REPORT ON FRESHWATER AND LAND PLANARIANS
FROM NEW CALEDONIA*
(With one plate and five text-figures)

Masaharu KAWAKATSU
Biological Laboratory, Fuji Women’s College, Sapporo, Japan

To the best of my knowledge the triclad fauna of the Island of New Caledonia (Nouvelle Calédonie) and the Loyalty Islands (Îles Loyalty) was studied by SCHRODER (1924); he described a total of twenty species of land planarians. There are however no records of freshwater planarians from these islands.

Dr. Y. SHIBATA of the Osaka Museum of Natural History, a member of “The Melanesia Expedition, 1958” made by the staff of the Museum, entrusted the author with the task of examining the collections of freshwater and land planarians. The material, which was fixed on the field, consists of two vials of specimens (11 specimens of freshwater and 3 specimens of land planarians). After examining sections of the present materials I have established that one is a described planariid species Cura pinguis (WEISS), 1910, and the other a described geoplanid species Geoplana cookeiana SCHRODER, 1924. In the present paper, the morphology of both species is described together with some remarks about the taxonomy and chorology of the known species of the genus Cura.

The author is indebted to Dr. Yasuhiko SHIBATA who kindly handed to me these interesting materials. Also for bibliographic help gratitude is expressed to the following people: Professor Marie M. JENKINS of Madison College, Harrisonburg, and Dr. Roman KENK of the Museum of Natural History, Smithsonian Institution, Washington, U. S. A., Dr. C. DEN HARTOG of the Rijksherbarium, Leiden, the Netherlands, Professor Elvezio GHIRARDELLI of Università di Trieste, Italy, Professor Eugène LEOUP of the Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium, and Professor Tor G. KARLING of the Naturhistoriska Riksmuseet, Stockholm, Sweden. I owe much to Dr. Elizabeth C. POPE of the Australian Museum, Sydney, and Miss Judith FLETCHER (formerly a student of the Department of Zoology of the Australian National University), Canberra, for their kindness of giving the author the Australian material for comparison with my present material of freshwater planarians. 1) 2)

* Contributions from the Osaka Museum of Natural History, No. 125.

Scientific Results of the Melanesia Expedition, No. 23.

1) Recently Dr. C. DEN HARTOG collected some freshwater Tricladis from Australia (in litt.). The results of his study will be published in the near future. Concerning the problem we had exchanged our views as well as the manuscripts of both articles.

2) The taxonomic description of the Australian material (Canberra) of Cura pinguis which I examined in the course of this study will be reported elsewhere (KAWAKATSU, In press).
List of Localities

According to the informations of Dr. SHIBATA, both freshwater and land planarians were collected from the Propriété ClementGERMAIN, Saint Louis, Vallée de la Thi, Region des Monts Koghis (about 12 kilometres north-east of Nouméa), Nouvelle Calédonie (Fig. 1). It is located in the southern part of Island (Lat. 22° S. and Long. 165° E.). The following remarks give the data found on the labels in the vials as well as on the note-book of the collector (Dr. Y. SHIBATA) together with my own notes from examination of the specimens.

No. 1. A small stream at the Vallée de la Thi. Altitude, about 500 m. October 10, 1958. Eleven strongly contracted specimens preserved in 80 percent methyl alcohol, 3～8 mm long and 2～4 mm broad. I have made a series of sections of all specimens and only five specimens of them proved to have sex organs. KAWAKATSU’S Specimen Lot No. 547 (a～k).

No. 2. Under dead vegetation of a wet forest at the Vallée de la Thi (near the Station

Fig.1. Map of the Notogaea and the south-eastern part of the Oriental Region, showing the records of Cura pinguia (WEISS). 1 : Jarrahdale in South-west Australia (cf. WEISS 1910). 2 : Buitenzorg in Java (cf. DE BEAUCHAMP 1929). 3 : Pools alongside the Apa-rima River, Southland, Lakes Lyndon, Pearson, Grasmere, Sarah, Raupo, etc. in the Canterbury district, streams and ponds in the vicinity of Christchurch in New Zealand (the localities of 'Curtisia stagnalis'; cf. NURSE 1950). 4 : Vallée de la Thi near Nouméa in New Caledonia (the locality of the material described in the present paper). 5 : The Jerabomberra Creek near Canberra in South-east Australia (cf. KAWAKATSU, In press).

Curtisia stagnalis Nurse, 1950. Trans. Royal Soc. New Zealand, 78: 414–415; Pl. 45, Figs. 4 and 4a, Pl. 47, Figs. 1, 2 and 3.


Description.

Every preserved specimen of this species which I examined was strongly contracted, i.e., convex above and concave below (Fig. 2 A–D; Pl. 1, Figs. A and B). This is a rather small pigmented species with a pair of normal eyes. Sexually mature specimens in a preserved condition are 6 to 8 mm long and 3 to 4 mm wide. In Dr. Shibata’s correspondence there is no records of the shape and size of the body of this species in living state. Judging from the external appearance of the preserved specimens, the head has a rather rounded form without conspicuous auricles (the typical appearance of the head of the genus Cura is a low triangular form with low blunt auricles). There is no distinct narrowing behind the head. The posterior end of the body is rounded.

The color of the back is dark brown; the ventral side is lighter colored. There are oblique, round shaped white areas in both sides of the head which represent the auricular sensory organ (Fig. 2 A and C; Pl. 1, Fig. A). The anterior margin of the body is mottled with distinct white stipples (usually eight in numbers) as shown in the sketches and photographs (Fig. 2 B–D; Pl. 1, Fig. B). Around the eyes there are rounded light areas. These characters in external appearance of the New Caledonian specimens described above are coincident with the figure of Weiss’s "Planaria pinguis" from South-west Australia (cf. Weiss 1910, Taf. XVIII, Figs. 6 and 11) as well as with that of De Beauchamp’s asexual specimen of "Planaria pinguis" from Buitenzorg, Java (cf. De Beauchamp 1929, Pl. XI, Fig. 4). Concerning the external appearance of Cura pinguis, Nurse (=Mrs. F. R. Allison; 1950, pp. 414 and Pl. 45, Figs. 4 and 4a) has given a rather brief description and figures of her new species "Curtisia stagnalis" from New Zealand in the article.

The pharynx of the almost all specimens examined protruded from the mouth (Fig. 2 B and C). The pharynx is rather short. In living worms it may be inserted at about the middle of the body. In histological sections, it was observed that the internal muscle zone of the pharynx consists of two layers, a very thick circular layer adjoining the epithelium of pharyngeal lumen and a thinner layer of longitudinal fibres. The anterior trunk of the intestine bears 8 to 10 lateral branches; each posterior trunk has 10 to 15 pairs of lateral branches.

The ovaries, a pair of fairly large compact masses, are situated in the usual anterior position of the body. The numerous yolk glands (or vitellaria) occur throughout the body
Fig. 2. *Cura pinguis* from New Caledonia. Sketches of three preserved specimens (No. 547 group). A and B: dorsal (A) and ventral (B) views of a specimen. Notice a pair of pigmented auricular sense organs. C: ventral view of a specimen. D: ventral view of the head of a specimen. Notice the white stippled.

No. 1). October 12, 1958. Three specimens preserved in 4 percent formalin, 30 ~ 50 mm long and 4 ~ 5 mm broad, all sexual, but the two of them are broken at the pharyngeal region. I have made a series of sections of two specimens; the anterior half of the body of the largest specimen was mounted on a slide. The third middle-sized specimen was preserved in 80 percent ethyl alcohol. Kawakatsu’s Specimen Lot No. 548 (a~c).

**Order TRICLADIDA**

**Suborder PALUDICOLA or PROBURSALIA**

Family **PLANARIIDAE**

Genus *Cura* **STRAND**, 1942

*Cura pinguis* (WEISS), 1910

*Planaria pinguis* WEISS, 1910. Zeitschr. Wiss. Zool., 94: 546-547; 595-599, Textfig.; Taf. XVIII, Figs. 6 and 11, Taf. XIX, Fig. 16, Taf. XXI, Fig. 32.

*Planaria pinguis* WEISS, 1910. DE BEAUCHAMP, 1929. Treubia, 10: 421-423; Pl. XI, Fig. 4.
the bulbar cavity is not differentiated. The common sperm duct continues as the ejaculatory duct, which opens symmetrically at the tip of the papilla. The outer wall of the papilla is covered with a thin cubical epithelium. Beneath the epithelium there is a thin layer of circular muscle fibres lined by other longitudinal fibres.

The common genital antrum is a wide cavity. Anteriorly it continues into the male genital antrum; posteriorly it leads into a narrow part of the antrum and opens ventrally at the genital pore, which is situated about halfway between the mouth and the posterior end of the body. The posterior wall of the common genital antrum receives the outlets of numerous eosinophilous glands (cement glands). These ducts are filled with a secretion of coarse granules.

The copulatory bursa is a rather small sack (at least in my specimens examined) lined with a tall glandular epithelium. The bursa stalk is narrow, runs posteriorly dorsal to the penis bulb along the midline, and curves ventrally to form a wide cavity, the vagina, and opens, from the dorsal side, at the anterior part of the common genital antrum. The vagina is lined by a glandular epithelium; its wall is thick and fairly muscular with intermingled circular and longitudinal fibres. The wall of the vagina is pierced by numerous gland ducts which open into the cavity (shell glands). These ducts are filled with a fine granular, weakly eosinophilic secretion.

The two ovovitelline ducts unite at the point dorsally to the genital pore and form a very short common ovovitelline duct. It opens into the vagina at the part near the posterior end of the bursa stalk.

**Geographical Variation of the Copulatory Apparatus in**

**Cura pinguis and the Differential Diagnosis**

As mentioned above, the anatomy of the copulatory apparatus of *Cura pinguis* from New Caledonia is closely similar to that of the species from South-west Australia which was described by Weiss (1910). Practically, it may be said that both figures (Fig. 3 in the present paper and Taf. XXI, Fig. 32 in the Weiss' 1910 paper) sufficiently agree. It is however observed that the layer of the circular muscle fibres underlying the glandular epithelium of the concave part of the penis bulb is thinner in the New Caledonian specimens than in the Weiss' Australian material (see also Weiss 1910, p. 597, Textfigure). I have also examined a sufficient number of the slides of *Cura pinguis* from the Jerabombera Creek near Canberra, Australia (Kawakatsu, In press). In the Canberra specimens which I examined, the following characters are conspicuous: a bundle of the circular muscle fibres of the concave part of the penis bulb and the penis glands well-developed; vagina less-developed. Judging from Nurse's figure (1950, Pl. 47, Fig. 1) of the copulatory apparatus of "Curtisia stagnalis" from New Zealand, these characters in the genital anatomy of

3) Weiss (1910, pp. 595–599, 601, Taf. XXI, Fig. 32) used a term "Atrium genitale femininum".
between intestinal diverticula.

The testes are few in number, from 1 to 2 on each side of the midline of the body, extending from the level of ovaries posteriorly to the base of the pharynx. The testes are ventrally located.

Sagittal view of the copulatory apparatus, reconstructed from several sets of sections of worms from the New Caledonian locality, are shown in Figure 3. The photomicrographs of the copulatory apparatus of two specimens are also shown in Plate 1 (Figs. C~G).

My figure of the copulatory apparatus of the New Caledonian material is closely similar to the Weiss’s figure (1910, Taf. XXI, Fig. 32) of the copulatory apparatus of "Planaria pinguis" from South-west Australia. In my specimens, the two sperm ducts join posteriorly to form a common sperm duct which enters the penis bulb. There is no enlargement of each sperm duct to form a spermiducal vesicle. The penis bulb appears lunate or a convexo-concave shape and the penis papilla has a long, slender, finger-like shape. The bulb is highly muscular in nature and is pierced by a considerable number of gland ducts (penis glands). The concaved posterior part of the bulb is covered with a tall, highly glandular epithelium, the cells of which project into the male antrum. Below the epithelium there are two layers of muscle fibres, one circular and the other longitudinal. In this species,
**Cura pinguis** from Australia were also found in the New Zealand material.

**Cura pinguis** differs from the other species of the genus in the details of the copulatory apparatus (penis bulb highly muscular of a lunate form without definite bulbar cavity; penis papilla long, finger-like shaped with a narrow ejaculatory duct which continues from the common sperm duct; ovovitelline ducts united to the common stem that enters the vagina at the part near the posterior end of the bursa stalk).

**Material.**

Eleven sets of sagittal serial sections (No. 547 a~k) deposited in the Osaka Museum of Natural History, Ōsaka. Two sets of sections, Specimen Nos. 547 a (8 slides) and 547 b (8 slides), preserved in the author's collection as a borrowed material from the Museum (they are retained in Professor Kawakatsu's room of Fuji Women's College, Sapporo).

**AFFINITIES AND THE DISTRIBUTION OF CURA PINGUIS, WITH CHOROLOGICAL REMARKS ON THE GENUS CURA SPECIES**

The genus **Cura** Strand, 1942 (a new name for the genus **Curtisia** von Graff, 1916; cf. Hyman 19514) ; Marcus 1955, pp. 111~112) can be separated from the closely related genus **Dugesia** Girard, 1850, on account of the following characters: head of low triangular form with low blunt auricles (only **Cura schubarti** Marcus, 1946, has a highly triangular head with long auricles); eyes two; colored; testes few, prepharyngeal or at most to the penis; penis with normal bulb and papilla and single bulbar cavity; copulatory bursa normal (or wanting only in **Cura foremanii** (Girard), 1852); ovovitelline ducts entering the bursal canal separately or after union; capsules spherical, stalked (cf. Hyman 1951, p. 160; Kenk 1930, p. 290; Marcus 1955, pp. 111~112).

The present distribution area of the genus thus defined is as follows: Africa, South and North Americas, the Falkland Islands, Australia, New Zealand, and New Caledonia (cf. Marcus 1955, pp. 111~112; see also Kawakatsu 1968, p. 17, Fig. III~2 "Map showing the worldwide distribution of the genus *Cura*"). The indubitable species of the genus are: **Cura jeanneli** (De Beauchamp), 1913, from East Africa; **Cura evelinae** Marcus, 1955, **Cura paeta** Marcus, 1955, and **Cura tinga** Marcus, 1955, from South Africa; **Cura foremanii** (Girard), 1852, from the United States and Canada in North America (cf. Curtis 1900; Hyman 1951; Kenk 1935); **Cura schubarti** (Marcus), 1946, from Brasil, **Cura patagonica** (Borelli), 1901, from South-east Argentina, and **Cura michaelseni** (Bohmig), 1902, from South America; **Cura falklandica** (Westblad), 1952, from the Falkland Islands; **Cura pinguis** (Weiss), 1910, from South Australia, New Zealand and New Caledonia.

De Beauchamp (1929) recorded the occurrence of asexual specimens of *Cura* (olin

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4) In my collection of literature, the preoccupied name, "Genus Curtisia Graff 1916", printed in the reprint of the Dr. Hyman's 1951 article (North American Triclad Turbellaria, XII), was corrected to "Genus Cura Strand 1942" by the Dr. Hyman's handwriting. I owe thanks to her treatment.
Planaria) pinguis from Buitenzorg, Java. Judging from his description and drawing of these asexual specimens from Java (de Beauchamp 1929, pp. 421–423, Pl. XI, Fig. 4), I agree to his identification (cf. de Beauchamp 1940 a and b; Marcus 1953, p. 25). Of course, there is some doubt that the Java specimens of Cura pinguis may be an immigrant from the Australian freshwater with some aquatic plants. I have an undescribed material of the genus Cura species from the Hawaiian Islands (Kawakatsu's unpublished data).

The freshwater planarians of the Southern Hemisphere have not been studied much except for some limited areas in Africa as well as in South America. As far as our present knowledge goes, the following five genera in Planariidae are distributed in the Southern Hemisphere. They are: Dugesia Girard, 1850, Cura Strand, 1942, Bopusula Marcus, 1946, Rhodax Marcus, 1946, and Polycelis Ehrenberg, 1831. The definition of the genus Spathula Nurse, 1950, which is described from New Zealand, is inadequate as a basis to the establishment of a new genus. It may include the genus Dugesia (cf. de Beauchamp 1951, pp. 94–96 and 1961, pp. 102–103). In these five genera, Bopusula and Rhodax are only recorded from Brasil. In the genus Polycelis, only one species, Polycelis oculi-marginata (Palombi), 1931 (olim Sorocelis oculi-marginata Palombi), is recorded from New Guinea (cf. de Beauchamp 1947; Kenk 1953, p. 182, foot-note 4). It is clear from these descriptions that Dugesia and Cura are the main and widely distributed genera in the Southern Hemisphere. 5)

In the Notogae, every described freshwater planarian species can be classified into two genera, i.e., Dugesia and Cura. However, the Notogaean Dugesia species, which have been described and recorded by Weiss (1910), Neppi (1904), Nurse (1950), and de Beauchamp (1951), include some dubious species in their taxonomy (cf. Kenk 1930; Marcus 1955, p. 20). 6) Cura pinguis is one of the representative planariid species in the Notogae. It is an interesting fact that this rather widely distributed Notogaean species shows some intraspecific geographical variations in its morphology.

5) From the taxonomic and chorological standpoints, I have proposed an opinion about the relation between the genera of freshwater planarians in the world at the Symposium of the Japanese Society of Systematic Zoology, held in Kyōto, on October 16, 1967 (cf. Kawakatsu 1968). A more detailed consideration of the problem will be discussed elsewhere.

6) The following seven species may be indubitable. They are: Dugesia hoernesi (Weiss), 1910, Dugesia glandulosa (Kenk), 1930 (olim Planaria striata Weiss, 1910), Dugesia graffi (Weiss), 1910, Dugesia böhmagi (Weiss), 1910, from South-west Australia; Dugesia schauinslandi (Neppi), 1904 (syn. Spathula limicola Nurse, 1950), Dugesia montana Nurse, 1950, and Dugesia fontinalis (Nurse), 1950, from New Zealand. Nurse (1950) described two varieties of Dugesia montana: D. m. var. montana and D. m. var. albolineata. The characters used by her to segregate both varieties are apparently inadequate as a basis to the establishment of two subspecies of Dugesia montana.
Suborder TERRICOLA
Family GEOPLANIDAE
Genus Geoplana Stimpson, 1857
Geoplana cookiana Schröder, 1924

The land planarians from New Caledonia and the Loyalty Islands were studied by Schröder (1924). He described and recorded twenty species of land planarians from these Islands. Among these forms fourteen species belong to the genus Geoplana Stimpson, 1857. The color patterns of my material examined correspond well enough with one of the Schröder's figures of Geoplana cookiana (Taf. II, Fig. 8 g). According to his descriptoins based only on the external features of the material, this species shows various color patterns.

Description.

The largest sexual specimen in preserved condition is about 50 mm long and 5 mm wide across the widest part. The shape of the body is typical of the genus, i.e., broad and flat in the prepharyngeal region, tapering posteriorly to a blunt end, and anteriorly more gradually to the normal head (Fig 4 A).

The animal is of a general pale and light coloration in the preserved condition. It is longitudinally striped on the dorsal surface with five light brown stripes on a pale yellowish brown ground. The stripes are arranged as follows: a narrow middorsal stripe, lateral stripes, and marginal stripes on each side. Both lateral and marginal stripes are somewhat broader than the middorsal stripe (Fig. 4 B). The ventral surface is uniformly light colored.

The eye arrangement is shown in Figure 4 (A and B). Outside of the marginal pigment stripe is found a row of eyes on each side. The eyes are larger and closer together on the head and become smaller and more widely spaced towards the posterior end. The eyes do not cross the anterior tip. About 150 eyes were counted on each side of the largest specimen.

In the largest specimen, the mouth is found at a distance of about 30 mm from the anterior tip. The pharynx is not so folded in appearance (a pharynx projected from the

Fig. 4. Geoplana cookiana Schröder from New Caledonia (No. 548 group). A: sketch of a preserved specimen. Notice the eye arrangement. B: color pattern and the eye arrangement at prepharyngeal level.
mouth opening is seen in the specimen in alcohol). The genital pore is situated at about the middle between the mouth opening and the posterior end of the body (Fig. 4 A).

The sectioned largest specimen proved to attain its full sexual maturity. Numerous small testes were located in a ventral row on each side of the midline; they were found nearly from the anterior tip to the level of the penis bulb. Another sectioned middle-size specimen has matured testes, but is posteriorly broken so that the copulatory apparatus is missing.

A sagittal view of the copulatory apparatus is shown in Figure 5. Photo-micrograph of the penis of the New Caledonian specimen which I examined is also shown in Plate 1 (Fig. H).

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Fig. 5. Diagram showing the sagittal view of the copulatory apparatus of *Geoplana cookiana* (No. 548 group).

- **bc**, distal glandular chamber of the bulbar cavity; **bc’**, proximal glandular chamber of the bulbar cavity; **ed**, ejaculatory duct; **fa**, female antrum; **gd**, glandular duct of the female antrum; **gp**, genital pore; **ma**, male antrum; **od**, oviduct; **pb** penis bulb; **pp**, penis papilla; **sd**, sperm duct; **sv**, spermiducal vesicle.

The genital pore leads dorsally into the large genital antrum, divisible into a rather narrow anterior extension, the male antrum, containing the penis papilla, and a wide posterior extension, the female antrum. The penis is large and extremely muscular consisting chiefly of the penis bulb with a relatively small rounded penis papilla. The bulb is set off from the parenchyma by a layer of muscle fibres coursing chiefly in longitudinal direction. The interior of the bulb is filled with sinuous muscle fibres; at the base of the papilla these fibres curve anteriorly to join with the muscle layer of the genital antrum and the parenchymal fibres. The penis papilla is closed with a low cubical epithelium; beneath the epithelium there appears to be two definite muscle layers, a layer of circular fibres and another of longitudinal fibres.
The two sperm ducts entering the penis bulb from the antero-lateral sides open into the small glandular chamber separately. This proximal chamber lined by a tall, highly glandular eosinophilous epithelium and opens posteriorly into the distal glandular chamber of the bulbar cavity by a single duct lined by a glandular epithelium. From this distal chamber a long ejaculatory duct, which is wider at the base of the bulb, proceeds to the tip at the penis papilla. Both the distal chamber of the bulbar cavity and the anterior half of the ejaculatory duct lined by a tall glandular eosinophilous epithelium. The penis bulb is accompanied by many gland cells (penis glands).

The female antrum, of elongated-funnel form, extends posteriorly from the common genital antrum. Posteriorly, it narrows into a glandular duct, which curves somewhat ventrally as a wide canal into whose posterior end the two oviducts open. This terminal canal of the female antrum or the glandular duct is encircled by numerous long-necked eosinophilous glands.

The entire genital antrum is lined by a very tall glandular epithelium, particularly well developed in the female antrum. Cells of the epithelium are filled with granules stained feebly eosinophilous. Many gland cells are seen in the adjacent parenchyma.

**Material.**

Two sets of sagittal serial sections (No. 548 a and b), one whole mount of the anterior half of the Specimen No. 548 b, and one preserved specimen in 80 percent ethyl alcohol (No. 548 c) deposited in the Osaka Museum of Natural History, Osaka. One set of sections, Specimen No. 548 a (posterior piece; 22 slides), preserved in the author’s collection as a borrowed material from the Museum (it is retained in Professor Kawakatsu’s room of Fuji Women’s College, Sapporo).

**References**


........, 1929. Triclades Terricoles, Triclades Paludicoles, Némertien. Treubia, 10 : 405 ± 430 + Pl. XI.


Stimpson, W., 1857. Prodromus descriptionis animalium evertibratorum quae in Expeditione ad Oceanum, Pacificum Septentrionalem a Republica Federata missa, Johanne Rodgers Duce, observavit et


Explanation of Plate 1

A and B. Preserved specimen of Cura pinguis (Weiss) from New Caledonia (dorsal and ventral views).
    No. 547 group. Posterior end of the body was bent over as shown.

C, D, E, F and G. Photomicrographs showing the sagittal view of the copulatory apparatus of Cura pinguis.

C. Copulatory apparatus. No. 547 a. cb, copulatory bursa; ma, male antrum; pb, penis bulb; v, vagina.

D. Copulatory apparatus. No. 547 b.

E. Copulatory apparatus. No. 547 c.

F. Enlarged photomicrograph of the basal part of the penis. No. 547 b. Notice the muscle fibres of the penis.

G. Vagina. No. 547 b. pp, penis papilla.

H. Photomicrograph showing the sagittal view of the penis of Geoplan a cookiana Schröder from New Caledonia. No. 548 a. ed, ejaculatory duct; ma, male antrum; pb, penis bulb.