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PARASTEPHOS OCCATUM, A NEW SPECIES OF HYPERBENTHIC COPEPOD (CALANOIDA: STEPHIDAE) FROM THE INLAND MARINE WATERS OF WASHINGTON STATE[1]

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Sars (1902) described the first species of *Parastephos*, *P. pallidus*. Additional descriptions of this species have been given by Sars (1903, 1919) and Scott (1903). More than a dozen species of the closely related *Stephos* Scott, 1892, have been described, but I am aware of no other *Parastephos* in the literature.

Most marine calanoid copepods are planktonic and not associated with the bottom. A few have been referred to as bottom-living, since they have been obtained almost exclusively on or near the bottom. Beyer (1958) used "hyperbenthos" in referring to animals living just above the bottom. He differentiated between those animals that are bound to this region and those that are not. Hyperbenthic animals are distinct from those living on (epibenthos) or in (endobenthos) the bottom. The hyperbenthic animals exist in a region about which relatively little is known.

Hyperbenthic calanoid copepods are seldom taken in plankton collections. Specially constructed dredges have been used to sample just above the sediment; such collections have yielded species encountered infrequently (Sars, 1902; Beyer, 1958; Matthews, 1961). However, hyperbenthic species may move upward and be captured with conventional nets.

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Certain calanoid families seem to contain mostly, if not entirely, hyperbenthic species. Other families of mostly planktonic species have genera of hyperbenthic species. Bradford (1969) has summarized many records of hyperbenthic calanoids. With the development of new techniques to sample the near-bottom plankton, previously unknown calanoids will be found. Such samples may also reveal unusual groups of other copepods, as Wilson (1965) suggested for harpacticoids.

The present species was first found during a study of the vertical distributions of Copepoda in Dabob Bay in 1960. Dabob Bay is an inlet with a maximum depth of 190 m, which joins Hood Canal about 20 miles southwest of its connection to Puget Sound, Washington. Bottom depth at station 1 was about 160 m; the sample was collected 29 October at 1430 hr. Bottom depth at station 2 was about 150 m; the sample was collected 27 December at 1620 hr. Samples were collected with Clarke-Bumpus quantitative plankton samplers (Paquette and Frolander, 1957) using nets with a mesh aperture of 215 μ. Samples were obtained by towing the net 20 min as close to the bottom as practicable; there was no indication that the bottom was struck. Wire-angle calculations indicated that the samples were taken not farther than a few meters from the bottom. From 10 to 20 m^3 of water were filtered for each sample.

The species was found again, in 1965, at Port Madison, Puget Sound; bottom depth at station 3 was about 20 m; this locality is described in detail by Lie (1968) as station 3. This sample was collected 28 February at 1115 hr, with a Beyer "plankton sled" towed on the bottom for 10 min. The design of the sled prevented sampling while it was being lowered or raised. The center of the net, a 0.5-m ring net with 215-μ mesh aperture, was towed about 55 cm above the bottom.

Body length measurements are from anterior border of prosome to posterior edge of caudal rami. Figures were drawn with the aid of a Wild M20 drawing tube. The letter after each

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FIG. 1. *Parastephos occatum* female: *a*, habitus, dorsal view (A); *b*, habitus, lateral view (A); *c*, first antenna (D); *d*, left leg 1 (F); *e*, leg 5 (F).

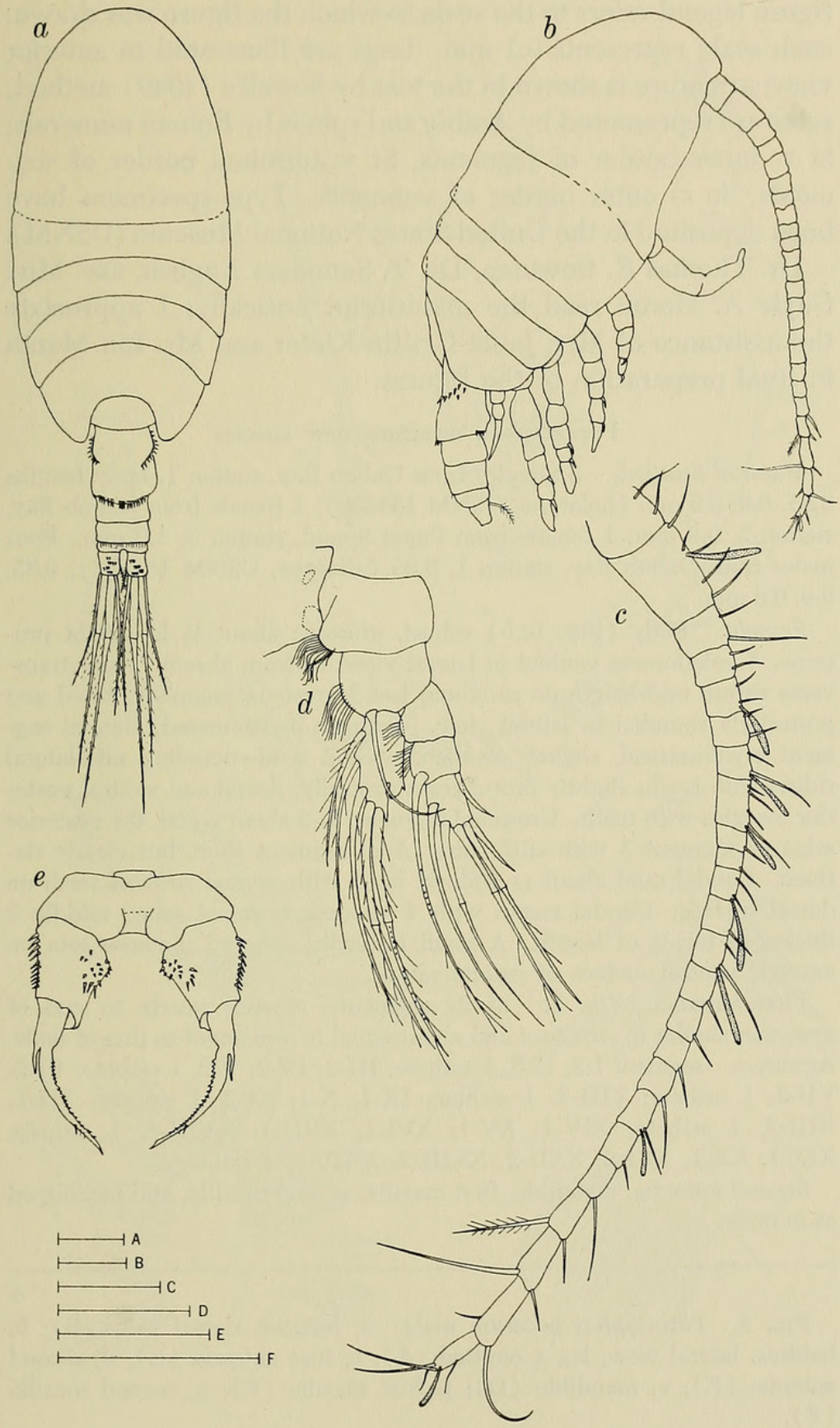

figure legend refers to the scale to which the figure was drawn; each scale represents 0.1 mm. Legs are illustrated in anterior view; armature is shown in the text by Sewell's (1949) method; setae are represented by Arabic and spines by Roman numerals; Si = inner border of segments, St = terminal border of segments, Se = outer border of segments. Type-specimens have been deposited in the United States National Museum (USNM).

Dr. Thomas E. Bowman, Dr. T. Saunders English, and Miss Gayle A. Heron read the manuscript critically; I appreciate the assistance of Mrs. Janet Griffin Kiefer and Mr. Ion Manta in final preparation of the figures.

Parastephos occatum new species

Material Studied: 3 females from Dabob Bay, station 1, body lengths 0.85, 0.9, 0.9 mm (holotype, USNM 134480); 1 female from Dabob Bay, station 2, 0.9 mm; 1 female from Puget Sound, station 3, 1.0 mm. Four males from Dabob Bay, station 1, 0.85 (allotype, USNM 134481), 0.85, 0.9, 0.9 mm.

Female: Body (Fig. 1*a,b*) robust, urosome about ⅓ length of prosome. Cephalosome vaulted in lateral view; rostrum absent. Faint transverse suture mid-length on prosome; last 2 prosomal segments fused and posteriorly rounded in lateral view. Urosome 4-segmented. Genital segment asymmetrical, slightly swollen, with 2 semi-encircling mid-lateral ridges with teeth; slightly protuberant ventrally; dorsal and ventral posterior margins with teeth. Urosomal segments 2–3 about equal, the posterior edge of segment 3 with stiff hairs. Anal segment short but clearly defined. Caudal rami about as wide as long, with several rows of teeth on dorsal surface. Caudal ramus with 4 plumose terminal setae, middle 2 thickened for ⅓ of length. A small inwardly directed plumose seta on anterior ventral surface of caudal ramus.

First antenna (Fig. 1*c*) of 24 segments; extends nearly to end of urosome; similar in structure and about equal in armament to that of male. Armature: segment I-2; II-5, 1 esthete; III-2; IV-2; V-2, 1 esthete; VI-2; VII-2, 1 esthete; VIII-4, 1 esthete; IX-1; X-1; XI-2, 1 esthete; XII-1; XIII-2, 1 esthete; XIV-1; XV-1; XVI-1; XVII-1; XVIII-1, 1 esthete; XIX-1; XX-1; XXI-2; XXII-2; XXIII-2; XXIV-4, 1 esthete.

Second antenna, mandible, first maxilla, second maxilla, and maxilliped as in male.

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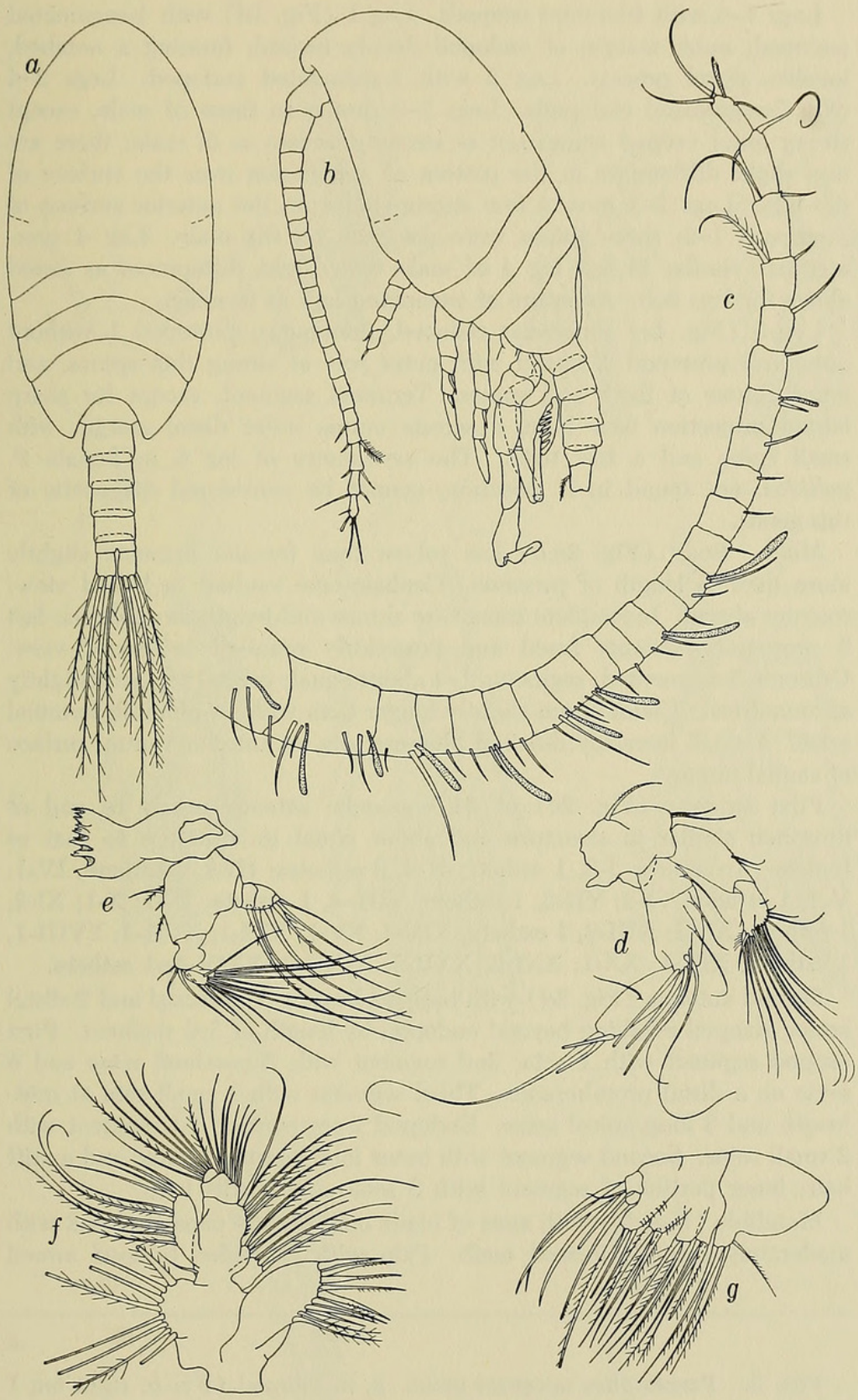
Fig. 2. *Parastephos occatum* male: *a*, habitus, dorsal view (B); *b*, habitus, lateral view, leg 4 omitted (A); *c*, first antenna (E); *d*, second antenna (E); *e*, mandible (D); *f*, first maxilla (F); *g*, second maxilla (F).


a
b
c
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Legs 1–4 with trimerous exopods. Leg 1 (Fig. 1*d*) with 1-segmented endopod; outer margin of endopod deeply incised, forming a notched, lobelike distal process. Leg 2 with 2-segmented endopod. Legs 3–4 with 3-segmented endopods. Legs 2–3 similar to those of male, except strong outer exopod spines not as strongly serrate as in male; there are also slight differences in the pattern of spinulation over the surface of the legs. Legs 2–4 have a few strong spines on the anterior surface of protopods 1–2; these spines were not seen on the male. Leg 4 symmetrical, similar to left leg 4 of male with slight differences as noted above for legs 2–3. Armature of swimming legs as in male.

Leg 5 (Fig. 1*e*) somewhat reduced, uniramous; protopod 1 without armature; protopod 2 armed with outer row of strong thin spines, and inner cluster of teeth and spines. Terminal segment, except for sharp lateral projection near base, a serrate curve; outer distal margin with small spine and a few hairs. The asymmetry of leg 5 in female *P. pallidus*, not found in *P. occatum*, cannot be considered diagnostic of this genus.

Male: Body (Fig. 2*a*,*b*) less robust than female; urosome slightly more than ⅓ length of prosome. Cephalosome vaulted in lateral view; rostrum absent. Incomplete transverse suture mid-length on prosome; last 2 prosomal segments fused and posteriorly rounded in lateral view. Urosome 5-segmented; segments 1–4 about equal; genital segment slightly asymmetrical. Caudal rami slightly longer than wide; 4 plumose terminal setae. A small inwardly directed plumose seta on anterior ventral surface of caudal ramus.

First antenna (Fig. 2*c*) of 24 segments; extends nearly to end of urosome; similar in structure and about equal in armature to that of female. Armature: I-3, 1 esthete; II-4, 2 esthetes; III-2, 1 esthete; IV-1; V-2, 1 esthete; VI-2; VII-2, 1 esthete; VIII–4, 1 esthete; IX-1; X-1; XI-2, 1 esthete; XII-1; XIII-2, 1 esthete; XIV-1; XV-1; XVI-1; XVII-1; XVIII-1, 1 esthete; XIX-1; XX-1; XXI-2; XXII-2; XXIII-2; XXIV-4, 1 esthete.

Second antenna (Fig. 2*d*) with basipod bearing 1 proximal and 2 distal setae. Exopod reaching beyond endopod by length of 3rd segment. First exopod segment with 1 seta; 2nd segment with 2 proximal setae and 5 setae on a distal protuberance. Third segment with 1 small seta at mid-length and 3 long apical setae. Endopod 2-segmented; 1st segment with 2 small setae. Second segment with outer lobe bearing 7 setae and a stiff hair; inner portion of segment with 8 setae and a stiff hair.

Mandible (Fig. 2*e*) with apex of blade only slightly expanded and with moderately strongly incised teeth. Palp with expanded basipod armed

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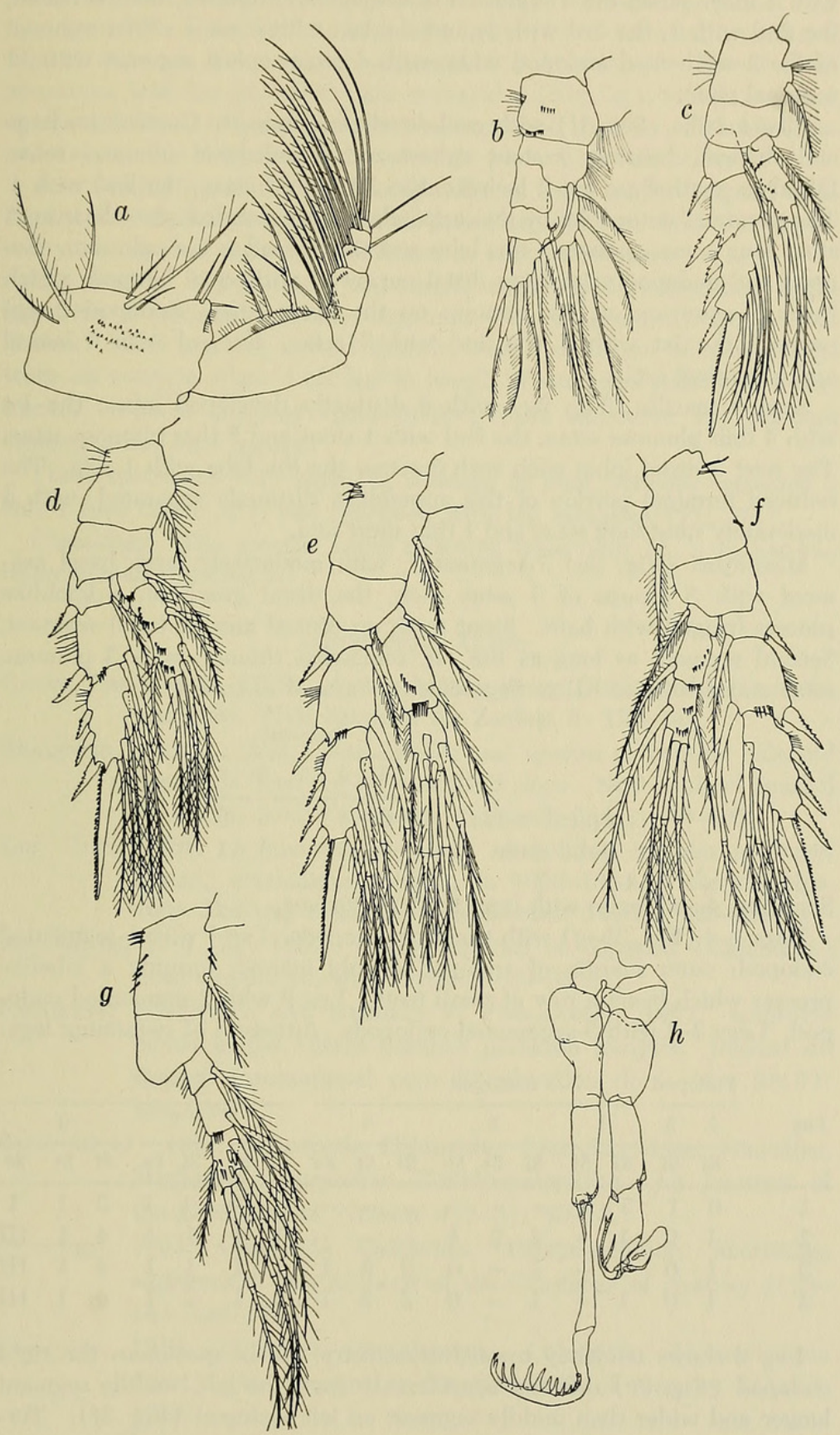
FIG. 3. *Parastephos occatum* male: *a*, maxilliped (F); *b*, right leg 1 (E); *c*, right leg 2 (E); *d*, right leg 3 (E); *e*, right leg 4 (E); *f*, left leg 4 (E); *g*, right leg 4, exopod omitted (E); *h*, leg 5 (C).


a
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with 4 inner setae; the 4 segments of exopod well-defined, the 1st naked, the 2nd with 1, the 3rd with 2, and the last with 3 setae. First segment of the 2-segmented endopod wide, with 4 setae; apical segment with 11 terminal setae.

First maxilla (Fig. 2*f*) with well-developed basipod. Gnathobase large and distinct, bearing 8 stout spines and 2 subapical plumose setae. Distal to gnathobase are 2 laciniae, the 1st with 3 setae, the 2nd with 4. The proximal outer lobe of this appendage an expanded plate bearing 8 stout long setae. Between this lobe and the exopod is a single seta. Exopod and endopod arise from distal narrowed portion of basipod, which bears 5 setae and a few spinules on the inner edge. Endopod 2-segmented; the 1st with 8, the 2nd with 7 setae. Exopod with 6 lateral and 4 terminal setae.

Second maxilla (Fig. 2*g*) with 6 distinctly developed lobes; the 1st with 4 thin plumose setae, the 2nd with 1 stout and 2 thin plumose setae. The next 3 distal lobes each with 3 setae; the 6th lobe with 1 seta. The reduced terminal portion of this appendage distinctly separated, with 4 moderately stout long setae and 1 thin short seta.

Maxilliped (Fig. 3*a*) 7-segmented, with moderately large basal segment with 3 groups of 3 setae each, the distal group on a knoblike process fringed with hairs. Stout teeth on central area of basal segment. Second segment as long as the 1st, somewhat thinner, with 3 plumose setae and 2 rows of hairs. Segments 3–7 armed as follows:

	Segment				
	3	4	5	6	7
Apical setae	6	4	3	3	3
Basal setae				1	1

Segments 4 and 5 also with stout teeth on surface.

Legs 1–4 (Fig. 3*b–g*) with trimerous exopods. Leg 1 with 1-segmented endopod; outer margin of endopod deeply incised, forming a lobelike process which bears a row of small teeth. Leg 2 with 2-segmented endopod. Legs 3–4 with 3-segmented endopods. Armature of swimming legs:

Leg	Protopod		Endopod									Exopod						
	1	2	1		2			3				1		2		3		
	Si	Si	Si	St	Si	St	Se	Si	St	Se		Si	Se	Si	Se	Si	St	Se
1	0	1	3	2	–	–	–	–	–	–		0	0	1	I	3	1	I
2	1	0	1	–	2	2	1	–	–	–		1	I	1	I	4	I	III
3	1	0	1	–	1	–	0	2	2	1		1	I	1	I	4	I	III
4	1	0	1	–	1	–	0	2	2	1		1	I	1	I	4	I	III

Leg 4 shows tendency toward asymmetry. On 2 specimens the right endopod (Fig. 3*e*) differed considerably from the left; middle segment longer and wider than middle segment on left endopod (Fig. 3*f*). Ter-

minal segment of right endopod armed with 3 bladelike processes that appear to be a fused series of spinules, present in a reduced, non-fused, typical state on the terminal segment of left endopod. The 2 other specimens with less-modified right endopod 4 (Fig. 3*g*); middle segment similar to that on left endopod; terminal segment, however, with bladelike processes and a thickened inner seta not present on left endopod.

Sars (1902) noted the same asymmetry of leg 4 on the original male *Parastephos pallidus*. Sars (1919), however, did not find this asymmetry in a second male collected later at another locality.

Leg 5 (Fig. 3*h*) elongate, uniramous, markedly asymmetrical. Right leg with 5 distinct segments; segments 1–4 progressively longer and thinner. Fifth segment curved sharply, armed with row of strong large teeth on concave edge. Left leg ⅔ length of extended right leg; 5-segmented. Fourth segment spoon-shaped, with lappetlike 5th segment tending to flex back upon it.

Three specimens with right leg 5 flexed at joint between segments 3 and 4 (see figure 2*b*); one specimen with leg extended (Fig. 3*h*).

Etymology: The specific name *occatum*, from occo (L.), to harrow, refers to male right leg 5.

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