somewhat less than one-sixth the length of the margin, and is separated from the unciliated part by a well-developed tooth.

The thelycum lacks an operculum; the medially incised posterior lip of the receptacular atrium thus overlies the anterior lip instead of being overlain by it.

Color in Formalin: Cornea of eyes pale chocolate-brown with dark internal area; median lobe of ocular somite with a black fleck. Mouthparts carmine with golden-brown setae; stomach and oesophagus deep carmine; leg-bases and ridges of pereionic sternites pale vermilion. Gastric gland cream-colored. Otherwise white (transparent-translucent in life?). The extreme oiliness of the gastric gland seems worthy of mention.

Remarks: *Petalidium suspiriosum* appears to differ from all other described material of the genus in that the rami of the anterior arthrobranches of IX-XII may bear as many as twelve lamellae, instead of "généralement cinq ou six par série" (Hansen, 1922, p. 189); and particularly in that there are two gills instead of one on XIII, of which the anterior is large and well developed rather than "rudimentaire ou rien."

P. suspiriosum differs further from *P. obesum* Kr. as described by Hansen, 1922, in the following particulars: In *P. obesum* the integument is stated to be "en outre réticulé;" the cervical sulcus is scarcely visible; both supra-orbital and hepatic spines are absent; there is no second tubercle proximal to the well-developed one at the distal end of the inner margin of the ocular peduncle; and the lips of the receptacular atrium of the female are covered by a well-developed operculum with convex posterior outline. It may be noted that in the lack of an operculum the thelycum of *Petalidium suspiriosum* resembles that of *Sicyonella* and of *Acetes* (Burkenroad, 1937, p. 509).

With regard to the other named species of the genus, *P. foliaceum* Bate, the available information is somewhat fragmentary and is so contradictory as perhaps even to indicate the existence of still another species of *Petalidium*. According to Bate, 1888, p. 349, Hansen, 1903, p. 54, and Illig, 1914, p. 373, the thirteenth somite lacks a gill completely in the eight adult or subadult specimens of *Petalidium* examined by these authors, all of which had been captured in subantarctic waters. Hansen, 1903, suggests that certain larval specimens of *Petalidium* including the type of *Sergestes obesum* Kroyer, in which the rudiment of a gill is present on XIII, may represent a species distinct from the adults then known in which this gill is always

absent; subsequently, Hansen (1922, p. 193) finds frequently but not always "une branchie rudimentaire" on XIII among twenty specimens taken in the temperate or tropical North Atlantic which he consequently distinguishes from *P. foliaceum* under the name *P. obesum* (Kroyer). Unfortunately, Hansen characterizes *P. foliaceum* only with the somewhat indefinite remarks that by reason of the absence of the rudimentary gill of XIII in some individuals of *P. obesum*, the presence only of this rudiment "peut compter comme caractère spécifique positif;" and that the figures of the petasma of subantarctic specimens, presumably of *P. foliaceum*, by Illig, 1914, and Stebbing, 1914, are in substantial agreement each with the other but different from Hansen's own figures of *P. obesum* "par plusieurs particularités".

Since the publication of Hansen's discussion, Illig, 1927, p. 283, has published a figure of the petasma of a specimen of *Petalidium* taken in the South Atlantic not far north of the previous records of *P. foliaceum*, which agrees very well with Hansen's figures of *P. obesum*. Illig, who seems not to have been aware of Hansen's later studies, and who does not discuss the branchial or carapacic characters of this particular male, reports his specimen as *P. foliaceum* without remarking that the petasma differs from that which he had previously figured under the same name. This difference between two figures referred by their author to the same species seems a good demonstration that two forms of petasma actually occur in the material of *Petalidium* previously known. The chief difference between these two forms of petasma seems to be that the distal, posterior lobule of lobus armatus of pars media is in *P. obesum* much smaller and less heavily armed than is the proximal, anterior lobule; whereas in *P. foliaceum* the distal, posterior lobule is the larger and more heavily armed of the two branches.

According to Bate, and to Hansen, 1903, p. 55, the *Challenger* specimens of *P. foliaceum* have neither hepatic nor supraorbital spines; the cervical sulcus is well developed; and the ocular peduncle sometimes bears two tubercles on its inner margin. According to Illig, 1914, the carapace of his specimens of *Petalidium*, which from his figure of the petasma seem referable to *P. foliaceum*, bears a well-developed cervical sulcus and (in contrast to Bate's and Hansen's specimens) both hepatic and supra-orbital spines; the ocular peduncle has two tubercles on its inner margin. Stebbing's description (1914, p. 284) of a specimen which by its petasma seems referable to *P. foliaceum* takes no account of the carapacic features or of the branchial formula, but his undetailed figure seems to indicate a well-developed cervical sulcus, and he states that the ocular peduncle bears two tubercles.

The above contradictory or incomplete accounts of *Petalidium foliaceum* seem to require, in the absence of information as to the female genitalia of this species or of the petasma of *P. suspiriosum*, that the distinction of these two forms must for the present rest entirely upon the difference in branchiae, which however seems so great (XIII with two gills in *P. suspiriosum*; without any in *P. foliaceum*) as to provide an excellent diagnostic.

Petalidium suspiriosum displays considerable superficial resemblance to *Sergestes mollis* Smith and *S. inous* Faxon, from which, however, it can instantly be distinguished by the quite different appearance of its anterior arthrobranches which are composed of fewer but larger rami, by the presence of an hepatic spine on the sides of its carapace, by the absence of more than one pair of lateral spinules on its telson, by its shorter but larger eyes with distomedially tuberculate peduncle, etc.

It seems possible that "*Sergestes* sp. indet." of Rathbun, 1904, p. 146, and Schmitt, 1921, p. 20, a female of about 38 mm. taken in 417 fathoms off San Diego, California, may refer to *Petalidium*. The extreme mutilation of the specimen, which is "without maxillipeds or trunk-legs," and which "resembles *S. mollis* Smith" but possesses "a minute hepatic spine," is suggestive of the present species.

LUCIFER Thompson.

Lucifer typus H. M. Edwards.

Leucifer typus, H. M. Edwards, 1837, p. 469.

Lucifer typus, Hansen, 1919, p. 53; Cecchini, 1928.

? *Lucifer ancestra*, Faxon, 1895, p. 214.

Range: Atlantic; Indo-Pacific; eastern North Pacific including Gulf of California. Surface (and midwater?).

Material: Two specimens were taken in the mouth of the Gulf of California, in 400 fathoms, as follows: Station 159: T-2 (2 ♂). Cat. No. 361,044.

Dimensions and Sexual Condition: Both specimens are sexually mature males measuring about 9.6 mm. in total length.

Remarks: No differences from Hansen's description are perceptible. It seems worth remarking that the scarlet spherule which occurs in the telson of *L. typus* and *L. faxoni* Borradaile of the genus at least, seems from the dissection of formalin material to be not a simple pigment spot but a ball of cells invested with a tunic of chromatophores.

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