

The Freshwater Planarians from New Guinea and Malaya¹⁾

By

Masaharu KAWAKATSU

Biological Laboratory, Fuji Women's College, Sapporo

(Communicated by Yoshinori IMAIZUMI)

Dr. T. IMAMURA of Ibaraki University entrusted the author with his collection of freshwater planarians of New Guinea and Malaysia. The material from New Guinea, of which none have hitherto been explored, was gladly received.

On examination of the preserved specimens and a series of their sections (stained with Delafield's haematoxylin and erythrosin), it has been found out that the New Guinean triclad belongs to an undescribed species of the genus *Dugesia* of the family Planariidae. The Malayan triclad seems to be a *Dugesia* species. The descriptions will be given in the present paper.

List of Localities and the Species Obtained

In the following list the Specimen Lot Number given for each group is the number registered in the author's fixing notebook according to his permanent recording system.

No. 1. Specimen Lot No. 1316 group. A stream at the Baiyer River Sanctuary, the southwestern area of the Bismarck Ranges, Taleo Territory, New Guinea (ca. Lat. 6°30'S and Long. 144°00'E). Altitude, about 1,200 m. Dec. 16, 1974. Only 3 sexually mature and 3 immature specimens of *Dugesia novaguineana* spec. nov. were collected. Coll. Dr. T. IMAMURA.

No. 2. Specimen Lot No. 1315 group. A small stream at Cameron Highlands, the west-central part of the Malay Peninsula, Pahang, Malaysia (ca. Lat. 5°30'N and Long. 101°00'E). Altitude, about 1,950 m. Feb. 4, 1975. Only 2 sexually immature specimens (and several fragments) of *Dugesia* sp. were collected. Coll. Dr. T. IMAMURA.

1) Scientific results of the Ibaraki University Zoological Expedition 1974-1975 to Oceania and Southeast Asia directed by Professor Taiji IMAMURA.

Order TRICLADIDA
Suborder PALUDICOLA or PROBURSALIA
Family Planariidae
Genus *Dugesia* GIRARD, 1850

Dugesia novaguineana KAWAKATSU, spec. nov.

All the preserved specimens fixed with 70% ethyl alcohol were cut into sagittal serial sections.

Description. This is a middle-sized and pigmented species that lives in epigeal waters. The appearance of both sexually mature and immature specimens in the preserved condition is shown in Fig. 1 (A-E). The animals (which were strongly contracted in the preserved condition) are about 10 to 12 mm in body length and 3 to 6 mm in width. The head is probably low triangular in form in the living state with blunt auricles. The body is rather broad and terminates in the bluntly pointed posterior end.

Two small eyes are situated on the dorsal side of the head at a level slightly anterior to auricles; the distance between them amounts to about one-third the width

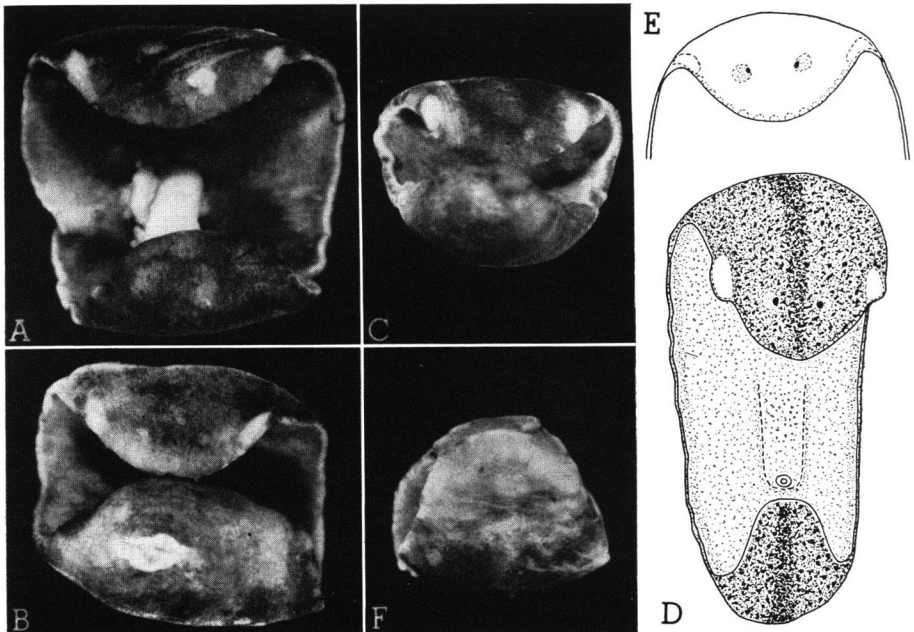


Fig. 1. *Dugesia novaguineana* spec. nov. (A-E; Specimen Lot No. 1316 group) and *Dugesia* sp. (F; species of Cameron Highlands; Specimen Lot No. 1315 group). — A-C. Photographs of three preserved specimens (left-side eye of the Specimen A is broken off). D. Sketch of the Specimen C in a slightly elongated condition observed in glycelin-alcohol. E. Sketch of the head of the Specimen B.

of head at the level of eyes. A pair of clear white areas around each eye is conspicuous; the epithelium covering this ocular area contains many small pigment granules of a dark brownish color (Fig. 1 A and E).

A non-pigmented auricular sense organ of a broad leaf-shape is visible on each side of head (Fig. 1, A–C, D and E). The sensory spots, white and small stipples at the anterior margin of head (14 to 16 in total number), are seen in every specimen examined (Fig. 1 E). The ground color of the dorsal surface of body is very dark brown with numerous, small pigment granules of blackish brown to reddish brown coloration. The ventral surface is a light brownish gray with numerous pigment granules of dark coloration.

The pharynx is inserted somewhat behind the middle of the body and measures about one-sixth the body length (in some specimens the pharynx was protruded from the mouth according to the effect of alcohol as a fixative; cf. KAWAKATSU & MIYAZAKI, 1972). The genital pore is situated in the midline at a level somewhat frontal to the middle of postpharyngeal region. The musculature of the pharynx shows the typical arrangement of the genus *Dugesia*: the inner musculature of the pharynx consists of a thick circular layer adjacent to the epithelium of the pharynx lumen and a thinner layer of longitudinal fibres. The outer musculature of the pharynx consists of two layers, the outer longitudinal and the inner circular muscle fibres (Fig. 2 A).

The anterior intestinal trunk has 15 to 20 branches on each side; each posterior trunk has 20 to 25 or more short lateral branches. The dorsal epithelium is thicker than the ventral one. The marginal adhesive zone is well developed.

A pair of ovaries occur in the usual ventral position of the anterior region (Fig. 2 C). Two oovitelline ducts converge in the region of copulatory apparatus and open separately into the posterior part of bursal canal or vagina. Numerous yolk glands (or vitellaria) occupy the normal position.

Numerous, small testes occupy the dorsal part of mesenchyme in three to four longitudinal zones extending from the posterior level of the ovaries to the nearly posterior end of the body. They attain about one-fourth the length of the dorso-ventral diameter of the body (Fig. 2 B–D). Their total number can be estimated almost 500 to 600 or more. The spermiducal vesicles on either side of the posterior part of pharynx and the copulatory bursa are highly conspicuous in the present new species.

The sagittal view of the copulatory apparatus of the best specimen of the three sexual animals is also shown in Fig. 3 (No. 1316 b; holotype). It is apparently preserved in a rather contracted condition. Photomicrographs of the parts of the genital organs including the copulatory apparatus are shown in Fig. 4 (A–E).

The penis has a large, hemispherical bulb embedded in the parenchyma and a moderately large, conical papilla of a moderately asymmetrical form. Both the bulb and the papilla are highly muscular in nature. The bulb contains a large, ovoidal shaped cavity (the bulbar cavity of the seminal vesicle). It receives a pair

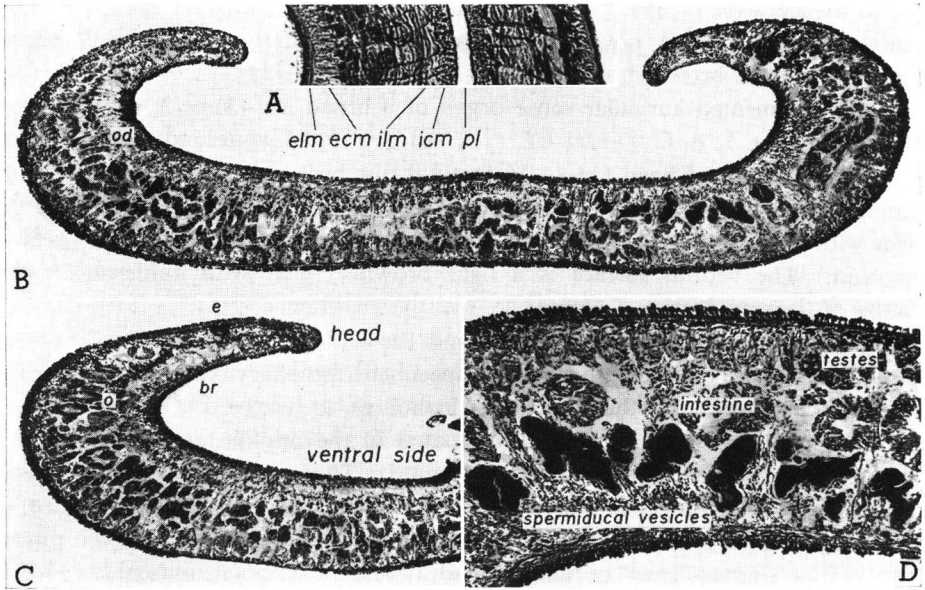


Fig. 2. *Dugesia novaguineana* spec. nov. (Specimen No. 1316 b; holotype). — A. Photomicrograph of the sagittal section of a part of pharynx. B–D. Photomicrographs of the sagittal sections showing the arrangements of testes and spermiducal vesicles. br, brain; e, eye; ecm, external circular muscle layer; elm, external longitudinal muscle layer; icm, internal circular muscle layer; ilm, internal longitudinal muscle layer; o, ovary; pl, pharynx lumen.

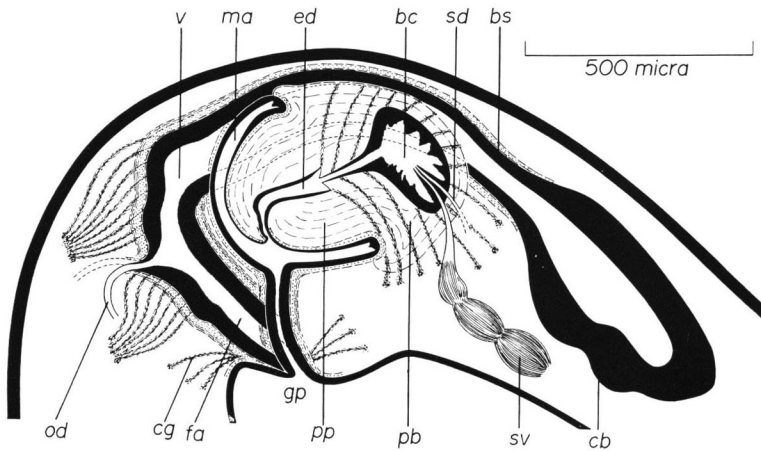


Fig. 3. Diagram showing the sagittal view of the copulatory apparatus of *Dugesia novaguineana* spec. nov. (Specimen No. 1316 b; holotype). bc, bulbar cavity; bs, bursa stalk; cb, copulatory bursa; cg, cement gland; ed, ejaculatory duct; fa, female antrum; gp, genital pore; ma, male antrum; od, ovovitelline duct; pb, penis bulb; pp, penis papilla; sd, sperm duct; sv, spermiducal vesicle; v, vagina.

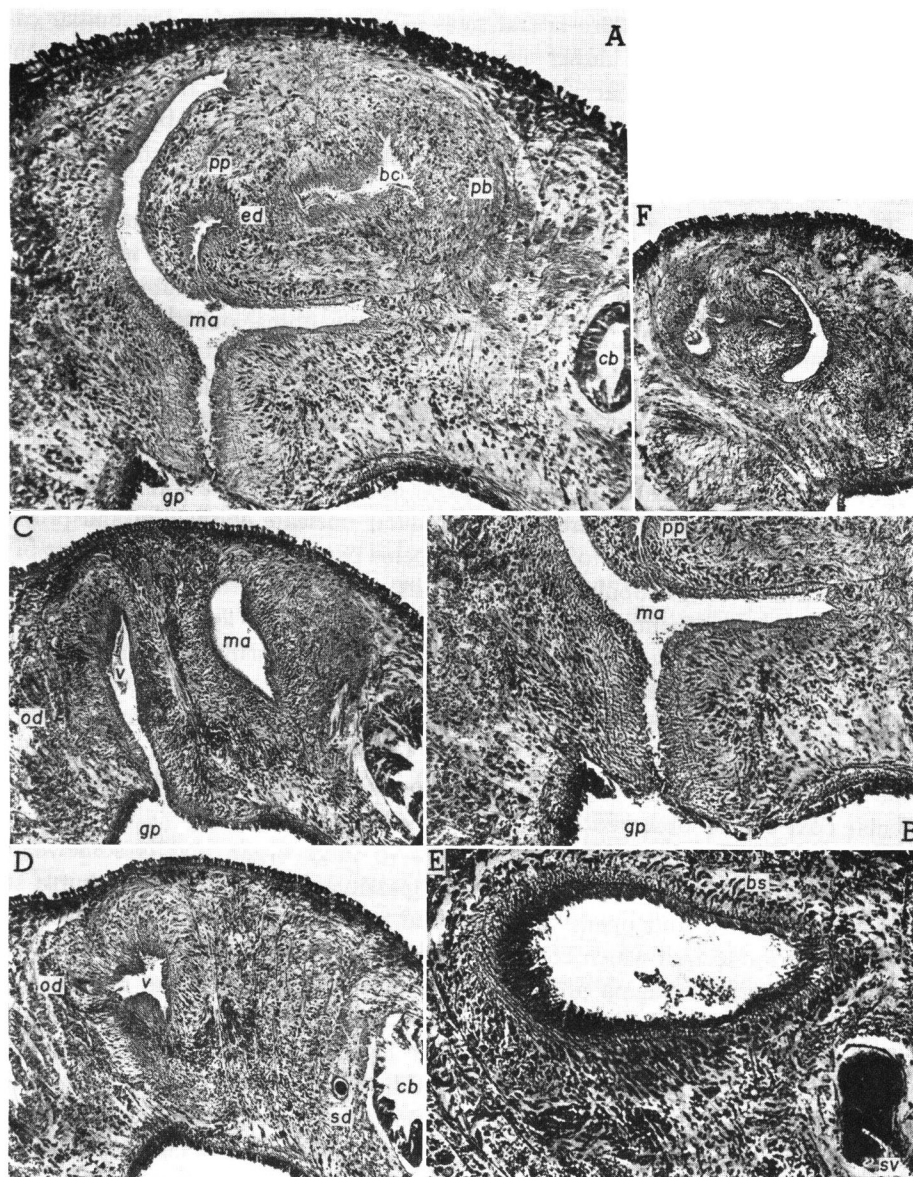


Fig. 4. Photomicrographs showing the parts of the copulatory apparatus of *Dugesia novaguineana* spec. nov. — A–E. Specimen No. 1316 b (holotype). A. Mid-sagittal section of the copulatory apparatus (enlarged). B. Enlarged photomicrograph of the posterior part of the male antrum. C and D. Near mid-sagittal sections of the copulatory apparatus. E. Near mid-sagittal section through the middle part of the bursal canal (enlarged). — F. Mid-sagittal section of the copulatory apparatus (Specimen No. 1316 f). C, D and F are same magnifications. bc, bulbar cavity; bs, bursa stalk; cb, copulatory bursa; ed, ejaculatory duct; gp, genital pore; ma, male antrum; pb, penis bulb; pp, penis papilla; sd, sperm duct; sv, spermiducal vesicle; v, vagina.

of sperm ducts from the postero-lateral sides as shown in Fig. 3. The bulbar cavity continues to the papilla as a rather narrow ejaculatory duct and opens at the ventral side of the penis papilla near its tip. A small diaphragm of the penis lumen is conspicuous in the present new species. The bulbar cavity is lined by a thick, highly glandular epithelium. The penis bulb is pierced by numerous ducts of the penis glands which open into the penis lumen.

The dorsal lip of the penis papilla is larger and pointed than the ventral lip. No conspicuous constriction at the basal part of the penis papilla is seen in the present new species. The outer wall of the papilla is covered with cubical epithelium. Below the epithelium there are two layers of muscle fibres, one thick circular and the other longitudinal.

The male genital antrum is a cup-shaped cavity which widens anteriorly and extremely narrows posteriorly. It opens to the genital pore (and into the female genital antrum or the distal end of the bursal canal near the genital pore). No common genital antrum is found in the present new species. The wall of the anterior part of the male antrum is covered with glandular nucleate epithelium and provided with two muscle layers similar to those of the penis papilla. The posterior part of the male antrum is a long, tubular cavity and its wall is covered with a tall, highly glandular nucleate epithelium. The epithelium contains heavily eosinophilous granules. The tubular cavity has a thick muscular coat consisting of three layers of fibres, i.e., a thin inner layer of longitudinal, a wide layer of circular, and a rather wide outer layer of longitudinal. It is observed that the middle circular and the outer longitudinal muscle fibres are more or less intermingled. The differentiation of the posterior tubular cavity of the male antrum surrounded by a rather thick muscular coat can be observed in the other specimens examined.

The copulatory bursa is a middle-sized to large organ and is somewhat irregularly lobed. Its lumen is lined with tall glandular epithelium. The bursa stalk is a rather long duct and opens to the genital pore. It is divided into two parts; a narrow anterior section which connects with the bursa and a posterior thick-walled wider section (i.e., the vagina and the female genital antrum). The muscular coat surrounding the anterior section of the bursa stalk consists of three layers of fibres, i.e., a thin layer of longitudinal, a rather wide layer of circular, and a thin layer of longitudinal. In the posterior section, the middle circular and the outer longitudinal layers of the muscle fibres become thicker than those of the anterior section and slightly intermingled. The glandular epithelium of the bursal canal has nuclei (it is very thick at the posterior section including the vagina and the female antrum). Numerous ducts of eosinophilous glands empty into the vagina. The ducts are filled with heavily stained secretion. The ovovitelline ducts are accompanied with many eosinophilic glands at their dorsal parts. Weakly eosinophilous cement glands open into the female genital antrum near the genital pore.

The cocoon of the present new species is not known.

Holotype. One set of sagittal serial sections (Specimen No. 1316 b; 9 slides) will

be deposited in the Department of Zoology, National Science Museum, Tokyo. One paratype will be deposited in the same Museum (No. 1316 d; 5 slides). The remaining slides including one of the paratypes of the fully mature specimen (No. 1316 f; 7 slides) are retained by the author (KAWAKATSU's laboratory, Fuji Women's College, Sapporo) as a borrowed material from the Museum.

Locality. A stream at the Baiyer River Sanctuary, Taleo Territory, New Guinea. Altitude, about 1,200 m. Collected by Dr. T. IMAMURA on December 16, 1974.

Taxonomic remarks and differential diagnosis. The taxonomy and distribution of *Dugesia* species from the countries of Southeast Asia and the western Pacific area have been described and discussed by several authors (cf. BALL, 1970; ICHIKAWA & KAWAKATSU, 1964, 1967; KAWAKATSU, 1965, 1967, 1969, 1971, 1972 a, b, c, d, 1973 a, b; KAWAKATSU & BASIL, 1971, 1975; KAWAKATSU, HORIKOSHI & AKAMA, 1972; KAWAKATSU & IWAKI, 1967, 1968; KAWAKATSU, IWAKI & KIM, 1967; KAWAKATSU & KANG, 1969; KAWAKATSU & KIM, 1966, 1967; KAWAKATSU & MACK-FIRÀ, 1975; KAWAKATSU, MORITA & IWAKI, 1967; KAWAKATSU & ÔGAWARA, 1974; KAWAKATSU & TANAKA, 1971, 1976; KAWAKATSU & WONG, 1975; MACK-FIRÀ & KAWAKATSU, 1972). Among the species known from those geographical areas, the following 6 species have an asymmetrical penis papilla with a diaphragm in the penis lumen and without the valve which forms a ring or a collar around the base of the penis papilla. They are: *D. indica* KAWAKATSU, 1969, from Central India; *D. burmaensis* (KABURAKI, 1918) from Burma; *D. nannophallus* BALL, 1970, from Ceylon (Sri Lanka); *D. andamanensis* (KABURAKI, 1925) from the Andaman Islands; *D. borneana* KAWAKATSU, 1972, from North Borneo; *D. japonica* ICHIKAWA et KAWAKATSU, 1964, from the Far East including the Japanese Islands. *Dugesia japonica* from the Southwest Islands of Japan and China has a well-developed valve surrounding the basal part of the penis papilla (cf. ICHIKAWA & KAWAKATSU, 1967; KAWAKATSU & TANAKA, 1971, 1976).

The present new species, *Dugesia novaguineana*, is easily separable from the species listed above in the following external and anatomical characters: a very dark coloration with distinct sensory spots at the anterior margin of the head, absence of the common genital antrum, presence of a moderately developed vagina, and the differentiation of a moderately developed muscular coat surrounding the posterior part of the male genital antrum and the vagina including the female genital antrum.

Dugesia novaguineana differs from the other members of the genus in the following characters: animal moderate in size and very dark-colored with numerous, small pigment granules on the dorsal surface (numerous pigment granules also distributed on the ventral surface); head subtriangular with low blunt auricles and with two non-pigmented auricular sense organs and clear sensory spots at the anterior margin of the head (14 to 16 in total number); two eyes; external musculature of the pharynx consists of outer longitudinal and inner circular layers; numerous dorsal testes lie in 3 to 4 longitudinal rows on either side and extend to near the posterior end; penis bulb large, hemispherical in shape and strongly muscular with an ovoidal shaped bulbar cavity into which sperm ducts enter separately; moderately asymmetrical penis

papilla conical with a diaphragm in the ejaculatory duct; the posterior part of the male genital antrum forms a tubular cavity with a rather thick muscular coat and opens to the genital pore (and into the distal end of the female genital antrum); copulatory bursa moderate in size, with a bursal canal which opens into the female genital antrum; the posterior half of the bursa stalk forms a moderately developed vagina with a thick muscular coat into which ovovitelline ducts enter separately.

Dugesia sp. (species of Cameron Highlands)

?*Dugesia* sp. (species of Cameron Highlands): KAWAKATSU & ÔGAWARA, 1974, Bull. Fuji Women's College, (12), (II), pp. 11–13, fig. 3 (A–C).

?*Dugesia* sp. (species of Penang): KAWAKATSU & ÔGAWARA, 1974, Bull. Fuji Women's College, (12), (II), pp. 73–74, figs. 3 (D–G) and 4.

Only two sexually immature specimens have been available for this study. The animals preserved in 70% ethyl alcohol are about 5 mm long and 1.5 mm broad. The head has a broad subtriangular form with bluntly pointed auricles. The color of the dorsal side is uniform light brown with numerous, small, dark brown pigments. Each of two eyes is surrounded with a usual clear space and two non-pigmented auricular sense organ are conspicuous. The sensory spots could be seen at the anterior margin of the head (10 in total number).

In the histological sections the external muscle layers of the pharynx consist of outer longitudinal and inner circular fibres.

Material. Three sets of serial sections including one large fragment (Specimen No. 1315 a–c) are retained by the author (KAWAKATSU's laboratory, Fuji Women's College, Sapporo).

Locality. A small stream at Cameron Highlands, Pahang, Malaysia. Altitude, about 1,950 m. Collected by Dr. T. IMAMURA on February 4, 1975.

Remarks. Judging from the external appearance of the animals examined, it is highly probable that the species is identical with *Dugesia* sp. (species of Cameron Highlands) and *Dugesia* sp. (species of Penang) which were recorded in the author's previous article (cf. KAWAKATSU & ÔGAWARA, 1974).

Acknowledgement

For providing the author with this interesting material from New Guinea and Malaya, he is grateful to Dr. Taiji IMAMURA of the Biological Institute, Faculty of Sciences, Ibaraki University, Mito. He is also grateful to Dr. Shun-Ichi UÉNO of the Department of Zoology, National Science Museum, Tokyo, and Mr. Yoshinobu MORIMOTO of Himeji Municipal High School, who were the members of the "Ibaraki University Zoological Expedition 1974–1975 to Oceania and Southeast Asia", for their unflinching kindness.

Summary

A new species of the genus *Dugesia* (Turbellaria, Tricladida, Paludicola), *Dugesia novaguineana* KAWAKATSU, spec. nov., from Taleo Territory, New Guinea, is described in the present paper. This new species differs from the related several Southeast Asiatic ones in having a very dark coloration and in the details of the genital anatomy. An undescribed *Dugesia* sp. (species of Cameron Highlands) from Malaya is also recorded.

References

- BALL, I. R., 1970. Freshwater triclads (Turbellaria, Tricladida) from the Oriental Region. *Zool. J. Linn. Soc.*, **49**: 271-294+pls. 1-2.
- GIRARD, C., 1850. A brief account of the fresh water species of Planariae inhabiting the United States. *Proc. Boston Soc. nat. Hist.*, **3**: 264-265.
- ICHIKAWA, A., & M. KAWAKATSU, 1964. A new freshwater planarian, *Dugesia japonica*, commonly but erroneously known as *Dugesia gonocephala* (DUGÈS). *Annot. zool. Japon.*, **37**: 185-194.
- & ——— 1967. Report on freshwater planaria from the Esat China Sea area. In KIRA & IWATA, *Nature and Life in Southeast Asia*, **5**: 175-188. Kyoto, Fauna and Flora Research Society.
- KAWAKATSU, M., 1965. On the ecology and distribution of freshwater planarians in the Japanese Islands, with special reference to their vertical distribution. *Hydrobiologia*, **26**: 349-408.
- 1967. On the ecology and distribution of freshwater planarians in the Japanese Islands, with special reference to their vertical distribution (Revised edition). *Bull. Fuji Women's College*, (5): 117-177.
- 1969. Report on freshwater planaria from India. *Annot. zool. Japon.*, **42**: 210-215.
- 1971. Problems on the morphological variation and the physiological races of a Japanese freshwater planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU. In KAWAKATSU & IBA, *Comm. Compil. Sci. Papers Publ. Occ. Retir. Prof. Hisao SUGINO at the Age of Sixty-five*. Ser. Turbellarians: 43-52. Osaka, Osaka Kyōiku University. (In Japanese, with English summary.)
- 1972 a. The freshwater planaria from the Batu Caves in Malaya. *Bull. Natn. Sci. Mus., Tokyo*, **15**: 339-346+pls. 1-3.
- 1972 b. Report on freshwater planaria from Borneo. *Contr. Biol. Lab. Kyoto Univ.*, (23): 115-122 (+pl. 1).
- 1972 c. Report on freshwater planarians from Malaya and Thailand. *Ibid.*, (24): 1-7 (+pls. 1-2).
- 1972 d. The freshwater planaria from the Philippines. *Annot. zool. Japon.*, **45**: 234-244.
- 1973 a. Report on freshwater planaria from Indonesia (Sumatra and Java). *Contr. Biol. Lab. Kyoto Univ.*, (24): 87-103+pls. 1-5.
- 1973 b. Report on freshwater planarians from Pakistan. *Bull. Fuji Women's College*, (11), (II): 79-95.
- & J. A. BASIL, 1971. Records of freshwater and land planarians from India. *Ibid.*, (9), (II): 41-50 (+pls. I-II).
- & ——— 1975. The freshwater planaria from South India. *Annot. zool. Japon.*, **48**: 34-42.
- , I. HORIKOSHI & H. AKAMA, 1972. Report on freshwater planarians from the Izu Peninsula and the Izu Islands in Japan. *Zool. Mag., Tokyo*, **81**: 119-126. (In Japanese, with English summary.)
- & S. IWAKI, 1967. Report on freshwater planaria from the Satsunan Islands and Kagoshima (Kyūshū) in South Japan. *Bull. Fuji Women's College*, (5): 179-185.

- KAWAKATSU, M., & S. IWAKI, 1968. Report on freshwater planaria from Taiwan (Formosa). *Bull. Fuji Women's College*, (6): 129-137.
- , ——— & W.-J. KIM, 1967. Report on freshwater planaria from Quelpart (Cheju) Island, Korea. *Zool. Mag., Tokyo*, **76**: 187-189. (In Japanese, with English summary.)
- & S.-W. KANG, 1969. Annotated bibliography of the Korean turbellarians. *Korean. J. Limnol.*, **2** (3-4): 43-49. (In Korean, with English summary.)
- & W.-J. KIM, 1966. Morphological studies on the freshwater planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU, from Korea. *Zool. Mag., Tokyo*, **75**: 103-107. (In Japanese, with English summary.)
- & ——— 1967. Results of the Speleological Survey in South Korea 1966. VI. Freshwater planarians from limestone caves of South Korea. *Bull. Natn. Sci. Mus., Tokyo*, **10**: 247-258 + pls. 1-3.
- & V. MACK-FIRÁ, 1975. The fauna of the insular lava caves in West Japan. XI. Proseriata et Tricladida (Turbellaria). *Bull. Natn. Sci. Mus., Tokyo*, (A), **1**: 77-84 + pl. 1.
- , S.-I. MORITA & S. IWAKI, 1967. Report on freshwater planaria from the Danjyo Islands (Kyúshû) in South Japan. *Bull. Fuji Women's College*, (5): 187-188.
- & T. MIYAZAKI, 1972. Effect of different fixatives on a common Japanese freshwater planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU. *Bull. Fuji Women's College*, (10), (II): 81-117 (+ pls. VII-XXXII).
- & G. ÔGAWARA, 1974. Additional report on freshwater planarians from North Borneo, Malaya, Sri Lanka, India, and South Africa. *Ibid.*, (12), (II): 69-86.
- & I. TANAKA, 1971. Additional report on freshwater planaria from the Southwest Islands of Japan. *Biol. Mag. Okinawa, Naha*, **8**: 46-52 (+ pls. I-II). (In Japanese, with English summary.)
- & ——— 1976. Additional report on freshwater planaria from the Southwest Islands of Japan, II. *Zool. Mag., Tokyo*, **85**: 73-77.
- & M.-H. WONG, 1975. The freshwater planaria from Hong Kong. *Annot. zool. Japon.*, **48**: 262-273.
- MACK-FIRÁ, V., & M. KAWAKATSU, 1972. The fauna of the lava caves around Mt. Fuji-san. XII. Proseriata et Tricladida (Turbellaria). *Bull. Natn. Sci. Mus., Tokyo*, **15**: 637-648 + pl. 1.