PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

issued by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 108 Washington : 1958 No. 3398

A REVIEW OF THE COPEPOD GENUS RIDGEWAYIA (CALANOIDA) WITH DESCRIPTIONS OF NEW SPECIES FROM THE DRY TORTUGAS, FLORIDA

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The calanoid copepods discussed herein represent a small number of incompletely known, closely allied species for which three generic names have been proposed. To this list are added two new species from collections made among the keys of the Dry Tortugas, Florida, by Mr. Clarence Shoemaker of the United States National Museum in the course of an amphipod survey of that region (Shoemaker, 1933, 1956). The debris washed from rocks and corraline algae taken at very shallow depths of a few inches to a few feet has yielded not only amphipods but other Crustacea among which were many small copepods. These included mostly Harpacticoida and Cyclopoida characteristic of such a habitat, but some Calanoida were also present. Among these were adults of the two new species and a few subadult males of an unknown species that are herein assigned to the genus *Ridgewayia*.

This rather unusual genus has been known since 1903 when Thompson and Scott described the female of *R. typica* from Ceylon. Since then, closely allied species have been described as the types of new genera without comment on their obvious relationship to *Ridgewayia*.

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Through a study of literature and comparison of descriptions with the Tortugas material, it is apparent that *Lampoidopus marki* Esterly from Bermuda and *Suezia canalis* Gurney from the Suez Canal are very closely allied to *Ridgewayia typica.* Of these species, only *marki* is known from both sexes, and has been listed in literature beyond the original record. Only the female of *typica* has been described; *canalis* is known only from the male. A single male specimen, representing either an unknown species or the male of *typica,* has been briefly described from Madras as *Suezia* sp. by Krishnaswamy (1953). Both this Madras male and that of *canalis* are relatable to the female of *Ridgewayia typica* through knowledge of both sexes of *marki* and the new Tortugas species. On the basis of present knowledge, there seems little justification for maintaining three generic names for this small group of species, and they are all herein referred to *Ridgewayia* (*R. typica, R. marki,* and *R. canalis*).

Specimens of only the new species have been available for study. The specific diagnoses included here are all based upon the original descriptions (text and figures); note is made of characters omitted in these descriptions.

Generic synonymy

The results of study of the literature and of the available specimens do not permit an absolute, unqualified synonymy of the generic names that have been proposed. Therefore this study is presented with the recognition and suggestion that *Lampoidopus* and *Suezia* may with increased knowledge be fully and satisfactorily separable generically from *Ridgewayia.* That this is not now possible is due largely to the fact that in *Ridgewayia* and *Suezia* only the one sex is known. If I were presenting a paper dealing only with literature, or with specimens of the same sexes as were originally available for the described species, it would seem sufficient to point out the hitherto unsuspected relationship of *Ridgewayia typica, Lampoidopus marki* and *Suezia canalis.* Since, however, there exists the primary problem of placing two new species as accurately as possible, it has been necessary to consider critically the question of whether there is any valid objective reason for not placing them in the genus of prior date.

The generic diagnosis given for *Ridgewayia* by Thompson and Scott (1903) confused the exopod and endopod of the antenna, and gave no information for the third leg of *typica.* It is also possible that the presence of an inner seta on the first basipod segments of legs 1 and 2 may have been overlooked. It is doubtful if the setation shown in the figure of the antennule is entirely exact. Otherwise the description is complete and accompanied by excellent figures. It affords therefore an adequate basis of support for inclusion in the genus *Ridgewayia* of the females of the new Tortugas species and of Esterly's

(1911) Bermuda species *marki*. Among calanoids, the modification of the female fifth leg is distinctive for these species. That of *R. typica* differs from that of the three American species only in having a shorter inner apical spine on the third exopod segment. This and other differentiating characters are either interpretable as specific, or concern structural features that have been sketchily presented, or could have been overlooked. These characters and features are pointed out in the specific diagnoses and discussion.

When the similarity of the basic characters is considered, it does not seem possible to me that there is any choice other than to refer the Tortugas material to *Ridgewayia*. It seems inconceivable that Esterly would have erected a new genus for his Bermuda specimens had he been aware of and considered the description of *R. typica*. Since the male of *typica* is still unknown, there exists no more justification for the genus *Lampoidopus* today than there did in 1911. Gurney (1927) appears to have been unaware of Esterly's paper, since he failed to point out not only the similarity of his Suez Canal specimens with the males described by Esterly, but in the same paper he named a new species of *Pseudocyclops* without noting its striking similarity to *P. magnus* described in Esterly's Bermuda paper. It also seems inconceivable that if Gurney had referred in his study to both Esterly's and Thompson and Scott's papers that he would have failed to note the relationship of his specimens to *Ridgewayia*, as shown through Esterly's description of both sexes. Krishnaswamy also makes no mention of *Ridgewayia* or of *Lampoidopus*. Thus, all the authors who have reported species of this group since the original description of *Ridgewayia typica* have failed to relate their material to it. Sewell (1929, 1932, 1948), in summaries of copepods of Indian waters, has not included *R. typica*, although *Suezia* is mentioned. The genus *Ridgewayia* has therefore in effect become buried in the literature.

The generic diagnosis given herein for *Ridgewayia* is a composite of the characters of both sexes of all the known species. It is detailed, contains exceptions and alternatives, and points out wherein knowledge is not complete for some species. Such a diagnosis is intended to form a working basis for the present report and also to be useful in future studies. In searching for the characters that indicate relationship of a group of calanoid species to one another, either on the generic or familial level, it is necessary to consider every appendage. In the species dealt with here, the evidence for their very close relationship is found in all appendages. Particularly noteworthy is the correlation of all oral appendages, the maxilliped and the first and fifth legs. The characteristics of these appendages in large groups may define a family, but they are also highly pertinent at the generic level in the Calanoida. It remains for future studies and accurate, detailed knowledge of both sexes of all the species to determine whether we are dealing here with more than one genus. Most of the differences that have been found to exist on the basis of literature, need, in my opinion, to be verified by further examination of specimens.

The determination of the proper generic status of all these species is primarily dependent upon knowledge of the male of *typica*. Its discovery should serve to differentiate *Ridgewayia* and *Lampoidopus* if they are truly generically distinct. It may or may not solve the status of *Suezia canalis,* which may be further dependent upon knowledge of the female and reexamination of the male. The two new Tortugas species would be referable to *Lampoidopus* if it is established as a separate genus.

Subclass COPEPODA

Order CALANOIDA

Genus *Ridgewayia* Thompson and A. Scott

Ridgewayia Thompson and A. Scott, 1903, p. 245.
Lampoidopus Esterly, 1911, p. 219, new synonym.
Suezia Gurney, 1927, p. 457, new synonym.

Diagnosis (emended): Species small, approximate range of length between 0.6 and 1.0 mm.

Metasome stout, 5–6-segmented, the somite of leg 1 distinctly or indistinctly separated, or fused with cephalic segment.

Urosome less than half the length of metasome, 3–4-segmented in female; if present, the fourth segment reduced to width of caudal rami; 4–5-segmented in male, fifth segment, if present, reduced as in female. Paired genital openings of female closely set (known only for the new species). Caudal rami longer than wide, with four terminal setae longer than rami, of these the second from the inner the longest (an outer spine also present in *marki* and in the new species).

Rostrum downturned, broad at base, rounded or pointed distally; filaments lacking.

Cephalic appendages all of primitive calanoid type, without reduction, excessive modification, or sexual differentiation.

Antennule reaching from near end of metasome to caudal rami; 25–26-segmented in female (21–22-segmented in *canalis*?); the three apical segments elongate. Left antennule male like that of female (where known); the right of 21–24 segments, with a moderately developed geniculation, segmentation beyond this specialized joint varying from three to four segments (geniculation reportedly not present in *canalis* and *Ridgewayia* sp. (Madras)).

Antenna: Outer ramus a little longer than inner, 7–8-segmented, only the apical segment elongate. Inner ramus 2-segmented, the first segment longer than the second, bearing 1–2 lateral setae; the second with terminal portion expanded into two setiferous lobes, the outer produced beyond the inner.

Mandible: Masticatory blade not conspicuously expanded, produced or grooved, with about 7–10 shallowly incised teeth not separated by any large gaps. Palp with broad, unsegmented basipod bearing 3–4 lateral setae. Exopod 4-segmented, the two distal segments more or less defined. Endopod 2-segmented, with numerous apical setae.

Maxillule (unknown for *canalis*): Basal portion well developed, with indistinct segmentation or none; its greater proximal part consisting of an expanded inner lobe (gnathobase) bearing short, spiniform setae; outer portion an unexpanded setiferous plate with 9–10 mostly elongate setae. Distad to this outer plate a reduced lobe (epipodite) bearing (in the new species) a single seta (no seta shown in illustrations for *typica, marki*). Inner side beyond gnathobase with two narrow laciniae, each bearing 4–5 setae. Beyond these laciniae, the basis elongated and produced on inner proximal side into setiferous lobe. Endopod attached just outside this lobe, 2-segmented (apical segment not shown as separated in *marki*); proximal segment greatly enlarged with several (6–8) lateral setae; apical segment reduced, with 5–6 setae. Exopod rather well developed, arising from the basis nearly opposite the inner laciniae (clearly separated in the new species, but not shown as demarcated in *marki, typica*), with lateral and apical groups of setae (exopod entirely unsegmented in *typica* and in the new species, but apex shown as demarcated in *marki*).

Maxilla: The whole equal to or a little longer than the basal segment of the maxilliped, with three broad primary divisions expanded into small setiferous lobes, and a reduced terminal portion which may or may not be distinctly separated or segmented. Lobes 5–7 in number, of which 1–3 are on the proximal division; the other two divisions each with two lobes. Setae of lobes long and slender, none conspicuously more developed than the others.

Maxilliped: Not conspicuously enlarged, but its length 3–4 times greater than that of the maxilla and longer than the first leg. The basipod of 2–3 segments (a proximal, nonsetiferous segment not shown in figures of other species, but present in the new species); second segment with four lobes or groups of setae. Endopod shorter than total basipod, of five well-defined segments; intercalated between it and basipod an incompletely separated segment bearing two setae.

Legs 1–4 slender, with narrow connecting pieces; biramous, both rami 3-segmented. Inner seta on basipod segment 2 of leg 1. (Information on setae of basipods otherwise incomplete in literature; the new species and *marki* have inner setae on both basipod segments of leg 1, and on basipod 1 of legs 2–4; legs 3 and 4 entirely unknown for *canalis;* leg 3 unknown for *typica.*) Exopod segments 1 and 2 with one outer spine and inner seta. Exopod segment 3, total number of outer and terminal spines (so far as known): three on legs 1 and 2, four on legs 3 and 4; these spines mostly without serrations or membranes; total number of inner setae: four on leg 1; five on legs 2–4. Endopod segment 1 with one inner seta on all legs; endopod segment 2 with two setae on legs 1 and 2, and on leg 3 where known; one or two setae on leg 4. Endopod segment 3, total of six setae on leg 1; eight on leg 2; five to eight on leg 3; six or seven on leg 4. Most of the setae divided into two joints, consisting of a stiff basal cylinder and a longer, flexible distal part, densely plumose.

Leg 5 of female showing only slight specific differences, slender, symmetrical, with well-developed 3-segmented exopod and reduced 2-segmented endopod. Exopod modified; segment 3 constricted basally and set into narrowed, well-defined socket of segment 2; the outer, distal spine-bearing portion of segment 2 enlarged and considerably produced beyond this insertion. Exopod segment 3 with four spines and four inner marginal setae. Endopod segment 1 reduced, without inner seta. Endopod segment 2 at least twice the length of first segment and usually longer; with seven setae (two outer, two apical, three inner). All setae with jointed bases.

Leg 5 of male: Right and left basipod segment 1 fused or with definable connecting plate. Both rami modified and strongly asymmetrical. Right exopod 2-segmented, sometimes with imperfectly separated apex; second segment tending to elongation, with two outer marginal spines, or with one proximal spine and more distally placed spinous points; the segmental portion beyond proximal spine narrowed and more or less incurved. Left exopod 3-segmented, or third segment not entirely separated from second (as in Gurney's figure for *canalis*); the whole third segment or apical portion considerably modified, with a short but stout basal portion from which may extend spines, complex ornamented processes and fragmented membranes of irregular length. Endopods unsegmented; the right elongate, nearly as long as or longer than exopod; the left much shorter than the right (tending to be about half as long or less); either endopod entirely unarmed, or with setae, spines or processes.

TYPE SPECIES: *Ridgewayia typica.*

Ridgewayia typica Thompson and A. Scott

Ridgewayia typica Thompson and A. Scott, 1903, p. 245, pl. 1, figs. 1–13.

DIAGNOSIS (after Thompson and Scott): *Female:* Length about 0.85 mm. Metasome of six well-defined segments, the somite of leg 1 clearly separated; ventral margin of last segment deeply incised and showing in lateral view a hooklike process. Rostrum broad and pointed. Urosome 4-segmented; genital segment with distal hooklike process on right side. Caudal ramus twice as long as broad, with four long apical setae (details unknown). Antennule reaching to near end of metasome, 25-segmented. Antenna, exopod 8-segmented. Maxilla with seven well-developed setiferous lobes, of which three belong to basal division.

Leg 1 (from figure): Exopod 2, outer distal part with inner, narrow, serrate process about half length of outer spine. Inner apical spine of exopod 3 nearly as long as total exopod (about 17:20). For armature of legs 1–4, see under "Discussion" (p. 168).

Leg 5: Exopod 3 with all four spines shorter than segment, the innermost apical spine of about same length as outer apical spine. Endopod 2, first inner seta placed above middle of segment, at point about 23 percent of total length of segment; first outer seta at point about 54 percent of length of segment.

Male: Unknown.

DISTRIBUTION: Ceylon, from the Muttuvaratu pearl oyster washings.

Ridgewayia sp. (Madras)

Suezia sp., Krishnaswamy, 1953, p. 127, figs. 7–9.

This reference is to a brief description of a single, damaged male specimen found in plankton collected on the Madras coast of India. The record is particularly interesting because it is from the same geographic region as *R. typica*, and raises the question of whether it may represent the unknown male of that species. Unfortunately, the description given is too incomplete to allow for any decision other than the relationship traceable through the species in which both sexes are known.

The textual description is brief and so may be repeated here exactly as given (with correction of obvious printing errors). "*Size:* Male 0.679 mm. *Colour:* Formalin fixed specimens appear yellow. *Salient features:* General body shape cyclopiform. The last thoracic segment with a small projection. The basal 2 of the endopod of first leg with a curved spine. Antennule not prehensile. Fifth leg highly modified and biramous."

Under "Remarks" there is a short comparison with Gurney's figures of the fifth leg of *Suezia canalis:* ". . . the left leg resembles Gurney's figures exactly while the right exopod differs from it in the second joint being shorter."

One of the figures given is of the last thoracic segment, and shows a spinous point somewhat similar to that of *typica,* but smaller. The other figures are of the first and fifth legs. Both call for comments on detail of structure.

In the figure of the first leg, both spines and processes are solidly inked, so that they cannot be distinguished from one another. The exopod would have the same number of spines as in the other species, if distinction had been made between the processes and spines. The long inner apical spine of exopod 3 is shorter than that shown for *typica*, being equal to the length of the third segment plus about half of segment 2, and may thus indicate that the two are not conspecific. In both the text and the figure there is some confusion as regards the distinction between the produced inner portion of the second basipod segment and the endopod. The text refers to the spine of the "basal 2 of the endopod." Obviously the spine referred to belongs to the second basipod segment and not to the endopod; it appears to be similar to the stout, curved seta of the other species. No inner setae are shown on endopod segments 1 and 2; this is probably due to incomplete delineation rather than actual lack of setae. Endopod segment 3 differs from all the other species in that there is a stout apical spine in the position of the spinous process, though because all processes and spines are solidly inked, the actual nature is not determinable from the illustration. There seem to be five inner setae, but these are somewhat indefinitely portrayed.

The structure of the fifth leg is for the most part clear from the figure. As further pointed out in the discussion (p. 171), the left exopod is relatable to the American species and is not identical to that of *canalis*. The important characteristics of the leg are: Right and left basipods about equal in length; the first segments not fused; left segment 2 with inner seta. Right second exopod segment only little longer than first, with one prominent, proximally placed outer marginal spine; beyond this spine the margin with a pair of closely set points beyond which the segment is abruptly shortened, narrowed, and inwardly directed. Right endopod reaching beyond exopod, with three inner marginal setae. Left exopod shortened but 3-segmented, not reaching to end of right exopod; segments 1 and 2 with prominent outer spines about as long as total exopod and closely set to one another; exopod segment 3 reduced (detail not shown in figure). Left endopod reaching to end of exopod, unarmed.

There is little doubt that this Madras specimen represents a different species from *canalis* or from any other in which males are known. Its occurrence near the type locality of *typica* makes it imperative that consideration be given to the possibility that it may be the male of that species. This point may or may not be establishable from a complete comparison of appendages.

Ridgewayia canalis (Gurney), new combination

Suezia canalis Gurney, 1927, p. 457, fig. 109.

DIAGNOSIS (after Gurney): *Female:* Unknown. *Male:* Length (2 specimens), 0.72, 0.74 mm. Body form "cyclopoid," metasome 6-segmented, lateral wing of last segment with small, backwardly directed tooth. Rostrum pointed. Urosome 4-segmented, fifth segment said to be "scarcely distinct."

Antennule reaching to about end of metasome; segmentation said to be "indistinct," of 21 or 22 segments; the right not prehensile. (No direct reference made to left antennule.) Exopod of antenna 7-segmented. Mandible palp as for genus. Maxillule undescribed. Maxilla shorter than segment 1 of maxilliped; with five inner setiferous lobes, of which one belongs to basal division; apical portion of two segments. Maxilliped as for genus (setae of basal segment appear to be incompletely shown in illustration).

Leg 1 (from fig. 109F): No inner seta shown on basipod 1; present on basipod 2. Exopods 1 and 2, outer margin with distal, serrate process, that of second segment about half length of outer spine. Exopod 3, inner apical spine shorter than segments 2+3, about 14:18. Endopod 1, outer margin with stout, partially separated lobe (as in new Tortugas species). Spines and setae as given for the genus.

Leg 2 with inner seta on basipod segment 1; setation of exopods and endopod as given for the genus (see also p. 169).

Legs 3 and 4 unknown, except that the rami are 3-segmented and the exopod spines lack hyaline membranes.

Leg 5 (from fig. 109H,I): No spines or setae shown on basipods; first basipod segments at least partially separated by connecting plate; right and left basipods of nearly equal length. Right exopod 2, outer margin with one spine set near proximal fourth of segment, the inner margin incised at this point and the segment narrowed and tapered, forming an incurved prolongation; outer margin with two minute spinous points at middle and near tip of segment. Left leg shorter than right. Outer spine of exopod 1 reaching to near end of leg, evenly tapered, with wide, serrated fringe. Exopod 2 produced into stout lateral spinous point inside of which is a modified spine ornamented with outer hyaline flange and inner basal process (comparable to outer spine of other species?). Inside this modified spine, a shorter produced portion of the segment shown as partially separated on the anterior side, divided into an outer, seemingly flattened structure with bifid tip, and an unmodified segmental inner portion (this appears to represent a reduced third segment, less complex in structure and armature than that of the other species). Endopods modified as in other species of the genus. The right elongate, reaching to near end of exopod, inner margin with four short, thick setae disposed along its length, the distal the largest and armed marginally with a hyaline flange. Left endopod much shorter than right, but nearly as long as the shortened left exopod, its outer distal margin with two short lobed processes.

DISTRIBUTION: Suez Canal. Original record from two specimens, taken in separate plankton collections at night, from Kabret and Ismailia.

REMARKS: Since only the female of *Ridgewayia typica* and the male of *R. canalis* are known, the question of their possible conspecificity has been considered in this study. It has been concluded from the following differences in the first leg and the cephalic appendages, exclusive of the antennule, that *R. canalis* is a distinct species and does not represent the male of *R. typica*:

ANTENNA: Endopod 8-segmented in *typica*, 7-segmented in *canalis;* last segment with 3 apical setae in *typica*, with 4 in *canalis*.

MAXILLA: Seven lobes in *typica*, of which three belong to the basal division; five lobes in *canalis*, of which one belongs to the basal division.

LEG 1: Exopod segment 1 without distal process on outer margin in *typica*, with process in *canalis*. Apical inner spine of exopod segment 3 longer than last two segments in *typica*, shorter in *canalis*.

These characters have been taken from illustrations given in the descriptions of the two species. The characters are easily determined for the antenna and maxilla, and it is probable, unless immature specimens were originally studied, that examination of the species when again collected will show them to be as given. With the exception of the spine length, the characters of the first leg need most careful study from an advantageous view. Mere comparison of the figures may not necessarily give exact detail of the armature of the exopods. All of these differences should also help in identifying the female of *canalis*.

Ridgewayia marki (Esterly), new combination

Lampoidopus marki Esterly, 1911, p. 219, pl. 1, fig. 4; pl. 2, figs. 13, 14, 20, 21; pl. 3, figs. 25, 26, 28–31, 34; pl. 4, figs. 35, 38, 42.—Pinney, 1933, p. 142.

DIAGNOSIS (after Esterly): Length of both sexes about 1.0 mm. Metasome 5-segmented, somite of leg 1 fused with cephalic segment. Rostrum broad and rounded at apex. Urosome female 3-segmented; male 4-segmented; caudal rami about 3.5 times as long as broad in both sexes. (See also p. 162.)

Antennules reaching to end of caudal rami; female and left male 25-segmented. Right antennule male geniculate, 23-segmented, "terminal portion 4-jointed." Antenna, exopod 8-segmented. Maxilla with six well-developed lobes and unsegmented apical portion; basal division with two lobes.

Leg 1 (from fig. 42): Exopod 2, outer distal part with flattened, serrate process, a slender spine (or process?) between it and outer spine, both shorter than outer spine. Inner apical spine of exopod 3 a little longer than exopod 2+3, equal to about 75 percent of total exopod length. (See p. 168 for detail of setal armature of legs 1–4.)

Leg 5, female: Exopod 3 with the three outer spines shorter than segment; inner apical spine subequal to segment and about twice the length of outer apical spine; basal joints of all inner setae reaching beyond point of insertion of succeeding seta. Endopod segment 2, first inner seta placed a little above middle, at point about 44 percent of total length of segment; first outer seta placed below middle of segment, at point about 69 percent of total length of segment.

Leg 5, male (rami separated in Esterly's illustrations, and the basal segments of left leg incompletely shown; not possible to judge relative length of left and right sides): Right exopod, outer spine of segment 1 reaching to about middle of segment 2; tip of exopod 2 truncated, without lappet or partial division, with two outer spines, relative length of segment and first and second spines about 38:20:15. Left exopod 3-segmented; segment 1 with long, narrow, setiform outer spine that reaches a little beyond the second segment. Second segment about twice the length of and much broader than first segment, its outer distal spine stout basally, tapered apically, its length only little more than half that of segment. Segment 3, membranes and processes elongated, length from base to tip exceeding that of segment 2 and reaching far beyond end of its outer spine. Endopods unarmed; the right elongate, club-shaped, reaching to beyond middle of last segment; the left shorter, length about twice its own width, reaching to near end of exopod 2.

Distribution: Bermuda Islands. In cave on small ledge-like island across from Agar's Island, at high tide (Esterly); in night plankton haul in Grasmere Cove, near shores of Bermuda (Pinney).

Ridgewayia gracilis, new species

Figures 1–27

Specimens examined: 31 females, 40 males. Vicinity of Loggerhead and Bush Keys, Dry Tortugas, off the southwestern coast of Florida, July 23–Aug. 12, 1926, Clarence R. Shoemaker.

Types: Holotype female (alcoholic) USNM 99511; allotype male (alcoholic) USNM 99512. Paratype specimens (slides and alcoholic) in U. S. National Museum collections.

DIAGNOSTIC CHARACTERS: Urosome female 4-segmented, male 5-segmented; the two middle caudal setae jointed basally. Antennules, female and left male, 26-segmented; segments 13–22 with partial rows of spinules. Right antennule male 23-segmented, with three segments beyond geniculation; segment preceding geniculation with distal longitudinal comblike row of spinules. Maxilla with six lobes, two on basal division. Total number setae, endopod 3, legs 1–4: 6, 8, 8, 7. Leg 1, inner apical spine of exopod 3 subequal to segments 2+3. Leg 5 female, inner apical spine of exopod 3 longer than outer spine, about as long as segment. Leg 5 male, right exopod 2, first outer spine about twice the length of second spine; left exopod 3-segmented, outer spine of segment 2 reaching beyond segment 3; left endopod with movable basal process as long as the endopod.

FEMALE

Length, dorsal midline, 0.83–0.90 mm.; the greater number of specimens 0.86–0.87 mm.

Body slender and of distinct calanoid shape. (In a few specimens, the fore part is curved downwards so that the body does not have the usual erect appearance shown in fig. 2. Although the normal flexibility of the body segments or effect of the preservative might account for some of this, there is a real though small difference in the amount of the curvature of the fore part of the body in individual specimens.) Metasome 2.7–3 times the length of the urosome, with its greatest width at beginning of second segment; 6-segmented, the division between the cephalic segment and that of leg 1 not so distinct as those of the other segments. Cephalic segment, in dorsal view, rounded anteriorly and tapered sharply outwards so that beyond the middle the segment is nearly as wide as the second segment; its length, in midline, a little greater than that of the other segments combined. Length of segment 2 a little less than that of segments 3 and 4 together (relative lengths, segments 2–4: 35:20:20). Segments 2–5 with lateral, apically acute, hyaline flanges. Last segment not expanded laterally, in dorsal view the "wings" narrowed and slightly pointed; in lateral view, the wings show on the inner edge, three notches bearing minute hairs, the notch nearest the outer edge the largest and easily visible, the others seen only at high magnification (fig. 3).

Urosome (fig. 1) 4-segmented, the genital segment the longest; the fourth segment very short, reduced to the width of the caudal rami, with which it is more or less fused medially, but clearly distinct outwardly. Relative lengths of the segments and rami (dorsal):

1	*2*	*3*	*4*	*CR*
28	13	10	4	16

Surface of all segments and of caudal rami, both dorsally and ventrally, covered by irregular groups of minute spinulose scales (not illustrated). Segments with nonserrate, inconspicuous fringe; second and third segments with a prominent proximal sclerotization on each side (fig. 1).

In lateral view, the genital segment appearing rounded and only a little produced ventrally. External portion of the genital field simple (fig. 8), more or less defined by a cuticular sclerotization which is heavier in the posterior area; the distal half with a crosswise, asymmetrical opercular flap drawn out on the right side into a pointed process; the slit formed by the flap noticeable in lateral view (fig. 2); when turned semilaterally, the process of the right side prominent. Paired genital openings set close together, rather large, filling most of the area defined by the external sclerotization (outlines visible with oil immersion objectives, but structurally indistinct).

Caudal ramus with its inner portion somewhat expanded proximally; the distal inner margin armed with fine hairs. In most specimens the rami a little divergent, but parallel in some specimens and closely set so that the inner expansions of the basal part cross over one another (the rami thus apparently with a somewhat flexible attachment).

Caudal setae consisting of an outer, subterminal spine shorter than the ramus, and four long, plumose, terminal setae, the outer of which is shorter than and the inner subequal to the urosome. The two middle setae with thickened, jointed bases; both longer than the urosome; the innermost of these two setae the longer, jointed secondarily near its distal third and without hairs beyond this joint. A short seta with very long marginal hairs inserted dorsally between the bases of the innermost setae. Ventrally, two flat spinules overlying the bases of the setae (fig. 7).

Rostrum (fig. 4) of the broad form characteristic of the genus, not demarcated at base, tapered to a rounded point. A pair of minute frontal hairs present above the base of the rostrum.

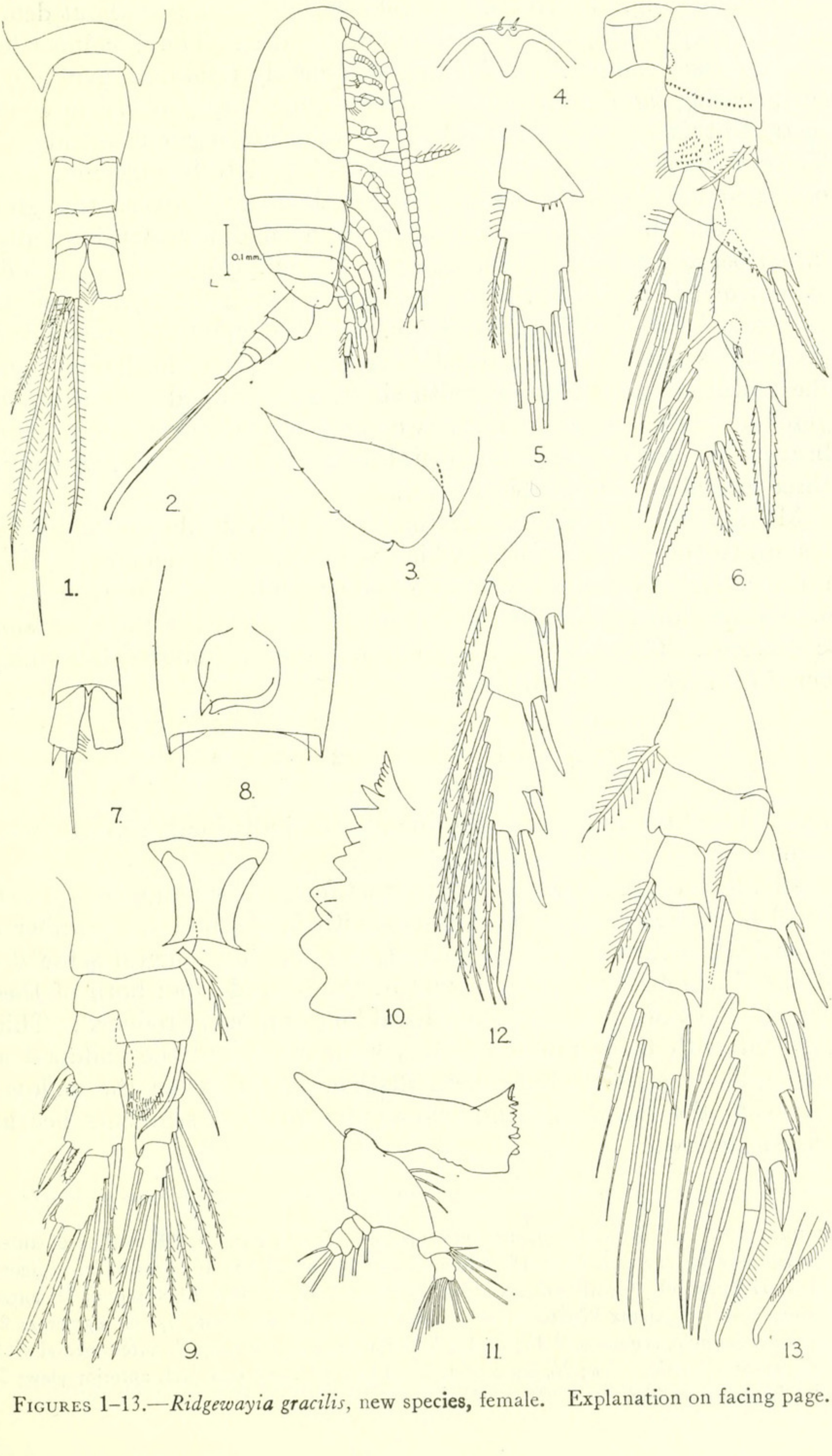
Antennule reaching to about the end of the metasome; comprised of 26 clearly defined segments (fig. 14). The two proximal segments subequal in length to one another (fig. 16), wider and longer than most of the succeeding segments except the four apical segments, which are progressively narrowed and lengthened (fig. 21). Two setae on every segment except segments 1, 21, and 22 which have only one each, segment 2 which has four setae, and segment 26 which has one lateral and five terminal setae. On many segments, particularly in the midportion of the antennule, the proximal seta short and hairlike. Elongate setae (reaching at least beyond the succeeding four segments) on segments 4, 8, 10, 13, and 22; the longest of these on segment 4 (reaching to segment 12) and on segment 22 (reaching to end of antennule; fig. 21). Some of the setae of apical segments modified by division into one or more joints (fig. 21). Aesthetes present on most of the segments, stouter than the setae and of uniform width throughout their length; those of the proximal segments (fig. 16) stouter than those beyond the midportion of the antennule; the longest that on segment 10 (reaching to the middle of segment 15). Segments 13–22 and 24–25 with small groups of surface spinules (figs. 15 and 21). Summary of setation of individual segments as follows (s=seta; a=aesthete):

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
s	4s	2s	2s	2s	2s	2s	2s	2s	2s	2s	2s	2s	2s	2s
a	a		a	a	a	a	a	a	a		a	a	a	a
		16	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*		
		2s	2s	2s	2s	2s	s	s	2s	2s	2s	6s		
		a	a			a				a		a		

Antenna (fig. 20) with basipod of two well-defined segments, the proximal with a plumose inner seta, the distal with two unarmed setae. Exopod reaching beyond inner ramus by about half the length of its apical segment; 8-segmented, the first seven segments differing little in length from one another, but progressively narrowed from the basal segment, each with a single inner seta; apical segment about 3 times the length of the other segments and with four terminally placed setae. Endopod of two stoutly developed segments, the apical (measured to end of outer lobe) about three-fourths the length of the first; two setae at distal inner third of first segment; inner lobe of second segment with eight setae graduated in length from outer to inner edge; the outer lobe with four setae.

Apex of mandible blade (fig. 11) only slightly expanded and with shallowly incised teeth (fig. 10). Palp with expanded basipod armed with three inner setae; the four segments of exopod well defined, the proximal three with inner seta, the apical with three setae of which the outer is much shorter than the others; first segment of endopod shorter and broader than the apical, with four inner, distally placed setae; apical segment of endopod with two groups of terminal setae, six in the outer group and three in the inner.

Figures 1–13.—*Ridgewayia gracilis,* new species, female: 1, Distal part of metasome and urosome, dorsal; 2, habitus, lateral; 3, detail of metasomal wing, lateral; 4, outline of rostrum, ventral, with frontal hairs; 5, leg 5, detail of endopod; 6, leg 5; 7, distal part of urosome and caudal rami, ventral; 8, genital segment, ventral, with detail of operculum; 9, leg 1; 10, detail of edge of mandible blade; 11, mandible blade, with palp; 12, leg 2, exopod; 13, leg 4, with detail of marginal armature of inner apical spine.



FIGURES 1–13.—*Ridgewayia gracilis*, new species, female. Explanation on facing page.

Maxillule (fig. 17) with well-developed basipod but without definable lines separating segments from one another. The first inner lobe (gnathobase) comparatively large, prominently produced, oval in outline, bearing eight stout spines and five subapically placed setae. Just distal to this lobe two narrow laciniae, each bearing four apical setae. The proximal outer portion an unexpanded plate bearing nine setae, of which the distal six are greatly lengthened. Between this group of setae and the basal attachment of the exopod, a protrusion (epipodite?) bearing a single setae. Exopod and endopod borne on the distal narrowed portion of the basipod, which has its inner part produced as a small lobe bearing four setae. The endopod 2-segmented; its proximal segment comparatively enlarged, with eight lateral setae; the apical segment reduced, with six setae. Exopod constricted beyond its middle so as to form two setiferous portions, the proximal bearing five lateral setae; the distal somewhat expanded and bearing three lateral and three apical setae.

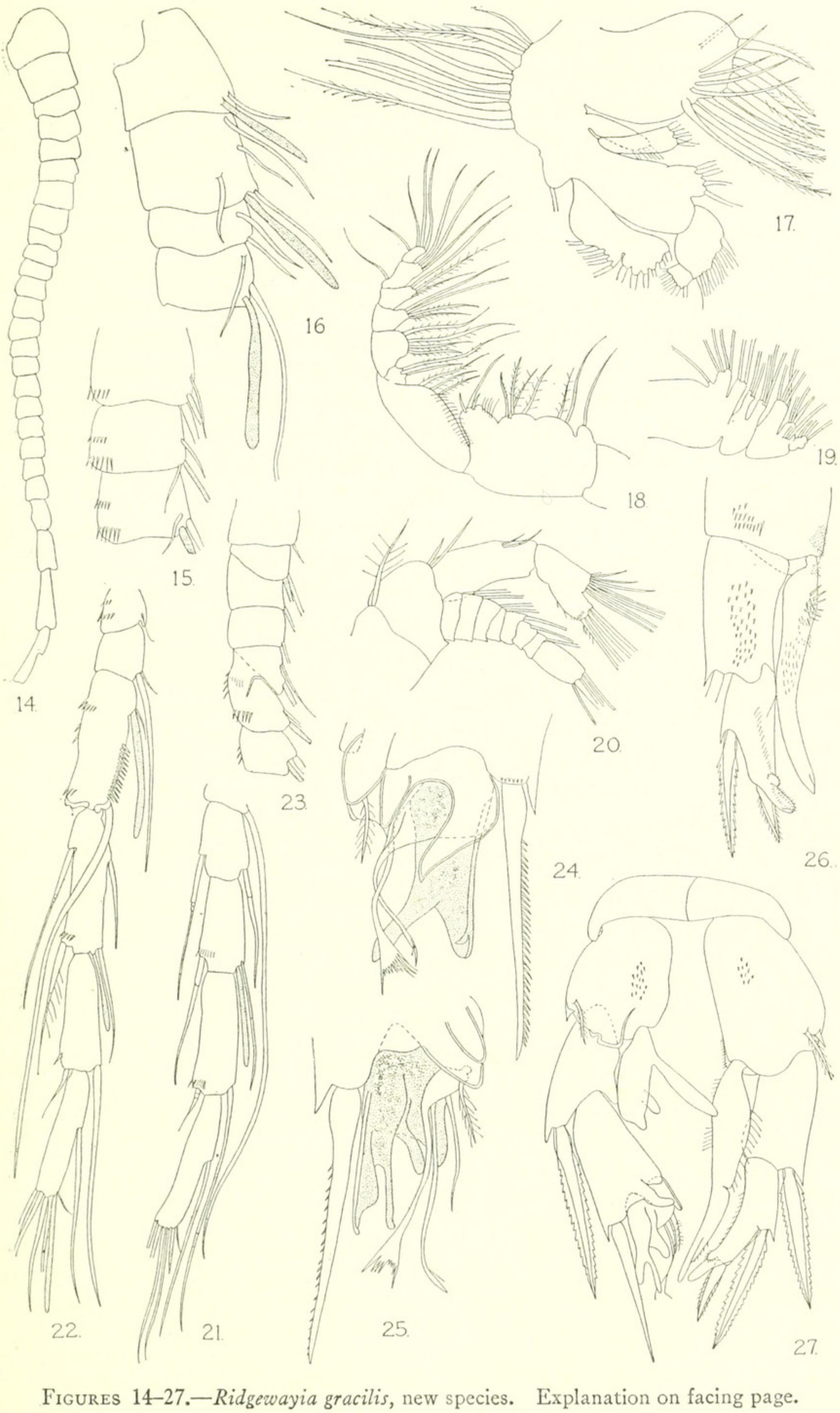
Maxilla (fig. 19) with six distinctly developed lobes of which two belong to the basal division, which is incompletely demarcated from the second. An accessory seta on a short stalk at the proximal base of the first lobe. The fifth lobe (the proximal of the third division) the largest. The number of setae on the lobes as follows (lobes numbered from proximal to distal):

Lobes:	*1*	*2*	*3*	*4*	*5*	*6*
Apical setae:	4	2	2	3	4	3
Basal setae:	1					2

The reduced terminal portion of the maxilla indistinctly separated and segmented, with three setae.

Maxilliped (fig. 18) with short, nonsetiferous basal segment (present in all dissections). Second segment with four lobes, the number of setae from proximal to distal lobe, 1, 2, 4, 3. The longest setae that of the first lobe and the proximal of the second lobe; both of these naked. Two of the setae of the distal lobe extremely reduced. Third segment with three plumose setae, between it and the endopod an incompletely separated segment, distinct neither from the endopod nor from the basipod. Endopod of five distinct segments bearing setae as follows:

FIGURES 14–27.—*Ridgewayia gracilis*, new species. 14–21, Female: 14, outline of antennule, showing segmentation; 15, antennule, segments 13–15; 16, antennule, segments 1–4; 17, maxillule, greatly enlarged; 18, maxilliped; 19, maxilla; 20, antenna; 21, antennule, apical segments 22–26. 22–27, Male: 22, right antennule, apical segments; 23, right antennule, segments 9–15; 24, leg 5, detail apex of left exopod, anteromedial view; 25, same, posterior view; 26, leg 5, detail right exopod and endopod, anterior view; 27, leg 5, posterior view.



FIGURES 14–27.—*Ridgewayia gracilis,* new species. Explanation on facing page.

Segment:	*1*	*2*	*3*	*4*	*5*
Apical setae:	4	4	3	3	3
Basal setae:				1	1

Legs 1–4: Both basal segments of leg 1 with inner seta; only first segment of legs 2–4 with inner seta. First two segments of exopod of legs 1–4 with outer spine and inner seta; segment 1 of endopod with inner seta, segment 2 with two inner setae.

Armature of third segments of both rami as follows (sp=spine; s=seta):

	Leg 1	*Leg 2*	*Leg 3*	*Leg 4*
Exopod:	3sp 4s	3sp 5s	4sp 5s	4sp 5s
Endopod:	6s	8s	8s	7s

Leg 1 (fig. 9) with several distinctive modifications. Outer spines of exopod with marginal flanges and tipped with a hair. Distad to the spine a flattened process; the processes of segments 1 and 2 with serrate edges; that of segment 1 very small; that of segment 2 larger, about half the length of the outer spine, between it and the spine an unarmed spiniform process; the process of segment 3 extremely small, nonserrate and placed at the outer distal corner of the segment. Inner apical spine of third segment of exopod subequal in length to segments 2+3. Seta of basipod segment 2 long and characteristically curved over the first two endopod segments. Distal outer portion of endopod segment 1 with an enlarged, partially separated, lobelike process or extension, densely setose on its anterior side. Segment 3 of endopod reduced in width, its terminal outer margin extended into spinous process.

Excepting the seta of endopod 1 of leg 1, all the setae of legs 1–5 jointed, usually below the middle. The proximal portion of these modified setae appear stiff and rodlike, and are sparsely plumose; the terminal flexible portion densely plumose. Spines of outer margins of exopods of legs 2 and 3 bladelike and unarmed (fig. 12), those of segments 1 and 2 elongate, reaching to near the base of the next spine or beyond, set into deeply defined sockets. The distal outer spine of segment 3 set in nearly terminal position with a prominent segmental process between it and the longer inner apical spine; inner spine about as long as its segment and unarmed. Spines of leg 4 (fig. 13) differing from those of legs 2 and 3 in having marginal flanges; the flange of the long inner apical spine of segment 3 armed with marginal hairs; near its distal fourth, these hairs cross over the surface of the spine to the edge of the inner margin.

Leg 5 (fig. 6): Basipod segments without inner setae; segment 2 with small outer spinous process and submarginally placed seta, usually inwardly directed; surface of these segments with groups of small spinules. Exopod segments 1 and 2 with stout outer spines armed marginally with serrate flanges; segment 2 with an inner, jointed seta, the stiff basal portion of which reaches more than halfway to the base of the first seta of segment 3. Exopod segment 3 with a group of three outer, serrate spines, all shorter than the segment; the two proximal spines placed marginally, the distal apically; the fourth spine (inner apical) with outer hyaline flange, about as long as the segment and nearly twice the length of the distal outer spine (about 60:35). The basal portions of the jointed setae of the inner margin of exopod 3 all reach beyond the base of the succeeding seta. Segment 1 of the endopod without seta; its outer distal margin produced to point. Segment 2 with seven jointed setae, the basal portion of each of the three inner setae reach beyond the base of the succeeding seta. The first outer seta placed just below the middle of the segment (at a point representing about 60 percent of the length of the inner margin of the segment); the first inner seta placed above the middle of the segment (at about 36 percent). Apical outer spinous process and basal portion of apical setae long, the process 20 percent, the setal bases 54 percent of the length of the inner margin of the segment. (See also p. 170.)

Male

Length, 0.8 mm. Habitus as in female. Urosome 5-segmented, the first four segments subequal to one another in length, the fifth reduced as in the female. Caudal rami and setae exactly like those of female.

Rostrum enlarged as in female, with broader tip and separated from forehead by a distinct surface demarcation across its entire base. All appendages except right antennule and fifth leg like those of female.

Left antennule 26-segmented and with setation as in female. Right antennule with proximal segments as in female; midportion modified in that segments 13 and 14 are fused outwardly and imperfectly divided from one another by a deep cleft beginning at the inner margin and extending irregularly into the middle of the segment (fig. 23). The antennule with 23 apparent free segments (counting 13 and 14 as two segments). The four apical segments elongated and of similar length (fig. 22); the point of geniculation between the proximal two of these segments (segments 20 and 21) so that there are three segments beyond the geniculation. Segment 20 with a longitudinal row of spinules arranged as a comb along the distal inner half. (See p. 163 for interpretation of segmentation.)

Leg 5 (figs. 24–27): First basal segments fused, forming a narrow crosswise bar to which the enlarged second basal segments are attached. Right basipod 2 longer than left, each with outer distally placed spinous process and submarginal seta. Right exopod: Segments subequal in length, the second narrowed. Outer spine of segment 1 with serrate flange, reaching to end of segment 2. First outer spine of segment 2 similar in size and armature to that of segment 1, second outer spine about half length of first; both spines reach beyond end of exopod. Apical part of segment 2 modified, an imperfectly separated, rounded serrate lappet on the inner margin opposite the placement of the second outer spine; beyond this lappet, the segment slightly incised on the anterior side (the possibility that this tip is at least partially movable is suggested by the various positions found in different dissections; the tip may or may not be interpretable as an imperfectly separated third segment).

Left exopod: Segment 2 much stouter than segment 1, broadened and stout at its apex into which is set the highly modified third segment; its outer distal spine narrowed and tapered, reaching beyond the tips of the processes of the third segment, armed only with outer marginal spinules. Third segment consisting of a shortened segmental portion clearly separated on the anterior side from the second segment (fig. 24) but imperfectly separated on the posteromedial side. The segmental portion of the surface of the anterior side deeply incised medially with heavy marginal sclerotizations and forming in part on its posterior side the base for the attachment of a set of thin, apically and irregularly fragmented membranes (or a single folded membrane) and three heavier, exceedingly flexible processes. Of these, the innermost simple in structure (setiform). One process, with an irregularly serrate, flared tip, has a broadened base which is set into a socket of the posteromedial portion of the segment (fig. 25). The other process is deeply widened at its base and attached inside the segment on the anterior side (fig. 24), below its attachment it is abruptly contracted into a long narrow setiform process with a slightly widened tip which is split near its end. These processes appeared in dissections separated as shown in figure 25, or twined around one another as in figure 24.

In interpreting the figures given here, it must be remembered that the membranes, though perhaps representing only one single structure, are irregularly fragmented and folded, and their appearance in any one dissection may be different from any other dissection. In figure 24, the membrane shown is only the expanded outer portion of that shown in figure 25; the edge appeared in all dissections to be strengthened by a heavy band.

Right endopod elongate-narrow, reaching to near end of exopod, the tip partially split; anterior side set basally with groups of surface spinules (fig. 26). Left endopod short, reaching only little beyond exopod segment 1; inner margin with two movable processes; the distal process short; the basal process nearly as long as the endopod (in dissections, this process found expanded as shown in fig. 27, or entirely "pulled in" and lying along the margin of the endopod).

Ridgewayia shoemakeri, new species

FIGURES 28–35

SPECIMENS EXAMINED: 2 females, 13 males. Occurring with *R. gracilis* in the vicinity of Loggerhead and Bush Keys, Dry Tortugas, Fla., July 23–Aug. 12, 1926, Clarence R. Shoemaker.

TYPES: Holotype female (slides) USNM 99517; allotype male (slides) USNM 99518. Paratype specimens (slides and alcoholic) in U. S. National Museum collections.

DIAGNOSTIC CHARACTERS: Urosome female 4-segmented, segments with distal serrate fringe; male 5-segmented; the two middle caudal setae not jointed basally in either sex. Antennules, female and left male, 26-segmented; segments 13–22 with row of spinules extending across distal edge of segment. Right antennule male 24-segmented, with four segments beyond geniculation; segment preceding geniculation without lateral comblike row of spinules. Maxilla with six inner lobes, of which two belong to basal division. Total number setae, endopod 3, legs 1–4: 6, 8, 8, 7. Leg 5 female, inner apical spine exopod 3 longer than outer spines, about as long as segment. Leg 5 male, right exopod 2, first outer spine only little longer than second spine; left exopod 3-segmented, outer spine of segment 2 reaching to end of modified processes of segment 3; right endopod with slender outer seta; left endopod unarmed.

FEMALE

Length, dorsal midline, 0.67–0.68 mm. Body slender, but lacking the erect appearance of *gracilis*, due to the strong curvature of the forepart of the cephalic segment (as shown for male, fig. 32). Proportions and segmentation of metasome very similar to those of *gracilis*. Cephalic segment longer than rest of metasome (about 80:71). Segments 5 and 6 both reduced in midline; wings of last segment like those of *gracilis*, except that the outer notch of the posterior edge is not enlarged.

Urosome segmented as in *gracilis*, the fourth being likewise reduced to the width of the caudal rami. Relative lengths of the segments and rami:

1	*2*	*3*	*4*	*CR*
20	8	6	2	13

Posterior edges of the segments with a complete dorsal fringe, that of segments 1–2 indistinctly serrate, that of segment 3 deeply serrate.

External genital field defined by sclerotization, the distal edge of operculum a flaplike opening, the right side rounded (fig. 31).

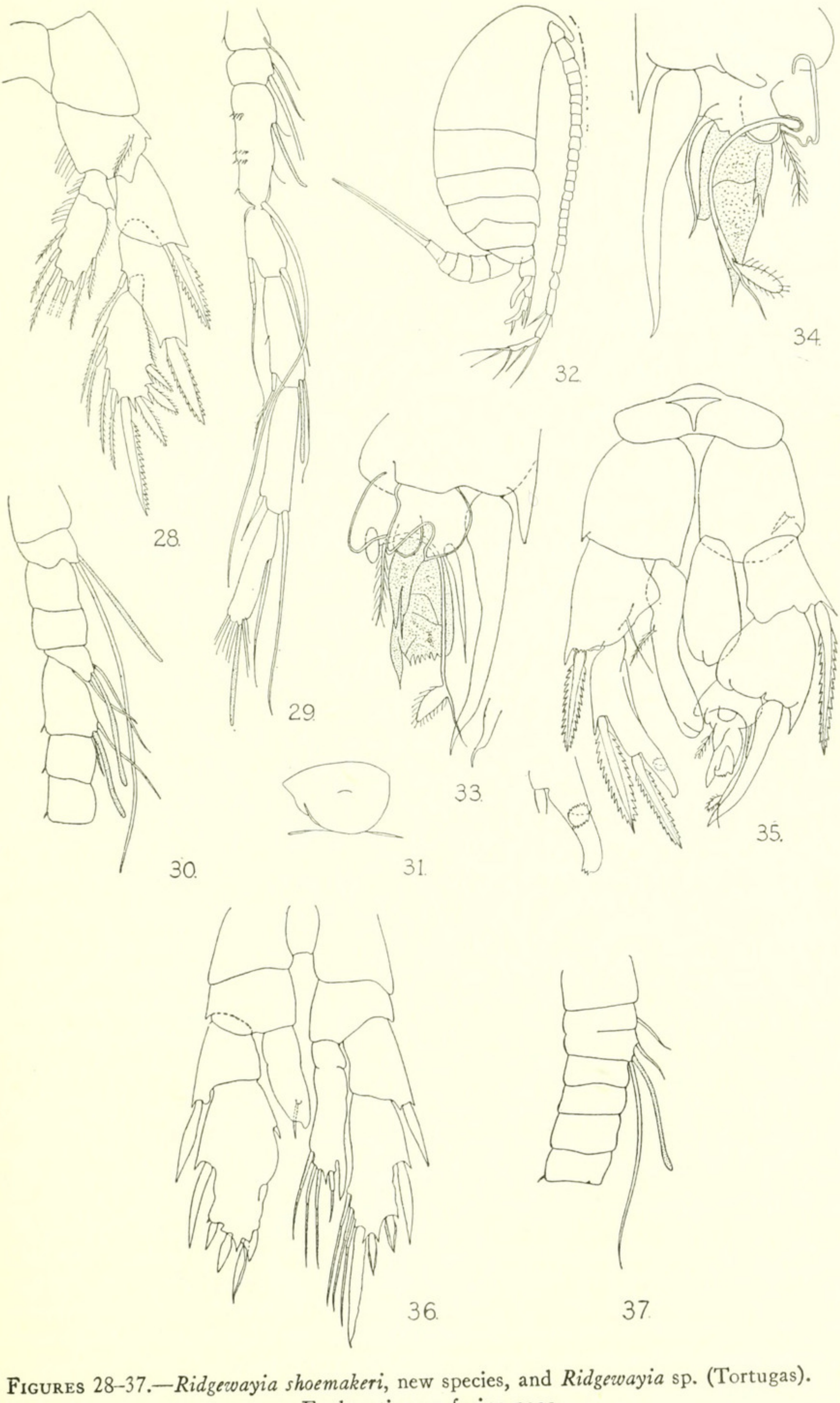
Caudal setae exactly like those of *gracilis*, except that the two long middle setae are not jointed at their bases.

Appendages differing very little from those of *gracilis*. Antennule longer, reaching to the end of the genital segment; clearly 26-segmented, the proportions of the segments and numerical setation exactly like *gracilis* except that the last four segments tend to greater elongation, and segment 24 is nearly subequal to 25 and 26; the long setae of segments 4, 8, 10, 13, and 22 comparatively shorter; the surface spinules of segments 13–22 arranged in single rows extending across the entire distal edge of the segment, size of spinules varying from segment to segment. Segmentation and setation of antenna and mandible palp like *gracilis*. Maxillule like *gracilis* except that the first of the two laciniae just distad to the gnathobase has five instead of four setae. Maxilla also with six large lobes, of which two belong to the basal portion; the apical portion clearly 2-segmented, a difference from *gracilis* that might be an individual variation or due to position in mounting. Maxilliped exactly like that of *gracilis*.

Legs 1–4 identical to *gracilis* in arrangement, structure, and number of setae and spines. Leg 1 differing slightly in that the spinous process between the outer spine and flattened process of exopod segment 2 is as long as the distal process instead of shorter; the inner apical spine of segment 3 about as long as segments 2+3.

Leg 5 (fig. 28) very similar to that of *gracilis*. Basal portions of all jointed setae of exopod and endopod comparatively shorter; that of exopod 2 hardly reaching beyond segment, first two setae of exopod 3 reaching about to point of insertion of succeeding setae. Endopod segment 2, first outer seta set below middle of segment, at point about 64 percent of total length; first inner seta set a little above the middle, at a point about 42 percent of total length; spinous process of outer margin short, only about 10 percent of total length of segment. (See also p. 170.)

FIGURES 28–37.—*Ridgewayia shoemakeri*, new species, and *Ridgewayia* sp. (Tortugas). 28–35: *R. shoemakeri*, new species: 28, female, leg 5; 29, male, right antennule, apical segments; 30, male, right antennule, segments 9–16, with armature of segments 10, 13, 14; 31, female, genital operculum; 32, male, habitus, lateral; 33, male, leg 5, detail apex of left exopod, anterior view; 34, same, posteromedial view; 35, male, leg 5, anterior view, with detail apex of right exopod. 36, 37, *Ridgewayia* sp. (Tortugas), male copepodid stage V: 36, leg 5, posterior view; 37, left antennule, segments 8–13, with armature of segment 9.



FIGURES 28–37.—*Ridgewayia shoemakeri*, new species, and *Ridgewayia* sp. (Tortugas). Explanation on facing page.

MALE

Length, 0.63–0.68 mm. Forepart of body strongly curved (fig. 32). Urosome 5-segmented, the fifth segment reduced. Antennules reaching beyond the metasome; the left like that of the female, the right (fig. 29) with 24 free segments, four beyond the point of geniculation. (See pp. 163–167 for comparison of segmentation with *gracilis*.) Segments 13 and 14 modified as in *gracilis* but completely separated (fig. 30). Segment preceding the geniculation without a comblike group of spinules.

Cephalic appendages and legs 1–4 as in female.

Leg 5 (figs. 33–35): First basal segments reduced in size and completely fused. Second basal segments of nearly equal size. Right exopod: Segment 1 with medial inner expansion and a very fine accessory seta; outer spine reaching just beyond base of first spine of second segment, with a broad, serrate hyaline flange. The two outer spines of segment 2 subequal to one another in length, both reaching beyond the end of the segment, and with serrate flanges. Beyond insertion of second spine, the inner margin of segment with a cleft and a serrate lappet which appears hardly separated from the anterior surface; tip of segment minutely serrate.

Left exopod: Segment 1 reduced in both width and length, with a stout outer spine reaching beyond segment 2 and armed with hyaline flange. Segment 2 broadened and thickened at its apex; its outer spine thick and irregular, without marginal flange or serrations, longer than its segment and reaching to about the same point as the longest of the processes of segment 3. Segment 3 distinctly separated from segment 2 on anterior side and very nearly so on posterior side. Membranes folded and irregular in length and fragmentation as in *gracilis* (figs. 33, 34). In addition to membranes, a plumose seta as in *gracilis*, and two modified processes. Of these, one simple in structure with a relatively small base, set into the segment near the outer edge, not reaching beyond the membranes. The other much longer, set into a well-defined socket on the inner portion of the segment; protruding from near its distal end a large flattened structure with hairy margins (from its position and mode of attachment this process comparable to the one with flared serrate tip in *gracilis*).

Right endopod elongate, reaching to near base of distal spine of exopod 2, without evidence of segmentation, armed only with a slender plumose seta on the outer edge. Left endopod swollen, not reaching quite to end of exopod 2, without ornamentation or processes.

Ridgewayia sp. (Tortugas)

FIGURES 36, 37

SPECIMENS EXAMINED: 6 males, copepodid stage V. Occurring with *R. gracilis* and *R. shoemakeri*, off Loggerhead Key, Dry Tortugas.

DESCRIPTION: Length, 0.665–0.69 mm. Somite of leg 1 separated from cephalic segment. Urosome 4-segmented; caudal rami with more or less distinct division of the outer margin near the base (representing incipient division of a reduced fifth segment ?); fourth segment with distal row of fine spinules ventrally and on the lateral areas of the dorsal side; caudal rami covered with hairs on both sides. Caudal setae of same relative lengths as in *gracilis* and *shoemakeri*, none jointed basally, but the longest jointed near the end as shown for *gracilis* in figure 1.

Antennules alike, reaching just beyond metasome; with 25 free segments; segment 9 somewhat elongate and partially divided by a line running from the inner margin to the middle of the segment, with two setal groups (fig. 37); segments 1 and 2 subequal in length; the three apical segments elongate, the last two subequal to one another.

All cephalic appendages weakly developed, but fully segmented. Exopod of antenna 8-segmented. Maxilla with six lobes, of which two are on the basal division.

Legs 1–4 fully segmented; segmentation and setation exactly as in *gracilis* and *shoemakeri*; all setae jointed. Leg 1 resembles the adult of *gracilis* and *shoemakeri*, but the processes of the outer margin of the exopod segments are not fully developed.

Leg 5 (fig. 36): First basipod segments well developed, connected by medial plate. Both exopods 2-segmented, the distal segments elongate and of similar length, the left broader than the right. Right exopod 2 with an outer medially placed spine that reaches to end of segment; distally with two shorter spines and a long apical spine equal to about three-fourths the segment length; distal inner portion with three closely set, jointed setae. Left exopod segment 2 with medially placed spine on outer margin, spine reaching beyond apex of segment; apex with three membranous spines of graduated length, increasing from outer to inner; the innermost with a stout inner marginal sclerotization; at inner apex of segment, a conspicuous hyaline projection overlying base of inner spine. Right endopod longer than left, its proximal part partially segmented; the apex armed with setae and processes; of these, the outermost a stout spiniform process arising laterally; setae four in number, all jointed basally. Left endopod broad, armed near distal part on anterior side with a slender surface seta; otherwise closely resembling the unarmed endopods of the adult *shoemakeri* and *marki*.

REMARKS: It does not seem possible to relate this subadult male to either of the Tortugas species. In many calanoid families the development of the fifth leg is progressive, and, if such were known to be true in *Ridgewayia*, it might be assumed that these copepodids represent a third unknown species in which the right exopod may have inner apical setae, and the right endopod is also armed with setae. However, there are often striking changes in this appendage between the recognized stage V and the adult, such as is known for *Centropages* (Gurney, 1931). It is therefore impossible to say with absolute certainty that this does not represent the subadult stage of one or the other of the two species. The left antennule in the adult could be 25- or 26-segmented, depending upon whether the partially divided ninth segment becomes fused or separated. There is no indication of modification of the right antennule, either in the middle or distal portions.

One interesting point brought out by examination of this copepodid is that the modified processes of the first leg are not fully developed until the adult stage, although the leg is otherwise like that of the adult.

Discussion

The name *Ridgewayia* was proposed in honor of Sir West Ridgeway, governor of Ceylon. Attention is drawn to this in order to emphasize that the spelling of the generic name is correct. A genus of birds, *Ridgwayia* Stejneger 1883, named for the ornithologist Robert Ridgway differs in the spelling by one letter.

For purposes of brevity in the following discussion, the new Tortugas species (*gracilis*, *shoemakeri*) and the Bermuda species (*marki*) are referred to collectively as the American species.

Specific Differentiation

Habitus: In general appearance, the species are alike. Only for *marki* is there a recorded lack of separation of the cephalic and first thoracic somites. Since the separation of this segment in the Tortugas material was not always as distinct as that of the other segments, specimens in future collections of *marki* should be carefully examined for indistinct or partial separation. There is also need to determine the possible presence of the reduced last urosomal segments in both *marki* and *canalis*. Esterly's (1911) drawing of the female shows the caudal rami united basally and suggests the presence of this reduced segment. The urosome of *canalis* (male) as illustrated is very like that of the subadult male listed herein as *Ridgewayia* sp. (Tortugas). Gurney (1927) says "Abdomen of four somites" but adds "the 5th somite scarcely distinct." The possibility that Gurney's specimens were in the subadult stage is dismissed on the basis of the apparent complete development of the first leg, and of Gurney's wide experience in study of developmental stages of copepods, precluding the possibility that he would err in this regard, even with an unfamiliar genus.

The specific difference noted in the two Tortugas species in the jointed basal portions of the two middle caudal setae is a valuable character for distinguishing whole specimens, and particularly the females of associated species. It is not mentioned for any of the other species, but should be recorded for all species encountered in future studies.

In all of the species the rostrum appears to be a large, somewhat expanded structure, without filaments.

ANTENNULE: The antennules of the two new species have been studied in detail at high magnification with oil immersion objectives. The material has been critically checked and rechecked, partly because the antennules of the female and that of the left side of the male are 26-segmented, differing thus from the segmentation recorded for *typica* and *marki*, or recognized for any other calanoid species. The greatest number of segments that has been conceded to be present in the antennule of existing calanoids is 25. The few instances in which a 26-segmented antennule has been reported are thought to be due to the fact that the observer included the surface eminence to which the antennule is attached. Whole specimens of both species as well as dissected antennules have been examined with this in mind, so that such an error would not be repeated in the case of these two species of *Ridgewayia*.

Gurney (1931, pp. 40–48; 1933, pp. 46–61) has discussed the interpretation of the armature and development of the antennule in relation to its evolution, and points out (1931, p. 42) that the primitive antennule of calanoids probably consisted of 27–28 segments, or even of 30 or 31 segments. It seems apparent in all species that some of the fusion leading to reduction has taken place in the proximal part of the antennule, particularly in the usual second segment of a 25-segmented appendage. This segment is usually comparatively long, and bears more than the two setae and aesthete considered to represent the archetypical grouping for each segment. The second segment shown in the illustration of the antennule of *typica* (Thompson and A. Scott, 1903, pl. 1, fig. 3) is elongate and appears to have two or even three groups of setae. On the basis of length it is comparable to segments 2 and 3 of *gracilis* and *shoemakeri*, indicating that the difference in segmentation of these congeners may be due to fusion in these proximal segments. Reference to the summary of setation given herein in the description of *gracilis*, and found to be identical in *shoemakeri*, shows that what is considered a primitive armature, as well as segmentation, has been largely retained—most segments have two setae, and aesthetes are abundantly distributed.

Although admittedly an obvious point, it does seem apropos to stress the desirability of including results of detailed critical examinations of the antennules in published records of any specimens of *Ridgewayia* or of allied genera. The discovery of two species of Calanoida with 26-segmented antennules is a matter of considerable systematic interest. Such an unusual segmentation might be an important part of a generic definition. In the present instance, it cannot separate the Tortugas species generically from *Ridgewayia typica* because the otherwise obviously related Bermuda species *marki* is said to have a 25-segmented antennule. If this is actually the case, then the difference in segmentation must be considered specific. However, on the basis of their descriptions, it is not inappropriate to suggest that there is need to verify whether the antennules of *typica* and *marki* are really 25-segmented, and, if so, how their armature compares with that of *gracilis* and *shoemakeri*. Esterly (1911) gave no detail of the female or left male antennules in his account of *marki*. The antennule is figured for *typica;* it shows a very elongate second segment, and three elongate distal segments. It is personally considered doubtful if the setation shown is entirely exact. There are two setae on nearly every segment but there is no distinction between setae and aesthetes, and many of the setae shown are too similar in length to have been based on exact observation.

Considered critically, it cannot be judged from the text of Gurney's description of *Suezia canalis* whether or not the segmentation given applies to both of the antennules or only to the right. No direct reference is made to that of the left side. If the statement "1st antenna of 21 or 22 joints" refers to both antennules, then the segmentation within this group of species varies over the considerable range of from 21 to 26 segments.

In the specimens observed, the geniculation of the male right antennule is only moderately developed. It was noted while working with the Tortugas material that the antennule could be turned or mounted in such a way that the jointing becomes obscured. There exists, however, as illustrated for the two Tortugas species and as shown by Esterly for *marki*, a real constriction between two of the distal elongate segments. In whole specimens (most advantageously observed in alcohol), the distal part of the antennule is frequently bent upwards or outwards at this joint as is characteristic of geniculate antennules. This modification as it occurs in these species of *Ridgewayia*, though weak, is obviously a specialized joint, giving to the distal portion of the antennule a unit flexibility and freedom of movement not present at any other part of the appendage. Such a specialized joint may be presumed to be functionally and structurally comparable to the variously developed geniculations found in many calanoid genera.

Gurney (1927) and Krishnaswamy (1953) have recorded non-geniculate antennules in their specimens. In reviewing their accounts in light of knowledge of these other species, it is difficult to know how to assess their records. Both worked with limited material (one or two specimens) and both presented their observations in a very brief fashion. Gurney's description can only be considered indefinite inasmuch as he referred to the joints as "rather indistinct." In view of the observation made in my study that the geniculation may easily be obscured in mounting, it does not seem unreasonable to consider this character as inadequately known in these two species. Since it may be of generic significance, it is an exceedingly important character to reaffirm by critical observation of both mounted and unmounted material.

The middle region of the male right antennule is not enlarged in *gracilis* and *shoemakeri,* but there are modifications of some segments. Segment 10 is shortened on the outer side. Segment 13 is even more reduced on the outer side, and while remaining distinctly separated in *shoemakeri* (fig. 30), it seems to have become partially fused with segment 14 in the specimens of *gracilis* that were critically examined. In both species, segment 14 is elongate on the outer side. In *gracilis* there is on the inner side a medial incision with sclerotized edges; the sclerotization appears to extend into the internal part of the segment. Beginning at this point in *gracilis,* and at a similar position in *shoemakeri,* there is a longitudinal muscle band that extends through segment 19. There is indication in Gurney's illustration of a modification at the same point of the antennule of *canalis,* involving a reduction of one segment and elongation of another, but no detail is given.

Esterly did not mention such a modification of these segments in the right antennule of *marki.* The antennule is described simply as "23-jointed" with a "4-jointed terminal portion." The modified geniculate portion of the antennule is illustrated, but unfortunately the figure does not include all the succeeding terminal segments. There is a question as to whether the "4-jointed terminal portion" was meant to include only the segments beyond the geniculation, since the two Tortugas species differ in having three or four segments beyond this joint. This difference is apparently due to a fusion in *gracilis* of the two segments immediately distad to the geniculation. This is shown by comparison of the terminal segments of the two species (figs. 22, 29). The two distal segments correspond to one another in elongation and in the number, placement, and length of the setae and aesthetes, and so would appear to be of identical origin. In *gracilis,* the segment preceding these has the appearance of at least two coalesced segments comparable to the two distinct segments of *shoemakeri*. The two groups of setae on the fused segment of *gracilis* correspond to those of the two separated segments of *shoemakeri* not only in placement but also in modification. It therefore appears that the geniculation occurs at exactly the same point, although the number of free segments beyond the joint is different.

In both *gracilis* and *shoemakeri* there are 20 free segments preceding the geniculation. There would appear to be no question that the modified segments of the midportion counted as segments 13 and 14 represent two segments (fig. 30). It therefore seems impossible to fix the position of the hinge at a point comparable to that presumed to be identical for all calanoids. It has long been held, as Gurney (1931, p. 47) emphasizes, that the ". . . position of the hinge may be regarded as a fixed point. In the Calanoida, this point is always between segs. 18 and 19." In these two species of *Ridgewayia* it seems correct to assume that the 26-segmented unmodified antennule of the male and female has resulted from a lack of fusion of two segments of the proximal area and may differ from the closely allied species *typica* in the division of these segments. The modified antennule agrees with the unmodified antennule in relative length and armature of the proximal segments. In comparing this 26-segmented antennule to the basic calanoid 25-segmented appendage from whose study the hinge position has been derived, it would seem necessary only to add one segment to arrive at a comparable position. The hinge in these two species of *Ridgewayia* should therefore fall between segments 19 and 20, but this is not the case. Not only are there 20 countable segments preceding the geniculation but the elongation and armature of the 20th segment suggests that it may have resulted from fusion of at least two or even three of the segments of the preceding stage.

Comparison of the armature of the unmodified antennule with that of the modified, may not indicate what segments are included in the fused distal region of the right appendage. But attention should be drawn to similarities that characterize certain areas of each in these two species. The proximal and the two distal segments are alike in armature and length. The groups of surface spinules occur on identical segments of the left and right side in both species (13–22 and 24–25). Segment 22 has a particularly long seta on the unmodified antennule; such a long seta is present on the segment preceding the geniculation in both species. Jointed setae are present on the unmodified antennule beginning with segment 23; similar setae are present beyond the geniculation point of the right antennule. Thus, on the basis of comparison of armature, the distal part of the segment preceding geniculation (visible segment 20) is comparable to segment 22 of the unmodified antennule. If this is a true correlation, then the elongate segment preceding the geniculation represents a fusion of three segments. Such an interpretation is easily supported in *shoemakeri* (fig. 29), which has three groups of spinules and three setal groups; in *gracilis*, the comb of spinules obscures any middle setal group.

These two Tortugas species are thus not only unusual among Calanoida in the segmentation of the antennule but also in the position of the specialized hinge. It is not too surprising to find calanoid copepods with 26-segmented antennules, but the difference in the hinge position is unexpected. This seeming departure from what has been considered a basic pattern raises the question as to how well the facts are known. In studying the literature it is apparent that knowledge of detail of antennule structure and armature is lacking for many species and genera. Most of the available data of worth come from the observations of early workers (Claus, Schmeil, Giesbrecht); among the most important examples are the incomparable, detailed figures of Giesbrecht (1892). Since then few workers have given more than the rudiments of antennule structure in their descriptions. This is unfortunate since it is apparent that some very exact patterns of segmentation and armature have been established in the evolutionary development of this appendage in the Calanoida, and it therefore has high significance at all taxonomic levels.

Antenna: This appendage is figured for all the species except *marki*, for which Esterly (1911) describes the exopod as 8-segmented. This agrees with the other species except *canalis*, which Gurney (1927) shows as having a 7-segmented exopod. All segments have an inner, lateral seta except the last, which has four apical setae in all except *typica*, for which three are shown (not known for *marki*).

Oral appendages: Where known, the mandible and maxilliped show no significant differences. The maxillule is unknown for *canalis*, but agrees closely in the other species. A single epipodal seta is present in *gracilis* and *shoemakeri* but is not shown for *typica* and *marki*, though the lobe is present in the illustration of the latter. This point should be checked in future studies of these two species as it may be of taxonomic importance. The number of setae shown in the figures of *typica* and *marki* on the various lobes and laciniae, and on the exopod and endopod, show slight differences from one another and from the new species. As some of these may have specific value and should be checked in future studies, they are summarized here (table 1).

The maxilla appears to have the most taxonomic importance of all the oral appendages in species differentiation, inasmuch as the number of lobes varies from five in *canalis* to seven in *typica*. The reduction is in the proximal portion of the appendage. The American species (including the subadult male) agree with one another in having two lobes on the basal division, and also have a seta at the base of the first lobe, not shown in either *typica* or *canalis*.

TABLE 1.—*Setation of maxillule in* Ridgewayia

(Unknown for *R. canalis,* and *Ridgewayia* sp. from Madras)

Species	Basal portion						Exopod	Endopod	
	Inner				Outer			Segment 1	Segment 2
	Gnathobase	Lacinia 1	Lacinia 2	Lobe of Basis	Coxa	Epipod			
typica	10	5	4	5	9	0	12	4(5?)	7(6?)
marki	13	5	4	5	10	0	11	8	6
gracilis	13	4	4	4	9	1	11	8	6
shoemakeri	13	5	4	4	9	1	11	8	6

LEGS 1–4: Complete information on the armature of legs 1–4 is available for only the American species. It is alike in the Tortugas species, including the subadult male of unknown identity (*Ridgewayia* sp., Tortugas). Since the specific pattern is probably established by this stage, it is included in the summaries of armature. Esterly (1911) illustrated only leg 1 of *marki*, but he gave a table of setation which, if correct, shows that the number of setae on the endopods of legs 3 and 4 differ from the Tortugas species. Information is incomplete for the other species, being known for only some of the legs of a single sex of each species. No summary of setation is given in the text, and only some of the legs are illustrated. These are:

typica ♀	legs 1, 2, 4
canalis ♂	legs 1, 2
sp. (Madras) ♂	leg 1

An inner seta is known to be present on basipod segment 2 of leg 1 in all the species; so far as known, it is absent on all the other legs, but the information available in the literature is complete only for the American species. The same incompleteness of information applies to the inner seta of the first basipod segment. The presence or absence of this seta may be a basic character on all taxonomic levels in calanoid copepods, and it is important that it be accurately determined for every leg of each species. As now recorded in the literature the inner seta of basipod 1 is as follows (+ present; — absent; ? unknown):

		Leg 1	*Leg 2*	*Leg 3*	*Leg 4*
typica	♀	−	−	?	+
sp. (Madras)	♂	−	?	?	?
canalis	♂	−	+	?	?
marki	♀ ♂	+	+	+	+
gracilis	♀ ♂	+	+	+	+
shoemakeri	♀ ♂	+	+	+	+
sp. (Tortugas)	♂	+	+	+	+

It is noteworthy that the figures given in the literature for the first three forms do not show this seta on leg 1, but that it is uniformly present in the American forms. This may be a character of significance on the generic level if it is correlated with other differences, and its presence or absence should be carefully determined in reexamination of the first three species. The presence or absence of this seta in the other legs is inconsistent in *typica* and *canalis*, so that it is difficult to accept the evidence as incontrovertible. Here again, future examination of specimens should be critical in this regard.

Where known, the armature of the first two segments of the exopod of each leg of the incompletely known species agrees with that of the

TABLE 2.—*Total number of spines and setae on segment 3 of exopod and endopod, legs 1–4 of* Ridgewayia

Species and known sex		Leg 1		Leg 2		Leg 3		Leg 4	
		Exo.	Endo.	Exo.	Endo.	Exo.	Endo.	Exo.	Endo.
typica	♀	7	6	8	8	?	?	9	7
sp. (Madras)	♂	7	7(6?)	?	?	?	?	?	?
canalis	♂	7	6	8	8	?	?	?	?
gracilis	♀ ♂	7	6	8	8	9	8	9	7
shoemakeri	♀ ♂	7	6	8	8	9	8	9	7
marki	♀ ♂	7	6	8	8	9	5	9	6
sp. (Tortugas)	♂	7	6	8	8	9	8	9	7

American species; that is, a single outer spine and single inner seta. With the exception of the first leg of the Madras specimen, the endopods likewise agree for legs 1–3; that is, one inner seta on segment 1 and two on segment 2. The complete absence of setae as shown for the Madras specimen would be very unusual, and, as suggested above, is probably due to incomplete delineation. Leg 4 is unknown for the Madras specimen and for *canalis; typica* agrees with the Tortugas species, but *marki* differs from the others in having only one seta on endopod segment 2.

Where known, the total number of spines and setae on the third exopod segment are like those of the new species, but there is some difference in the total number of setae on the third endopod segment of legs 3 and 4, as shown in table 2.

Leg 5, Female: This appendage is so similar in the four species in which the female is known that only very precise examination reveals the small differences that do exist. The leg of *typica* differs noticeably from the American species only in the shortness of the innermost apical spine of the third exopod segment (see key, p. 173). Differences in the three American species are found only in the comparative lengths of the basal joints of the setae of the exopod and endopod and in the placement of the proximal inner and outer setae of the second endopod segment. These latter differences have been expressed in the text of the descriptions of the new species as the percentage of the inner margin of the segment. The length of the outer apical spinous process and of the basal portion of the outer apical seta of the endopod are expressed as a similar percentage. There is a striking difference between some of these points in the two Tortugas species (figs. 5, 28 and table 3). From the figure given for *marki*, the placement of the setae is very similar to *shoemakeri*. Esterly's (1911) figure of *marki* does not show the outer spinous process. *R. typica* seemingly differs from the others in the much closer placement of the proximal inner seta to the base of the segment.

Table 3.—*Female leg 5,* Ridgewayia. *Ratio of certain characters of endopod segment 2, expressed as percentage of total length of inner margin of segment*

(KEY: A, distance between base of inner margin and placement of first inner seta; B, distance between base of inner margin and placement of first outer seta; C, length of outer spinous process; D, length of basal joint of outer apical seta)

Species	A	B	C	D
typica	23	54	23	60
gracilis	36	60	20	54
marki	44	69	?	50
shoemakeri	42	64	10	33

Since these characters of the endopod may be useful in differentiating species, a comparison has been made in table 3 between the two new species and the other species. Measurements were made with a millimeter rule on the illustrations given for *typica* and *marki*. These, of course, do not represent exact measurements, but in the absence of specimens they serve very well for comparative purposes.

They are included in table 3 as percentage figures determined in the same way as those for *gracilis* and *shoemakeri*.

LEG 5, MALE: An important part of the generic definition as now constituted is found in the modification and asymmetrical development of the endopods of the male fifth leg. This is expressed in the elongation of that of the right side in contrast to the shorter, broadened endopod of the left side and in the varied armature of the different species. The armature seemingly is specific in nature, although with increased knowledge it may be found, in part, to define groups of species or even genera. In the known species, segmentation is suppressed in the adult, but since the subadult male (*Ridgewayia* sp., Tortugas) shows partial segmentation of the right endopod, it may be that some species may be found in which at least the right endopod is distinctly segmented.

The right exopod is 2-segmented in all the five known adult males (including *Ridgewayia* sp., Madras). The first segment is very similar in all the species, but the second segment shows definable differences. The three American species are noticeably most similar to one another not only in the shape and length of the segment but in the presence of two similarly placed outer spines. In *canalis* and the Madras male there is only one well-developed spine, the second or even a third spine being suppressed or broken off in the available specimen. Gurney's (1927) figure shows two spinous points along the extended outer margin of *canalis*, and the exceedingly shortened segment of the Madras male has a projection of closely set points very suggestive at least of the remnants of the cuticular points defining the placement of a spine. With this exception, this segment of the leg of the Madras male, though shortened, is more similar to the American species than it is to that of *canalis*.

The left exopod is separable into three distinct segments in the American species. The third segment is highly modified and is set into a centrally recessed area of the expanded, strongly built apex of the second segment. There is a higher degree of segmental development in *shoemakeri* than in *gracilis*. In *marki*, the apical processes and membranes are much more elongate than in either of the Tortugas species, but in other respects the whole left leg shows more similarity between *shoemakeri* and *marki* than exists between *shoemakeri* and the associated Tortugas species.

Although shortened, the left exopod of the Madras male is easily correlated with that of the American species. The figure given by Krishnaswamy (1953) is reduced in size and allows for little detail; however, its outline is entirely credible and its structure interpretable in light of knowledge of the American species. The outer spines of the first and second segments are present and strongly developed, being nearly as long as the exopod itself. These spines are placed close together, the second segment being much reduced on the outer side. The apical portion appears to be structurally comparable to the modified third segment of the American species. Its simplicity may be due to reduction or lack of some of the processes and fragmented membranes that complicate the structure in the other species, but it is certainly to be correlated with them. Indeed, it appears much like this portion of the exopod in the Tortugas specimens whenever they were viewed under relatively low power (fig. 35). Examination at high magnification with oil immersion objectives might well reveal complex detail in the Madras species such as has been found to exist in the American species. Krishnaswamy's (1953) unnamed specimen is therefore seemingly relatable to these species through the fifth leg. In the presence of setae on the right endopod, in the lack of the second outer spine of the right exopod 2, and in the seeming reduction of the left exopod it represents a possible link between the American species and *canalis*. In the case of this latter species, however, the structure of the apical portion of the left exopod may be somewhat different. As drawn by Gurney (1927) it has a flattened appearance and is difficult to reconcile exactly with the observed species. Such a difference may be entirely graphic in nature. Here again there is need for further examination, and probably also comparison with actual specimens of some of the other species.

Both of the Tortugas species have the first basipod segments fused and comparatively reduced. Unfortunately, Esterly (1911) has not shown or described the basipods completely for *marki*. In his illustrations the legs are entirely separated. A reduced but separated segment is shown for the right leg, but only a portion of the left second basipod segment is included. It would be instructive to know the exact condition, since *marki* and the Tortugas species are obviously congeneric. Gurney shows well-developed segments joined by a center connecting plate very similar to that of the subadult Tortugas male (fig. 36). Apparently the first basipod segments are well developed and separated in the Madras specimen. Correlated with other differences, the lack of fusion may have generic or other taxonomic significance, and it is a character that should be carefully noted.

It is difficult to interpret the fifth leg of the subadult male (*Ridgewayia* sp., Tortugas) in relation to the appendage in the adult. If it does represent a copepodid stage of one of the two known Tortugas species, then considerable change must take place between stage V and the molt to the adult. This would involve fusion of the basal segments, loss of one spine of the apex of the right exopod, and loss of the inner setae of the exopod and of the endopod. However, since two species are known in which the setae are present on the right endopod, it might be predicted that an unknown species with this character is present in Tortugas waters. The apical membranous spines and hyaline processes of the left exopod may or may not be the beginnings of development of the complex armature of the third segment of the adult. Again, they may represent armature belonging to a species that has a simpler development of this part of the exopod, such as shown for *canalis*.

The significant characters of the fifth leg have been summarized in table 4. The segmentation and spinal armature of the left exopod of *canalis* is listed as uncertain (see diagnosis of *canalis*, p. 145).

TABLE 4.—*Comparative characters of male leg 5,* Ridgewayia

(KEY: (+) character present; (−) character absent; (?) unknown)

Species	Basipod	Right exopod	Left exopod		Right endopod	Left endopod
	First segments fused	No. spines on segment 2	No. segments	No. spines	Inner setae	Armed with lobes or processes
marki	?	2	3	2	−	−
shoemakeri	+	2	3	2	−	−
gracilis	+	2	3	2	−	+
sp. (Madras)	−	1	3	2	+	−
canalis	−	1	2(3?)	1(2?)	+	+

Key to known species of *Ridgewayia*

The following key has been devised to include both sexes and to summarize and emphasize, in part, similarity of known basic characters that may point up generic or species-group distinctions. Unfortunately, the Madras male cannot be included in the key because of insufficient information. It differs strikingly from all other known males in that the right endopod of the fifth leg reaches beyond the apex of the relatively shortened right exopod. Characters of the caudal setae and antennules used in couplets 3 and 4 need verification in *marki*.

1. Antenna, exopod 7-segmented; maxilla with total of 5 lobes, of which one belongs to basal segment. (Female unknown.) . . . . . . ***R. canalis***
   Antenna, exopod 8-segmented; maxilla with total of 6–7 lobes, of which more than one belongs to basal segment 2
2. Maxilla, basal segment with 3 lobes; leg 5 female, exopod 3, innermost spine not longer than other spines. (Male unknown.) . . . . ***R. typica***
   Maxilla, basal segment with 2 lobes; leg 5 female, exopod 3, innermost spine longer than other spines, about equal to length of segment 3

3. Middle caudal setae jointed at bases; leg 5 female, endopod 2, first inner seta placed near the proximal third (equaling about 36 percent of total length of inner margin); leg 5 male, left endopod with a proximal, inner, movable process about as long as endopod . . . . ***R. gracilis,*** new species

Middle caudal setae not jointed at bases; leg 5 female, this seta placed below the proximal third (at about 42–44 percent of margin); leg 5 male, left endopod unarmed 4

4. Antennules, female and left male, 26-segmented; leg 4, endopod segment 2 with 2 inner setae, segment 3 with 7 setae; leg 5 male, left exopod 2, outer spine longer than its segment, reaching about to same point as longest apical process . . . . ***R. shoemakeri,*** new species

Antennules, female and left male, 25-segmented; leg 4, endopod 2 with 1 inner seta, segment 3 with 6 setae; leg 5 male, left exopod 2, outer spine shorter than its segment, reaching only to about middle of extended apical membranes and processes . . . . ***R. marki***

Systematic position

Ridgewayia (as represented by the female of *R. typica*) was referred to the Calanidae by Thompson and Scott (1903) on the basis of the resemblances of the cephalic appendages and legs 1–4. The lack of agreement in the fifth legs was noted. As now known, the highly modified fifth legs of both sexes and the geniculate antennule exclude the genus from the Calanidae, but Thompson and Scott are correct in their implication that the unreduced, simply modified oral appendages and the first four pairs of legs are essentially primitive in structure.

In his comments on *Lampoidopus marki*, Esterly (1911) did not place the genus systematically.

Gurney (1927) doubtfully referred *Suezia canalis* to the Pseudocyclopidae because of its "general resemblance" to *Pseudocyclops*. He pointed out, however, that *canalis* differs "very materially from *Pseudocyclops*" but that he felt that "it must either be included in the Pseudocyclopidae or have a new family instituted for its reception," a course "hardly justified without more complete knowledge of the two sexes." Sewell (1932) and Krishnaswamy (1953) have listed *Suezia* in the Pseudocyclopidae without comment.

The demonstrated relationship of the species considered herein makes it possible to evaluate more critically their possible relationship to the Pseudocyclopidae. There is some merit in Gurney's suggestion, though the strongest resemblances between *Ridgewayia* and *Pseudocyclops*, the only known genus of the family, are the superficial ones of body form and habitat. Both have the stout body that is seemingly characteristic of extremely littoral and bottom-living calanoids. The segmentation of the body (including the reduced anal segment), the caudal setae, and the large, unfilamented rostrum are similar. The segmentation and armature of legs 1–4 are alike. There is also some similarity in the fifth legs of the females, though the distinctive modification of the exopod of *Ridgewayia* is not found in *Pseudocyclops*, and the endopod of *Pseudocyclops* varies considerably in segmentation and armature from species to species. If other characters showed strong correlation, the differences in the female fifth leg are such that they could well be considered generic rather than familial. It is more difficult, however, to correlate the highly complex male fifth leg of *Pseudocyclops* with that of *Ridgewayia*, though relationship of the two genera might be assumed through the modified endopods and the apical armature of the left exopod.

In what are more easily comparable and, in part, more fundamental characters, the two genera differ more widely. Important among these is the contrast in the location of the paired genital openings of the female. Those of *Pseudocyclops* are widely separated; those of *Ridgewayia*, as exemplified by the two Tortugas species, are closely set as in most other Calanoida. The antennule of *Ridgewayia* is longer than that of *Pseudocyclops*, which has the segments reduced both in number and length so that the antennule is usually shorter than the cephalic segment. In *Pseudocyclops* the right antennule of the male is also more strongly geniculate and otherwise modified. The rami of the antennae differ in their segmentation pattern. There are strong resemblances in the mandible—the blades being very much alike in the two genera and the palps differing principally in the elongation of the basipod in *Pseudocyclops*. The maxillule has the same number of elements, but in *Pseudocyclops* the distal portions tend to elongation, and some parts have much more reduced armature than found in *Ridgewayia*. There are very striking differences in the structure of the maxillae and maxillipeds of the two genera; in *Pseudocyclops*, the maxilliped is much reduced. In general, the several differences of the cephalic appendages do not indicate an extremely close relationship between the two genera. This, combined with the difference in the location of the genital openings, seems to exclude placement in the same family. On the other hand, the likeness of habitus and habitat and the similarities of the legs may indicate some degree of phylogenetic relationship.

The group of species referred herein to the single genus *Ridgewayia* have been shown to be in part inadequately known. The lack of knowledge, however, is specific or generic. The species are quite obviously referable to the same family. In the complete absence of any other family in which they can be placed, and in light of more complete knowledge than was available to former authors, it is appropriate to propose for these species a new family, as follows:

RIDGEWAYIIDAE, new family

Copepoda, Calanoida. Detailed diagnostic characters as given above for the unique genus *Ridgewayia*. Characterized principally by the combination of unreduced and little-specialized cephalic appendages, weakly geniculate right male antennule, fully segmented legs 1–4, and distinctively modified but biramose fifth legs in both sexes.

TYPE AND ONLY KNOWN GENUS (as herein defined): *Ridgewayia* Thompson and A. Scott (1903).

Gurney (1931, p. 84) has outlined a grouping of the calanoid families that is taxonomically very useful. For the most part, the new family Ridgewayiidae is taxonomically referable to the definition of the first group, the Centropagina. Gurney considered this group to represent the most primitive of the Calanoida and to be closely allied to another group which included only the Calanidae. Within the Centropagina there are some genera with highly modified fifth legs and reduced endopods (such as *Isias*), so there would appear little reason to exclude *Ridgewayia* because of the complexity of the left exopod and modification of the endopods of the male fifth legs. The more primitive segmentation of the antennule found in the new Tortugas species emphasizes rather than negates relationship with this group. However, when the phylogenetic position of this family is considered it is probable that important significance must be given to the segmentation of the geniculate antennule in relation to the seemingly unusual position of the hinge. Too little is known to evaluate this at present, and *Ridgewayia* appears as a highly singular genus exhibiting a combination of primitive characters with others of unique or specialized modification. For taxonomic purposes, however, the Ridgewayiidae may be currently placed with Gurney's Centropagina or considered allied to that group.

Similar taxonomic considerations may apply, with some qualifications, to the Pseudocyclopidae, placed by Gurney in an undefined group of "uncertain position." Gurney's concept of the Pseudocylopidae may have been somewhat in error inasmuch as he appears to have considered it as including the very anomalous genus *Platycopia*, which he spoke of as being "related to *Pseudocyclops*" (1931, p. 82). As has been pointed out (M. S. Wilson, 1946), *Platycopia* is unique among known calanoids and cannot be closely related to any known genus. Nor is there any known allied family as implied by Lang (1948, pp. 24, 26) in his reference to "Platycopiidae and closely allied families." Lang has placed the Platycopiidae in a suborder separate from the Calanoida. Nomenclaturally, Lang's system has the regrettable and inconvenient effect of eliminating entirely the much-used term Calanoida, which, though equivalent to Giesbrecht's term Gymnoplea, has long been preferred and extensively used. Lang's comments on the systematics of the Copepoda are brief and in part inconclusive, but the concepts presented are worthy of consideration by systematists. Attention is drawn here to Lang's paper because it is one that may easily be overlooked by specialists in the Calanoida.

Habitat and distribution

The existing records of *Ridgewayia* are all from tropical or subtropical coastal areas. Although they suggest that the species may be somewhat localized, they are too few to verify such a suggestion. They more strongly support the indication that the genus is not a pelagic form. This indication is not refuted by the instances in which it occurred in plankton hauls because the records of occurrence are so few and only one or two specimens were captured. Hauls reported by Gurney and Pinney were made at night when bottom copepods may ascend to higher water levels. Gurney interpreted *Suezia canalis* as "a species living on the bottom during the day" and included the record in the report on the littoral rather than the pelagic Copepoda of the Suez Canal.

The four species represented in collections by several specimens were all found in comparable situations. Specimens of *R. typica* were found in sediment from oyster shells taken on a reef; *marki* occurred in an island cave dominated by the coral *Agaricia gracilis;* and the two new species from the Dry Tortugas were associated with corraline algae. The warm, shallow waters of tropical and subtropical reefs and rocky shores, particularly among islands, is therefore suggested as a common habitat of the genus. This is unusual for Calanoida, but it is such a little-investigated habitat of Copepoda that our information concerning the calanoids that may occur in such situations is very meager.

That the genus may also be a bottom-living form of deeper coastal waters is suggested by the records in which the species occurred in plankton hauls. Aside from the investigations made by Thomas Scott and G. O. Sars on the north European coast, the bottom-living calanoids are practically unknown. Since Scott and Sars found several genera and species not closely related to one another or to known pelagic genera and families, it would appear safe to hazard the guess that there may exist other species, genera, or even families of Calanoida that are as yet undiscovered. There are published records of only five genera of this habitat group from American waters. *Pseudocyclops* has been recorded from northern Canadian waters by C. B. Wilson (1936) and from Bermuda by Esterly (1911). A new species of *Stephos* was found in collections from James Bay by Willey (1923). Two new species of *Platycopia* were described from the Maine coast by M. S. Wilson (1946). *Ridgewayia* was found in Bermuda by Esterly (1911) and to this is now added the Dry Tortugas records. In addition, Fleminger (1957) has described new species of *Stephos* and *Bradyidius* from the Gulf of Mexico.

The distribution of the species of *Ridgewayia* emphasizes the known faunistic affinity between the Indo-West-Pacific region and the American tropical Atlantic (West Indian) region (Ekman, 1953; Hyman, 1955). Sewell (1948) has listed many species of pelagic copepods common to the two areas and has also (1940, p. 354) pointed out the similarity of the littoral copepod fauna of the Suez Canal with that of the coasts of India and Ceylon. The littoral copepod fauna of the West Indian region is scarcely known, but Willey (1930) has shown the Bermudan harpacticoid fauna to be related to that of the Suez Canal. Nicholls (1944) has pointed out the striking similarity of Suez Canal and Bermudan species of *Pseudocyclops* (*P. magnus* Esterly, 1911, and *P. latens* Gurney, 1927). The closely allied Tortugas and Bermuda species of *Ridgewayia* emphasize the relationship of these two areas of the West Indian region, and, through their demonstrated relationship to species of the Suez Canal and the Indian coast, are another example of littoral animals zoogeographically linking the Indo-West-Pacific and West Indian regions.

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U. S. GOVERNMENT PRINTING OFFICE: 1958