

**Trematodes of a New Genus, *Neoplagioporus* gen. n.
(Digenea: Opcoelidae: Plagioporinae), and an Unidentified Opcoelid
from Freshwater Fishes of Japan**

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Abstract

A new genus, *Neoplagioporus* gen. n., is proposed in the subfamily Plagioporinae Manter, 1947 (Opcoelidae). It is morphologically characterized chiefly by the distinctly bipartite, short and straight seminal vesicle, the sinistrally submedian genital pore, the usually trilobate or rarely smooth to bilobate ovary, and the vitelline follicles usually entering the forebody or rarely being confined to the hindbody. *Neoplagioporus zacconis* (Yamaguti, 1934), comb. n. (= *Caudotestis zacconis* Yamaguti, 1934, type species), *N. ayu* (Takahashi, 1928), comb. n. (= *Podocotyle ayu* Takahashi, 1928), *N. elongatus* (Goto et Ozaki, 1930), comb. n. (= *Lebouria elongata* Goto et Ozaki, 1930 = *C. orientalis* Yamaguti, 1934, syn. n. = *C. gnathopogonis* Yamaguti, 1934, syn. n.), and an unidentified opcoelid are described and figured from Japanese freshwater fishes. Data on their hosts, geographical distribution and life cycles are given.

Key words: digeneans, *Neoplagioporus* gen. n., Opcoelidae, freshwater fishes, Japan

This paper, the fifth in a series on the digenetic trematodes of the Japanese freshwater fishes, covers three species of a new genus in the subfamily Plagioporinae Manter, 1947, and an unidentified trematode, all in the family Opcoelidae Ozaki, 1925.

The materials and methods and the diagnosis of the Opcoelidae have appeared in the first and third papers (Shimazu, 1988a, b).

Subfamily Plagioporinae Manter, 1947

Plagioporinae Manter, 1947, p. 286 (type genus, *Plagioporus* Stafford, 1904).

Diagnosis. Opcoelidae. Intestinal ceca ending blindly, forming a cyclocecum or opening separately at or near posterior extremity of body. Ventral sucker sessile or pedunculate, with no appendages. Testes two or three to ten. Cirrus pouch entire, containing seminal vesicle, prostatic complex and cirrus. External seminal vesicle

absent. Genital pore ventral, median or sinistrally submedian, prebifurcal. Ovary pretesticular or opposite anterior testis. Seminal receptacle present, canalicular. Uterus usually pretesticular, sometimes extending into testicular region. Eggs filamented or not, nonembryonated when laid. Vitelline follicles distributed along ceca, entering forebody or confined to hindbody. Intestinal parasites of marine and freshwater fishes and amphibians.

Miracidia nonoculate, with one pair of flame cells; epidermal cell formula reportedly 6, 7, 4, 2. Cotylomicrocercous cercariae produced in daughter sporocysts in prosobranch snails; flame cell formula $2 [(2+2) + (2+2)] = 16$. Metacercariae encysting in aquatic arthropods and octopuses, rarely attaining sexual maturity to bear eggs while still in their cysts.

Discussion. This diagnosis has been based mainly on Manter (1947), Yamaguti (1971, 1975), Gibson and Bray (1982, 1984) and the present study.

Although it is beyond the scope of this paper, it would be worth mentioning the cirrus pouch

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in the Opecoelidae. The cirrus pouch may fall roughly into two types: type 1, in which the cirrus pouch is entire and encloses the whole of the seminal vesicle, the prostatic complex and the cirrus as seen in the Plagioporinae (see this paper); and type 2, in which it is not entire and encloses only the anteriormost or distal portion of the seminal vesicle, the prostatic complex and the cirrus, or may be weakly developed or almost lacking as seen in the subfamily Opecoelinae Ozaki, 1925 (Shimazu, 1988b), except in a few genera or species with an entire cirrus pouch (Holton, 1984). *Opecoelus variabilis* Cribb, 1985 (Opecoelinae), has the cirrus pouch of type 2 in the adult stage (Cribb, 1985; my unpublished reexamination of his specimens). I was able to observe the formation and change in structure of the cirrus pouch in the metacercarial stage of this trematode. Living metacercariae were obtained from *Caridina nilotica* and *Macrobrachium australiense* caught in the Brisbane River, Queensland, Australia, from 1988 to 1989. My observations suggest that the cirrus pouch of type 1 is fully formed by earlier stages of development of the metacercaria and that later in more advanced stages it changes its structure from type 1 to type 2 when its proximal or posterior part disappears (possibly degenerates or ruptures) while leaving the remainder enclosing the distal portion of the seminal vesicle, the prostatic complex and the cirrus. A similar change in structure of the cirrus pouch during ontogeny might also occur in some other species of an opecoeline genus, *Coitocaecum* Nicoll, 1915 (Shimazu, 1988b), though *C. anaspidis* Hickman, 1934, keeps an entire cirrus pouch of type 1 even in the adult stage (Holton, 1984). The entire cirrus pouch of type 1 is considered primitive, and the partial or not entire cirrus pouch of type 2, derived. This supports, in part, Gibson and Bray's (1984) speculation on evolutionary relationships among opecoelid subfamilies.

There have been reported three plagioporines from Japanese freshwater fishes. Since they cannot be adequately allocated to any of the known genera in the subfamily, a new genus is erected for them as follows.

Genus *Neoplagioporus* gen. n.

Diagnosis. Opecoelidae: Plagioporinae. Body elongate to ovate, nonspinose, not oculate. Oral sucker ventroterminal. Prepharynx very short. Pharynx well developed. Esophagus fairly long, bifurcating in front of ventral sucker; intestinal ceca ending blindly near posterior extremity of body or slightly more anteriorly. Ventral sucker sessile, in anterior half of body. Testes two, smooth or indented, tandem or slightly diagonal, in posterior half of body. Cirrus pouch entire, in front of ventral sucker or overlapping it posteriorly; seminal vesicle distinctly bipartite, short, straight; pars prostatica small, accompanied by prostatic cells; cirrus short. Genital atrium small. Genital pore ventral, sinistrally submedian, prebifurcal. Ovary usually trilobed or rarely globular to bilobed, usually submedian, pretesticular. Seminal receptacle canalicular, postovarian. Laurer's canal present. Ootype complex preovarian. Uterus usually pretesticular, rarely extending into testicular region, intercecal. Eggs not filamented, not embryonated when laid. Vitelline follicles distributed along ceca, usually extending into forebody or rarely limited to hindbody, separate or confluent anteriorly, ending posteriorly at posterior extremity of body or some distance in front of it. Excretory vesicle I-shaped, reaching to level of testes; flame cell formula $2[(2+2)+(2+2)] = 16$. Known from intestine of freshwater fishes.

Type species: *Caudotestis zacconis* Yamaguti, 1934.

Life cycle: Unknown.

Discussion. Major morphological characters of this new genus, *Neoplagioporus* gen. n., are: the seminal vesicle being distinctly bipartite, short and straight; the genital pore being ventral, sinistrally submedian and prebifurcal; the ovary being usually trilobate or rarely globular to bilobate; and the vitelline follicles usually extending into the forebody or rarely being limited to the hindbody. In morphology the genus appears to be more closely related to *Podocotyle* Dujardin, 1845, *Plagioporus* Stafford, 1904, *Neolebouria* Gibson, 1976, and *Macvicaria*

Gibson et Bray, 1982, out of many genera proposed in the subfamily, but it can be readily distinguished from them by a combination of the above-mentioned characters. The genus *Podocotyle* (probably brackishwater and marine forms) has a trilobed ovary and the vitellaria usually confined to the hindbody (Gibson and Bray, 1982). *Fasciola atomon* Rudolphi, 1802, or *P. atomon* (Rudolphi, 1802) Odhner, 1905, which has been generally accepted as the type species, possesses a long, looped or convoluted tubular seminal vesicle (Odhner, 1905; MacKenzie and Gibson, 1970; Gibson and Bray, 1982). According to Gibson and Bray (1982), the type species is *Distoma angulatum* Dujardin, 1845, or *P. angulata* (Dujardin, 1845) Stiles et Hassall, 1898 (= *P. staffordi* Miller, 1941 = *P. atomon* var. *dispar* Nicoll, 1909 = *Podocotyle* sp. of MacKenzie and Gibson, 1970), in which a tubular cirrus pouch is long and looped as well (Nicoll, 1909; Dollfus, 1968; MacKenzie and Gibson, 1970). Stafford (1904) and Miller (1940, 1941) gave brief descriptions and a figure for *Pl. serotinus* Stafford, 1904 (a freshwater form), the type species of the genus *Plagioporus*. It has a spherical ovary and the vitellaria distributed from the esophagus to the posterior end of the body. The internal anatomy of the cirrus pouch has never been described. I reexamined three immature syntypes of the species (NMCP 1900-1821) (Stafford, 1904; Miller, 1940, 1941) loaned from the Canadian Museum of Nature, Ottawa. Although they were so thick and deeply stained with carmine that they were not good for observing their detailed morphology, (1) a tubular seminal vesicle was weakly winding or looped but not bipartite; (2) the cirrus was long; (3) the ovary was spherical; (4) a canalicular seminal receptacle was small; (5) anteriorly confluent vitelline follicles were present from the esophageal level to some distance from the posterior end of the body and sometimes much thinner or almost lacking at the ventral sucker level; and (6) a short excretory vesicle extended anteriorly to near the posterior testis but did not reach it. I also examined four (one immature and three gravid) specimens (NMCP 1900-1635) of *Pl. serotinus* found in the intestine of *Cyprinus carpio* at

Montreal in 1904. They were indeed similar to the syntypes in morphology, but in one of them the ovarian complex was located between the two testes. Many species were described in the genus *Plagioporus* from not only freshwater fishes but also amphibians and marine fishes. Gibson and Bray (1982) restricted the genus to freshwater forms with a short excretory vesicle which reaches forward at the most to the level of the posterior testis and created a new genus, *Macvicaria*, for marine forms with a longer excretory vesicle which extends at least to the level of the anterior testis. The type species, *Distomum alacre* Looss, 1901, or *M. alacris* (Looss, 1901) Gibson et Bray, 1982, has a rounded ovary, a long and looped or convoluted seminal vesicle and the vitellaria commencing about the level of the genital pore (Gibson and Bray, 1982). The genus *Neolebouria* (marine forms) has a trilobed ovary, a long, looped (or convoluted) seminal vesicle and the vitelline follicles entering the forebody (Gibson, 1976; Gibson and Bray, 1982). The present new genus also appears to resemble the genus *Pseudosphaerostomum* Koval' et Shevchenko, 1970 (Opcoelidae: Sphaerostominae Poche, 1926). However, the type and only species, *Ps. caudotestis* Koval' et Shevchenko, 1970 (a freshwater form), has a saccular seminal vesicle and a dome-shaped muscular outgrowth surrounding the genital pore (Koval' and Shevchenko, 1970).

For the present the following three species are included in the new genus. Because of the sinistrally submedian genital pore, they are easily excluded from the genera *Lebouria* Nicoll, 1909 (a junior synonym of *Peracreadium* Nicoll, 1909), and *Caudotestis* Isaïchikov, 1928, both with a median genital pore (Nicoll, 1909; Bray, 1979; Gibson and Bray, 1982).

Neoplagioporus zacconis
(Yamaguti, 1934), comb. n.
 (Figs. 1-5)

- Caudotestis zacconis* Yamaguti, 1934, pp. 292-294, fig. 21.
C. zacconis: Yamaguti, 1938, p.20, plate-fig. 1; 1942, pp. 332-333.
Plagioporus (*C.*) *zacconis*: Yamaguti, 1954, p. 76.

Pl. (Pl.) zacconis: Skrjabin and Koval', 1958, pp. 533–537.

Material examined. 1) Lot 1. Two gravid whole-mounts (holotype and paratype, MPM Coll. No. 22221) of *C. zacconis* of Yamaguti (1934) from the intestine of *Zacco temmincki* (Cyprinidae) (type host) from [the Asako River] in Hyogo Prefecture on March 23, 1932. Yamaguti actually collected four specimens, but the two others have not yet been located.

2) Lot 2. Three gravid whole-mounts (MPM Coll. No. 22178) of *C. zacconis* of Yamaguti (1938) from the intestine of [*Z. platypus*] from Lake Suwa, Nagano Prefecture, on [May 17, 1935]. Yamaguti claimed to have obtained these from *Z. temmincki*, but the Japanese name of the host fish written by him on the labels of the two slides is "Oikawa," the scientific name for which is *Z. platypus*.

3) Lot 3. One gravid whole-mount (MPM Coll. No. 22222) of *C. zacconis* of Yamaguti (1942) from the intestine of *Oncorhynchus masou* [= *O. m. masou*] (Salmonidae) from Kasumigaura at [Tsuchiura, Ibaraki Prefecture], on April 4, 1940.

4) Lot 4. One immature and 4 gravid whole-mounts (NSMT-Pl 3623) from the intestine of *Z. platypus* from the Chikuma River at Ueda, Nagano Prefecture, on June 1, 1973.

5) Lot 5. Three immature and 3 gravid whole-mounts (NSMT-Pl 3624–3626) from the intestine of *Z. platypus* from the Oppe River at Ogose and the Iruma River at Hanno, both in Saitama Prefecture, on May 19 and October 13, 1976.

6) Lot 6. Three gravid whole-mounts (NSMT-Pl 3627) from the intestine of *Z. platypus* from the Kannose River at Matsugase, Hiroshima Prefecture, on October 30, 1976.

Description. 1) For the original description and figure for *C. zacconis*, see Yamaguti (1934).

From lot 1, 2 gravid whole-mounts measured (Figs. 1 and 2). Body oval, broadest at ovarian level, 1.42–1.58 by 0.67–0.87; forebody 0.63–0.67, 40–47% of body length. Oral sucker subterminal, 0.18–0.20 by 0.17–0.19. Prepharynx short. Pharynx barrel-shaped, 0.10

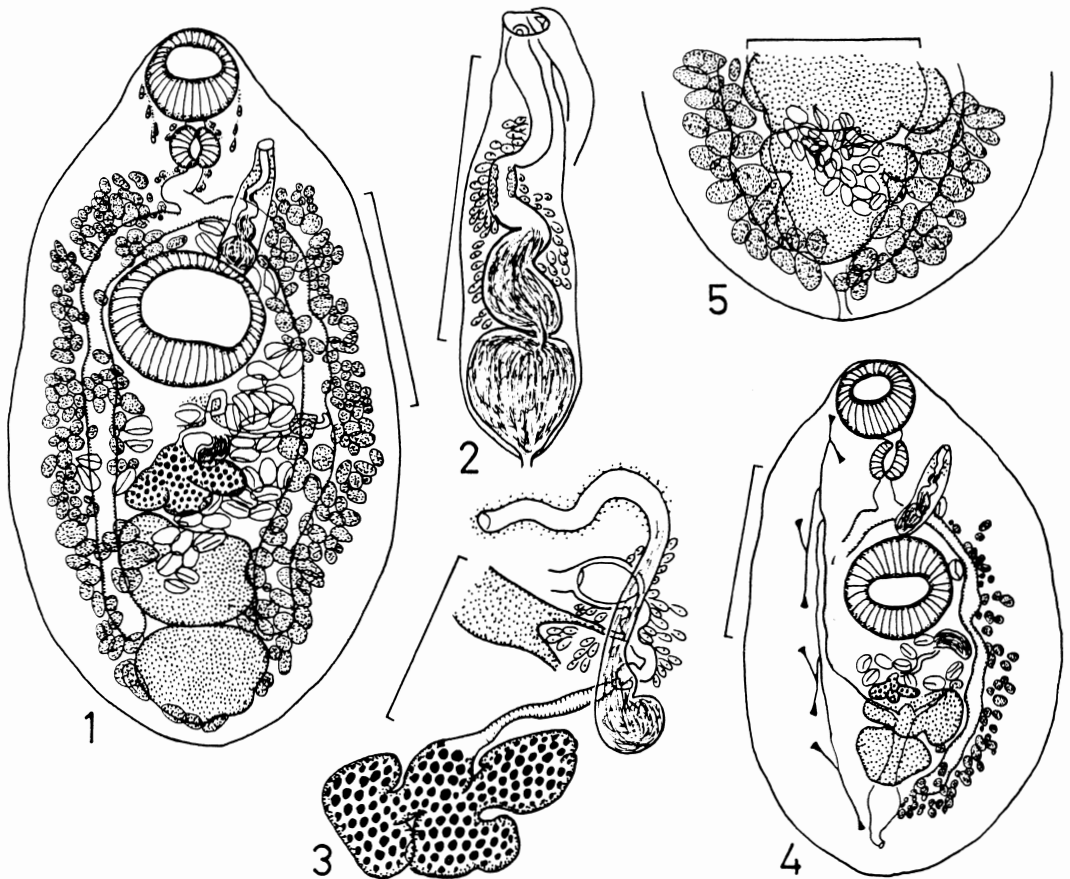
by 0.09–0.12. Esophagus short, straight or sinuous, 0.10–0.11 long, bifurcating about halfway between pharynx and ventral sucker; intestinal ceca reaching to midlevel between two testes or posterior border of posterior testis. Gland cells sparse, surrounding prepharynx and esophagus. Ventral sucker 0.30–0.31 by 0.32–0.36; sucker width ratio 1: 1.70–2.09.

Testes entire or irregularly indented, tandem, in middle of hindbody, 0.09–0.22 by 0.10–0.31. Cirrus pouch claviform, a little overlapping ventral sucker posteriorly, 0.30–0.35 by 0.08–0.09; seminal vesicle short, divided into elliptical and thin-walled posterior part and clavate, thick-walled and somewhat sinuous anterior part; pars prostatica small, with well-developed prostatic cells around it; cirrus short. Genital atrium shallow. Genital pore at level of pharynx or slightly behind it. Ovary deeply 3-lobed, pretesticular, sinistrally submedian, 0.16 by 0.16–0.27. Seminal receptacle canalicular, retort-shaped, almost median, side by side with ovary, 0.10–0.12 by 0.05–0.08. Laurer's canal passing transversely to left, opening dorsally to left cecum. Ootype complex preovarian, in front of seminal receptacle. Uterus extending backward along median line to midlevel of anterior testis; metraterm present. Eggs not embryonated, 70–80 by 36–40 μm (collapsed). Vitelline follicles distributed from behind pharynx to posterior border of posterior testis, embracing it there, lateral, ventral and medial to ceca, not seen dorsal to them, absent from peripheral lateral fields of body, confluent or separate anteriorly. Excretory system not worked out.

Yamaguti (1934) described the excretory vesicle as Y-shaped, but this is not true (seen below).

2) For lots 2 and 3, see Yamaguti (1938, 1942). In lot 2, the testes were smooth or indented, the eggs measured 70–77 by 37–45 μm . Fig. 3 shows the ovarian complex in lot 3. In this specimen, the ovary was located sinistral to the anterior testis, and the eggs measured 65–72 by 40 μm . The excretory vesicle could not be worked out in these specimens.

3) From lots 4 and 5, 10 gravid whole-mounts measured (Figs. 4 and 5). Body 1.46–3.08 by



Figs. 1–5. *Neoplagioporus zacconis*. 1 and 2: Holotype (lot 1) of *Caudotestis zacconis*, adult, entire worm and male terminal genitalia, ventral view. 3: Ovarian complex (lot 3), dorsal view. 4: Adult worm (lot 5), excretory system, ventral view. 5: Adult worm (lot 6), posterior part of body, ventral view. (Scale bars: 0.5 mm in Figs. 1, 4 and 5; 0.2 mm in Figs. 2 and 3.)

0.87–1.50; forebody 0.63–1.34, 35–45% of body length. Oral sucker 0.20–0.24 by 0.22–0.29. Pharynx 0.12–0.14 by 0.10–0.16. Esophagus straight or curved, 0.12–0.31 long; ceca sometimes extending to posterior border of posterior testis. Ventral sucker 0.29–0.45 by 0.31–0.45; sucker width ratio 1: 1.44–1.62.

Testes irregular in shape, tandem or slightly oblique, 0.16–0.53 by 0.22–0.51. Cirrus pouch 0.28–0.67 by 0.08–0.17, in front of ventral sucker or a little overlapping it. Ovary 3-lobed, pretesticular or to right of anterior testis, 0.16–0.27 by 0.24–0.40. Seminal receptacle 0.12–0.20 by 0.11–0.16. Uterus usually pretesticular, rarely extending to midlevel of

posterior testis. Eggs 63–80 by 38–44 μm in balsam. Excretory vesicle I-shaped, reaching to midlevel of anterior testis (a little farther than anterior testis in smaller, immature worms); flame cells unfolded fan-shaped, large, about 35 by 19 μm , with a formula of $2[(2+2)+(2+2)] = 16$; excretory pore dorso- or ventro-terminal. Other characteristics agreed well with those in lots 1–3.

Discussion. This species, *Neoplagioporus zacconis* (Yamaguti, 1934), comb. n., differs from the two others (see below) in the body being oval and broader, and the vitellaria being absent from both peripheral fields of the body and extending into the posttesticular space to embrace

the posterior testis there.

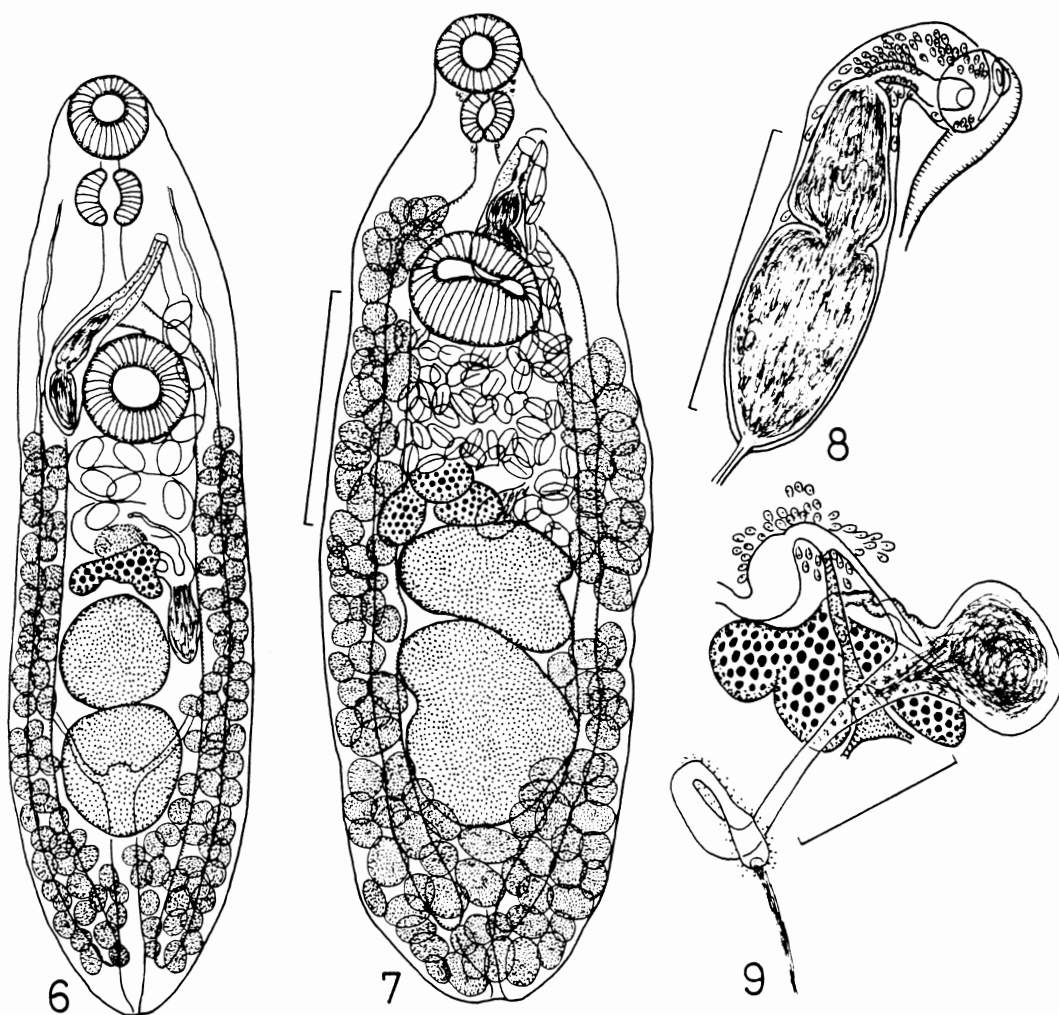
The species lives in *Oncorhynchus masou masou*, *Zacco platypus* and *Z. temmincki* in Japan (Yamaguti, 1934, 1938, 1942; this paper) and *Opsariichthys bidens* (Cyprinidae) in Fujian, China (Wang *et al.*, 1985). Its life cycle is unknown.

Neoplagioporus ayu (Takahashi, 1928),
 comb. n.
 (Figs. 6–9)

Podocotyle ayu Takahashi, 1928, pp. 51–55, figs. 1–3.
P. ayu: Yamaguti, 1934, pp. 294–295, fig. 22.

Material examined. 1) Lot 1. Five gravid whole-mounts (MPM Coll. No. 22579) of *P. ayu* of Yamaguti (1934) from the intestine of *Plecoglossus altivelis* (Plecoglossidae) from [the Hozu River, Kyoto Prefecture, on July 15, 1929, and July 16, 1932].

2) Lot 2. Three gravid whole-mounts (MPM Coll. No. 22624) of *P. ayu* of Yamaguti (1934) from the intestine of *Ple. altivelis* from [the Yura



Figs. 6–9. *Neoplagioporus ayu*. 6: Adult worm of *Podocotyle ayu*, ventral view, redrawn from Takahashi (1928). 7: Adult worm (lot 2), ventral view. 8: Male terminal genitalia (lot 1), ventral view. 9: Ovarian complex (lot 1), dorsal view.
 (Scale bars: 0.5 mm in Fig. 7; 0.2 mm in Figs. 8 and 9.)

River, Kyoto Prefecture, on November 20, 1929].

Description. 1) From the original description and figures for *P. ayu* by Takahashi (1928) with some slight alterations (Fig. 6). Body flat, elliptical, tapering at both rounded ends, 1.474 (mean) (1.220–1.740, range) by 0.364 (0.300–0.400) in whole-mounts. Tegument smooth, 2.2–3.5 μm thick. Oral sucker ventro-subterminal, 0.160 (0.147–0.175) in transverse diameter. Prepharynx 0.028 long. Pharynx 0.106 (0.105–0.112) by 0.102 (0.098–0.105). Esophagus narrow, 0.114 (0.105–0.175) by 0.035, bifurcating in front of ventral sucker a short distance off; intestinal ceca 0.028–0.042 wide, passing along both sides of body almost to posterior end of body. Ventral sucker larger than oral, 0.198 (0.196–0.203) in diameter, median, at end of anterior third of body.

Testes two, spherical, median, closely tandem, contiguous, in center of hindbody, anterior one 0.170 (0.154–0.224) and posterior one 0.209 (0.175–0.245) in diameter. Cirrus pouch [entire in fig. 1], slender, slightly curved conical body, 0.400 by 0.060, extending backward up to level between center of ventral sucker and posterior border of ventral sucker; its wall made of an internal circular layer and an external longitudinal layer of muscle fibers; seminal vesicle divided into two parts, occupying almost posterior half of cirrus pouch; pars prostatica comparatively small, prostatic cells present; ejaculatory duct acting as a protrusible cirrus in its terminal part. Genital pore ventral, sinistrosubmedian, a little behind pharynx. Ovary directly in front of anterior testis, slightly to right of median line, irregular in shape, slightly lobed; oviduct starting from dorsal aspect of ovary, coiling several times toward dorsal and left direction, turning toward left and anterior direction to receive a common vitelline duct, and then passing to ootype. [Seminal receptacle canalicular, lying between ovary and anterior testis and left cecum in figs. 1 and 2.] Laurer's canal arising from seminal receptacle at its left anterodorsal surface, opening dorsally near median line between ventral sucker and anterior testis. Ootype 0.081 by 0.051, surrounded by Mehlis' gland. Uterus slightly convoluted in region among posterior border of

ventral sucker, anterior testis and ceca, containing some 10 to 40 eggs; metraterm short. Eggs operculated, oval, thin-shelled, slightly yellowish brown, 0.0715 (0.0667–0.0759) by 0.0451 (0.0437–0.0483), containing an unsegmented ovum measuring 0.0184–0.023 in diameter and numerous yolk cells; no knob present at anopercular pole. Vitelline follicles numerous, 0.028–0.035 in diameter, extending continuously along ceca from level of posterior, seldom anterior border, of ventral sucker to posterior end of body, lateral fields approaching each other very closely in posterior region of body; vitelline reservoir just anterior and slightly dorsal to ovary. Excretory vesicle tubular, extending anteriorly as far as midlevel of posterior testis, giving off two main excretory canals there; each of them passing anteriorly along side of body to pharynx; many fine granules present in excretory vesicle and main excretory canals; excretory pore at posterior end of body.

2) For the brief original description and figure for lots 1 and 2, see Yamaguti (1934).

From lots 1 and 2, 8 gravid whole-mounts measured (Figs. 7–9). Body 1.30–2.53 by 0.47–0.71; forebody 0.40–0.79, 24–32% of body length. Oral sucker 0.12–0.16 by 0.12–0.18. Prepharynx present. Pharynx large, 0.09–0.14 by 0.07–0.10. Esophagus 0.08–0.24 long; ceca ending near posterior extremity of body. Ventral sucker 0.17–0.24 by 0.23–0.31; sucker width ratio 1: 1.45–1.76. Testes entire or irregular in shape, almost tandem, anterior one smaller than posterior one, 0.14–0.40 in diameter. Cirrus pouch clavate, short, reaching posteriorly to midlevel of ventral sucker, 0.24–0.34 by 0.08–0.16; seminal vesicle bipartite, short, straight; pars prostatica small, accompanied by prostatic cells; cirrus short. Ovary 3-lobed, dextrally submedian or median, 0.12–0.20 by 0.18–0.31. Seminal receptacle canalicular, retort-shaped, near ovary, 0.16 by 0.08–0.16. Laurer's canal normal, postovarian. Ootype complex preovarian. Uterus coiling several times among ventral sucker, ceca, ovary and anterior testis; metraterm short. Eggs 70–76 by 38–44 μm (collapsed). Vitellaria commencing anteriorly at midlevel of ventral sucker on both

sides of body (in one specimen, at bifurcal level on right or aporal side of body but at posterior border of ventral sucker on left side of body, Fig. 7), lateral, ventral and medial to ceca, not seen dorsal to them, separate anteriorly, confluent in posttesticular space. Excretory system not worked out. Other morphological features agreed with the above original description.

Yamaguti (1934) described and figured Laurer's canal as narrow with no cellular coat in its distal portion and ending blindly. Re-examination of lot 1 has proved that the canal is normal, opening dorsally, and that what he called the distal portion of it is a bundle of sperm having come out of the aperture of the canal (Fig. 9).

Discussion. Takahashi (1928) erected a new species, *Podocotyle ayu*, from the intestine of *Ple. altivelis* of the Asahi River, Okayama Prefecture. I have been unable to trace his type material. Yamaguti (1934) briefly described his specimens (lots 1 and 2).

The species should also be assigned to the new genus as *Neoplagioporus ayu* (Takahashi, 1928), comb. n., though the vitellaria are slightly variable in anterior limit from bifurcal level to level of the posterior margin of the ventral sucker (Takahashi, 1928; this paper). The species is different from the next species (see below) in a larger pharynx, the ceca and vitellaria always extending to near the posterior end of the body, and smaller eggs.

The species has been recorded only from *Plecoglossus altivelis* of Japan (Takahashi, 1928; Yamaguti, 1934; this paper). Its life cycle is unknown.

Neoplagioporus elongatus
(Goto et Ozaki, 1930), comb. n.
(Figs. 10–17)

Lebouria elongata Goto et Ozaki, 1930, pp. 75–76, fig. 2.

Caudotestis orientalis Yamaguti, 1934, pp. 288–290, fig. 19. (syn. n.)

C. gnathopogonis Yamaguti, 1934, pp. 290–292, fig. 20. (syn. n.)

Plagioporus elongata: Price, 1934, p. 6.

Pl. (C.) elongatus: Yamaguti, 1954, p. 76.

Pl. (C.) gnathopogonis: Yamaguti, 1954, p. 76.

Pl. (C.) orientalis: Yamaguti, 1954, p. 76.

Pl. (Pl.) elongatus: Skrjabin and Koval', 1958, pp. 459–460.

Pl. (Pl.) orientalis: Skrjabin and Koval', 1958, pp. 494–498.

Neolebouria elongatus: Gibson, 1976, p. 252.

Material examined. 1) Lot 1. Seventy-four gravid whole-mounts (MPM Coll. No. 30024) of *Lebouria* of Ozaki from *Sarcocheilichthys variegatus* (Cyprinidae) (other data not given). (One species and two subspecies in *Sarcocheilichthys* are known to occur in Japan: *S. biwaensis*, *S. variegatus variegatus* and *S. v. microoculus*; but all of them have been recognized as a single species, *S. variegatus*, until recently.)

2) Lot 2. Two gravid whole-mounts (holotype and paratype, MPM Coll. No. 22219) of *C. orientalis* of Yamaguti (1934) from the intestine of *S. variegatus* from [Lake Ogura, Kyoto Prefecture, on October 26, 1931]; and 1 gravid whole-mount (paratype, MPM Coll. No. 22180) from the intestine of *Pseudogobio esocinus* (Cyprinidae) from the Yodo River in [Kyoto Prefecture?] (date not given).

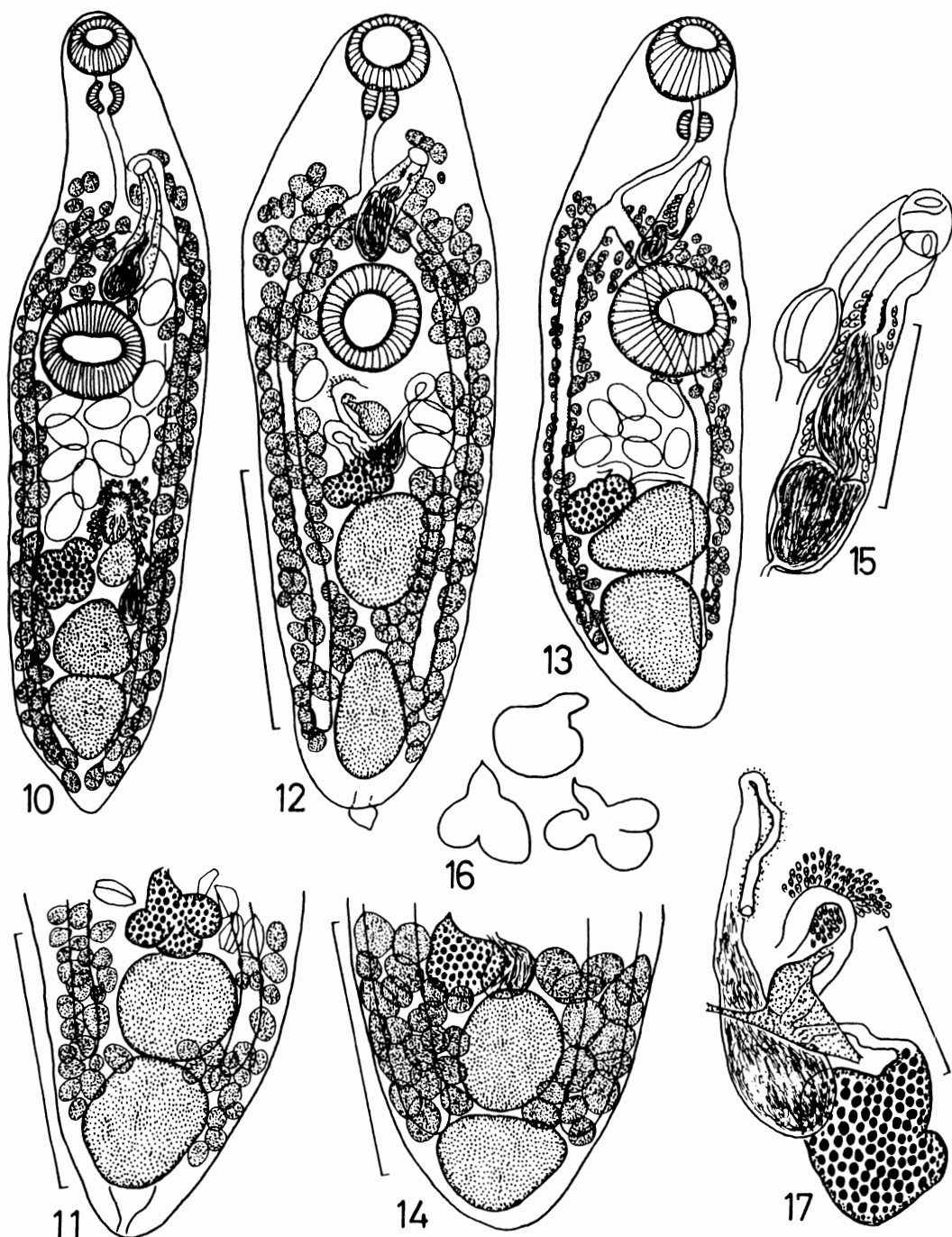
3) Lot 3. One gravid whole-mount (holotype, MPM Coll. No. 22220) of *C. gnathopogonis* of Yamaguti (1934) from the intestine of *Gnathopogon elongatus* (Cyprinidae) from Lake Biwa, Shiga Prefecture, on [March 13, 1932]. He described this species from the two specimens, but the other has not yet been located.

4) Lot 4. Two gravid whole-mounts (MPM Coll. No. 22181) of *C. orientalis* of Yamaguti (unpublished) from the intestine of *S. variegatus* [= *S. v. microoculus*?] from Lake Suwa, Nagano Prefecture, on March 30, 1936.

5) Lot 5. One gravid whole-mount (MPM Coll. No. 22631) of *Caudotestis* of Yamaguti (unpublished) from the intestine of *S. variegatus* from Lake Biwa on December 3, 1938.

6) Lot 6. One gravid whole-mount (MPM Coll. No. 22625) of Yamaguti (unidentified and unpublished) from the stomach of *Odontobutis obscura* (Gobiidae) from Lake Ogura on May 4, 1932.

7) Lot 7. Twelve immature and 113 gravid



Figs. 10–17. *Neoplagioporus elongatus*. 10: Adult worm of *Lebouria elongata*, ventral view, redrawn from Goto and Ozaki (1930). 11: Adult worm (lot 1), posterior part of body, ventral view. 12: Holotype (lot 2) of *Caudotestis orientalis*, adult, ventral view. 13: Holotype (lot 3, 1.41 by 0.4 mm) of *C. gnathopogonis*, adult, ventral view, redrawn from Yamaguti (1934). 14: Adult worm (lot 7), posterior part of body, ventral view. 15: Male terminal genitalia (lot 7), ventral view. 16: Ovaries (lot 7). 17: Ovarian complex (lot 7), dorsal view. (Scale bars: 0.5 mm in Figs. 11, 12 and 14; 0.2 mm in Figs. 15 and 17.)

whole-mounts (NSMT-PI 3628–3630) from the intestine of *S. v. microoculus* from Lake Biwa at Onoe on May 4 and June 3, 1980, and November 29, 1983. One (3628) of them was collected by Nagasawa, and ten (3630) were taken out of formalin-preserved fish.

8) Lot 8. Thirty-three gravid whole-mounts (NSMT-PI 3631) from the intestine of *Hemibarbus barbus* (Cyprinidae) from Lake Biwa at Onoe on June 3, 1980.

9) Lot 9. One gravid whole-mount (NSMT-PI 3632) from the intestine of *Tribolodon hakonensis* (Cyprinidae) from Lake Biwa at Onoe on June 3, 1980.

Description. 1) From the original description and figure for *L. elongata* by Goto and Ozaki (1930) with some slight alterations (Fig. 10). Body elongate, somewhat flattened, 1.12–1.49 by 0.31–0.38, with rounded anterior and rather pointed posterior extremities. Oral sucker sub-terminal, 0.12–0.14 in diameter. [Prepharynx present in fig. 2.] Pharynx small, 0.065–0.07 long. Esophagus bifurcating midway between pharynx and ventral sucker; intestinal ceca straight, ending near posterior end of body. Ventral sucker much larger than oral, 0.18–0.21 in diameter, at hind end of anterior half of body.

Testes ovoid, 0.15–0.2 by 0.13–0.16, tandem, [contiguous in fig. 2], in last quarter of body length. Cirrus pouch elongated clavate, 0.16–0.22 by 0.05–0.08, extending from genital pore to anterior border of ventral sucker; seminal vesicle large, attenuated anteriorly, full of sperm, located in posterior half of cirrus pouch, passing into ejaculatory duct [sic]; pars prostatica not differentiated; prostatic cells present. Genital pore about midway between median line and left margin of body as also between pharynx and intestinal bifurcation. Ovary on right and in front of anterior testis, smaller than testis [sic], with 4–6 peripheral lobes. Seminal receptacle medium-sized, pear-shaped, sinistrodorsal to anterior testis. [Ootype complex dextrally submedian, anterior to ovary and vitelline reservoir in fig. 2. Laurer's canal not described.] Uterine convolutions few, between anterior testis and ventral sucker. Eggs large, few, [10 in fig. 2], light yellow, long oval, 0.09–0.098 by 0.057–0.06,

with a thin shell. Vitelline follicles moderately developed, oval, not closely packed, surrounding ceca on external, ventral and dorsal sides, extending from level of genital pore to posterior end of body, coalescing in median line in front of ventral sucker: vitelline reservoir on left side of ovary. [Excretory system not described.]

From lot 1, 10 gravid whole-mounts measured (Fig. 11). Body nonspinose, 0.87–1.42 by 0.30–0.35; forebody 0.40–0.62, 39–46% of body length. Pharynx 0.05–0.06 by 0.05–0.07; ceca ending usually near posterior end of body or rarely at testicular level. Ventral sucker 0.17–0.20 by 0.16–0.22; sucker width ratio 1: 1.28–1.55. Testes tandem or slightly diagonal when the ovary is located anterodextral or dextral to the anterior one, entire or a little indented, 0.10–0.17 by 0.08–0.12. Cirrus pouch claviform, thin-walled, in front of ventral sucker, 0.20–0.26 by 0.05–0.06; seminal vesicle distinctly divided, posterior part oval, anterior part clavate; pars prostatica small, accompanied by prostatic cells; cirrus short, protrusible. Ovary globular or 2- to 3-lobed, anterior, anterodextral or dextral to anterior testis, 0.09–0.12 by 0.08–0.11. Seminal receptacle canalicular, retort-shaped, median or on left side of ovary, anterior to dorsal to anterior testis, 0.06–0.10 by 0.05–0.06. Laurer's canal not worked out. Ootype complex preovarian. Eggs not embryonated, less than 20 in number, 84–96 by 50–60 μm . Vitelline follicles extending anteriorly to midlevel of esophagus, confluent or separate anteriorly, ending posteriorly usually at near posterior end of body or sometimes at level of posterior border of posterior testis, lateral, ventral and medial to ceca, not seen dorsal to them. Excretory vesicle I-shaped, reaching to anterior testis. Other features agreed with the above description.

2) For the original description and figure for *C. orientalis* (lot 2), see Yamaguti (1934). He described the testes as separated by the vitelline follicles, the seminal vesicle as tubular and convoluted, and the excretory vesicle as Y-shaped. Reexamination of lot 2 has shown that the testes are separated in the holotype but contiguous in the others, and the seminal vesicle is divided and

straight (Fig. 12). Although the excretory vesicle has not been worked out, its shape given by him is quite questionable from my present study of the other specimens. Lots 4 and 5 were similar to lot 2.

3) For the original description and figure for *C. gnathopogonis* (lot 3), see Yamaguti (1934). Lot 3 was stained so poor that I could not examine it in detail. His original figure (fig. 20) is reproduced here (Fig. 13). According to him, the eggs are 0.0815 by 0.05, with a conspicuously truncated opercular pole. In lot 3 the operculum was small and sinking, and the eggs were 86–96 by 48–56 μm .

Lots 6 and 8 resembled lot 3: testes large, posterior one located behind ceca and vitellaria; ovary almost globular; and eggs measuring 68–80 by 40–50 μm .

4) From lots 7 and 9, 10 better gravid whole-mounts (lot 7) measured (Figs. 14–17). Body 0.79–2.68 by 0.55–0.79; forebody 0.31–1.02, 37–45% of body length. Oral sucker 0.09–0.20 by 0.13–0.21. Pharynx 0.05–0.09 by 0.05–0.08. Esophagus 0.06–0.27 long; ceca ending at from midlevel between two testes to level behind posterior testis. Ventral sucker 0.16–0.31 by 0.20–0.31; sucker width ratio 1: 1.45–1.66. Testes usually contiguous, rarely slightly separated, sometimes shifted toward posterior end of body, 0.13–0.51 by 0.16–0.40. Cirrus pouch 0.14–0.39 by 0.06–0.10; seminal vesicle bipartite, short, straight; pars prostatica small; cirrus short. Ovary globular, 2- or 3-lobed regardless of maturity of worms, 0.09–0.24 by 0.08–0.24. Seminal receptacle 0.09–0.16 by 0.08–0.12. Laurer's canal extending anteriorly, making a U-turn before opening dorsally. Eggs 76–90 by 44–60 μm in balsam. Vitelline follicles ending posteriorly at various levels from between two testes to near posterior end of body, not entering intertesticular space. Excretory vesicle I-shaped, reaching to anterior testis.

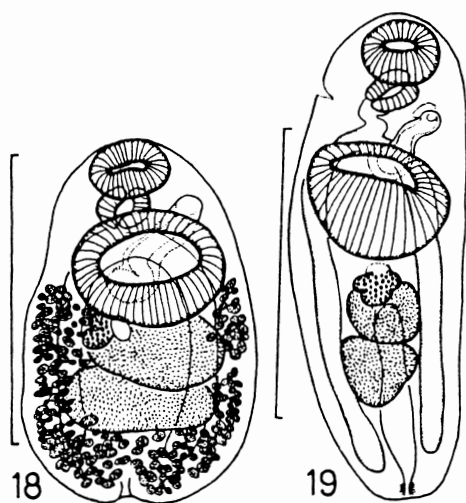
The posterior testis was sometimes situated behind the ceca and vitellaria. It seems that this posterior position is not an effect of fixation with flattening but an intraspecific morphological variation, since this feature was also seen in the specimens taken out of the formalin-preserved

fish (lot 7, 3630).

Discussion. Goto and Ozaki (1930) described this species, *Lebouria elongata*, as a new species from the intestine of *S. variegatus* from Lake Biwa. Lot 1 is probably part of the type material though it is not designated so. Most of the specimens agree well with the original description and figure by them for the species. There can be seen some differences in posterior extent of the ceca, shape of the ovary, and posterior limit of the vitellaria between them, but I consider these differences slight and within the range of intra-specific variation of the species.

Yamaguti (1934) created a new species, *Caudotestis orientalis* (lot 2), distinguishing it from *L. elongata* by the ceca and vitellaria extending barely to the midlevel of the posterior testis. He also erected another new species, *C. gnathopogonis* (lot 3), separating it from *C. orientalis* by the testes being contiguous and the eggs being smaller (0.0815 by 0.05) with a truncated opercular pole. Skrjabin and Koval' (1958) synonymized *C. gnathopogonis* with *C. orientalis*. As have been shown above, the wide range of morphological variation observed in lots 1, 7 and 9 embraces all the diagnostic criteria pointed out by Yamaguti for both species. These lots are closely similar in morphology, host and locality and so regarded as the same species, or *L. elongata*. The truncated operculum has sometimes been observed in eggs in the other balsam-mounted specimens. I conclude that both *C. orientalis* and *C. gnathopogonis* are junior synonyms of *L. elongata*, or *Neoplagioporus elongatus* (Goto et Ozaki, 1930), comb. n.

The species parasitizes *Gnathopogon elongatus*, *Hemibarbus barbus*, *Odontobutis obscura*, *Pseudogobio esocinus*, *Sarcocheilichthys variegatus*, *S. v. microoculus* and *Tribolodon hakonensis* in Japan (Goto and Ozaki, 1930; Yamaguti, 1934; this paper) and *Xenocypris argentea* (Cyprinidae) in Fujian, China (Wang, 1984; Wang et al., 1985). Its life cycle is unknown.



Figs. 18 and 19. Opecoelidae gen. sp., ventral view.
(Scale bars: 0.5 mm.)

Opecoelidae gen. sp.

(Figs. 18 and 19)

Material examined. Six whole-mounts (5 immature and 1 just matured, NSMT-PI 3100–3101) collected by Nagasawa from the intestine of *Oncorhynchus keta* (smolt) (Salmonidae) from the Shin River at Hamanaka, Hokkaido, on June 10 and 11, 1981. These are stained very poor.

Description. Body (Figs. 18 and 19) elongate or oval, smooth, with no eyespots, 0.59–0.83 by 0.30–0.35; forebody 0.23–0.40, 37–47% of total body length. Oral sucker 0.10–0.13 by 0.10–0.15. Pharynx 0.06–0.09 by 0.05–0.07. Esophagus short, bifurcating in front of ventral sucker; intestinal caeca thick, slender, ending blindly near posterior extremity of body. Ventral sucker large, sessile, 0.16–0.20 by 0.19–0.25, with no papillae; sucker width ratio 1: 1.41–2.46.

Testes two, tandem, in middle of hindbody, 0.08–0.11 by 0.12–0.17. Cirrus pouch possibly entire and extending to midlevel of ventral sucker. Genital pore ventral, sinistrosubmedian, prececal. Ovary possibly trilobate, submedian or median, pretesticular, 0.04–0.05 by 0.06. Seminal receptacle, Laurer's canal and ootype complex

obscure. One egg 46 by 32 μm . Vitelline follicles extending from midlevel of ventral sucker to posterior end of body, surrounding caeca, continuous, confluent in posttesticular space. Excretory vesicle I-shaped, extending anteriorly at least to hind testis (possibly to fore testis).

Discussion. Although the male terminal genitalia and the ovarian complex are obscure, its general morphology suggests that this trematode is a member of the Opecoelinae or Plagioporinae. It remains to be identified until many better additional specimens are studied.

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