

REPORT ON FRESHWATER PLANARIA FROM  
THE SATSUNAN ISLANDS AND KAGOSHIMA  
(KYÛSHÛ) IN SOUTH JAPAN\*<sup>1</sup>

by

MASAHARU KAWAKATSU and SUMIE IWAKI

The Satsunan Islands in South Japan lies from Lat. 27° N. to Lat. 31° N. and from Long. 128° E. to Long. 131° E. It consists of three main islands (Amami-Ôshima Island, Yakushima Island and Tanegashima Island) and many small islands (the Amami Islands and the Tokara Islands). To the best of our knowledge there are some fragmental records of the freshwater planarians from the Satsunan Islands. However, the morphological descriptions of them have not been published yet.

In 1857, STIMPSON described under the name *Planaria cinerea*, a planarian which he had found in a brooklet in Amami-Ôshima Island. His description is as follows (Descriptiones specierum novarum, 44 on page 30): PLANARIA CINEREA. Oblonga, subconvexa, postice attenuata, lateribus leviter convexis; fronte triangulari, in media paullo producta; auriculis mediocribus. Corpus colore supra cinereum, fascia mediana subpinnata obscuriore. Ocelli auriculis oppositi; pigmento ovali ad latus internum globuli mediocris. Long. 0. 4; lat. 0. 11 poll. *Hab.* in fossis insulae "Ousima", Japoniae Australis.\*<sup>2</sup> STIMPSON's *Planaria cinerea* may belong to the genus *Dugesia* (cf. ICHIKAWA & KAWAKATSU 1964 a, b, 1967; KAWAKATSU 1965a, b, c, 1966a, b).

In the spring of 1937, K. I. OKUGAWA, a member of the Limnological Survey to the Southwest Islands of Japan made by the staff of the Ôtsu Hydrobiological Station of Kyoto Imperial University, collected freshwater planaria from several Islands: Tanegashima Island (the Kawakami River at Furuta), Yakushima Island (a brooklet at Miyanoura), Amami-Ôshima Island (brooks at Tsubone and Nishinakama), Okinawa Island (a spring in Naha City and a tributary of the Hijyagã River; cf. ICHIKAWA & KAWAKATSU 1967, p. 177, Fig. 1; TANAKA, UNTEN & UNTEN 1965, p. 426, Fig. 1), and Taiwan or Formosa. OKUGAWA (1938) identified the planarian species which he had collected from these

\*1. This study has been supported in part by a Grant in Aid for Fundamental Scientific Research from the Japanese Ministry of Education (KAWAKATSU, 1967).

\*2. The following descriptions are cited from Wilhelm HEINE's book of travels: Die Expedition in die Seen China, Japan und Ochotsk. 1858-1859. Erster Band, IX. Die Vincennes und Hancock in Lew-Chew, der Amakirrima-Gruppe, Ou-Sima und Simoda. Die Inseln Montgomer, Oukiu, Katonai-Sima und Ou-Sima. pp. 136-138).

"Den 1 (1855). Mai brachte ich größtentheils damit zu, am Lande und hauptsächlich in den Reisfeldern und auf den Abhängen der Hügel nach schönen naturwissenschaftlichen Exemplaren zu suchen. Ich erbeutete viele Frösche (*Rana* und *Hyla*), einige Süßwasser-Muscheln (*Paludina*, *Melania* und *Planaria*). Zwischen vertrocknetem Laube fand ich mehrere Gattungen von Landplanaria, fonst aber waren Landmuscheln, mit Ausnahme der gemeineren Arten, spärlich. An den Abhängen fand ich ein merkwürdiges terrestrisches Annelid. In feuchten Löchern zwischen den Hügeln war ein gesleckter Salamander sehr häufig, und zwischen den Felsen und den Häusern Einwohner kamen gelegentlich einige Eidechsen vor." Etc.

"Am 2. Wüschte ich etwas mehr von den Straßen zu sehen, etc. Es befanden sich darunter viele schöne Muscheln, *Oypraca*, *Gonea*, *Lima* und nackte Mollusken, wie *Aplysia*, *Pleurobranchus*, *Doris*, *Coriocella*, *Goniodoris* und *Cynthia*, ein Dutzend oder mehr schöne, große und herrlich gefärbte Gattungen *Eurylepta*, *Stylochus* und andere *Planariae*, verschiedene schöne Sternfische, Ophiuroiden von ungewöhnlicher Größe, verschiedene merkwürdige Holothurien, unter denen sich eine gallertartige durchsichtige Gattung befand, so wie eine ungeheure Varietät von Würmern; die Erustaceen waren im Verhältniß nicht so zahlreich; drei oder vier Gattungen von Echinus hingegen waren im Ueberfluß vorhanden." Etc.

islands was *Euplanaria gonocephala* (DUGÈS), i. e., *Dugesia gonocephala* (DUGÈS) (cf. OKUGAWA 1947, 1953, 1960, 1965).

After the World War II, in November of 1953, the survey trips in the Satsunan Islands and Kagoshima in South Kyūshū for collecting the freshwater planarians were carried out by the first author with his co-worker, Mr. Y. TARUI. Only one species, *Dugesia gonocephala* (DUGÈS), was found commonly in Yakushima Island (cf. KAWAKATSU's Studies on the vertical distribution of Japanese freshwater planarian, IV. 1956; KAWAKATSU & TARUI 1955).

It is, however, proved clear that the common *Dugesia* species from the Far East including the Japanese Islands is *Dugesia japonica* ICHIKAWA et KAWAKATSU, 1964; the Asiatic species is not identical with an European and African *Dugesia gonocephala* (DUGÈS) (cf. ICHIKAWA & KAWAKATSU 1964a,b, 1967; KAWAKATSU 1965 a, b, c, 1966). Recently, the morphological description of *Dugesia japonica* from the East China Sea area (Taiwan, Okinawa and China) has been reported by ICHIKAWA & KAWAKATSU (1967). While the 1967 paper was in the press, through the kindness and interest of Dr. S. SUZUKI, arachnologist at Hiroshima University, the first author received a number of preserved specimens of *Dugesia* species from Amami-Ōshima Island, where the planarians are common, according to his letter, in brooklets under stones. Dr. SUZUKI's material from Amami-Ōshima Island, hitherto not described for the morphology of the species, was very welcome. In the present paper, morphological observations with specimens of *Dugesia* sp. from Amami-Ōshima Island, as well as with those of *Dugesia japonica* from Yakushima Island and Kagoshima, are described.

The authors' grateful thanks are due to Professor Seishō SUZUKI who kindly handed to them this interesting material. Also for bibliographic help gratitude is expressed to our colleague, Professor Marie M. JENKINS of Madison College, U. S. A. Thanks are also due to Mr. A. KATAYAMA, Associate Professor of English Literature of Fuji Women's College, for reading the manuscript.

#### LIST OF LOCALITIES

##### A. Amami-Ōshima Island

No. 1. A plain brooklet at Sumiyō-mura. Altitude, 20 m. July 21, 1965. Four middle-sized specimens of *Dugesia* sp. fixed in 10% formalin, 10-12 mm long and 1 mm broad; and 1 head fragment. Every specimens proved to be not sexually mature. KAWAKATSU's Specimen No. 578a. Coll. Dr. S. SUZUKI.

##### B. Yakushima Island

In Yakushima Island, *Dugesia japonica* was distributed widely in brooks, brooklets and in the streams running through the highland marshy places (Hananoegō) below the altitude of about 1800 metres (cf. OKUGAWA & KAWAKATSU 1956, pp. 30-46). The following specimens were used in the present study.

No. 2. A brooklet at Anbo. Altitude, 15 m. November 13, 1953. Water temp. 20°C, pH 5.8. One middle-sized specimen fixed in Bouin's fluid (preserved in 80% ethyl alcohol), 13 mm long and 1 mm broad. It proved to be not mature. Specimen No. 36a. Coll. M. KAWAKATSU and Mr. Y. TARUI.

No. 3. Brooks and brooklets in the Kosugidani Valley (a middle portion of the Anbo River), Mt. Miyanoura-dake. Altitude, 600-800 m. November 14-16, 1953. Water temp. 14-15°C, pH 5.2-5.6. Two middle-sized specimens fixed in Bouin's fluid (preserved in 80% ethyl alcohol), 12-15 mm long and 1.5 mm broad. Both specimens proved to be not mature. Specimen No. 37a and b. Coll. M. KAWAKATSU and Mr. Y. TARUI.

No. 4. A creek at Onoaida (near the source of Onoaida Hot Spring). Altitude, 80 m. November 18, 1953. Water temp. 20°C, pH 5.0. Three middle-sized specimens fixed in Bouin's fluid (preserved in 80% ethyl alcohol), 12-15 mm long and 1.5 mm broad. Only one specimen was sexual but not fully matured (Specimen No. 38a); the other specimens proved to be not mature (Specimen No. 38b and c). Coll.

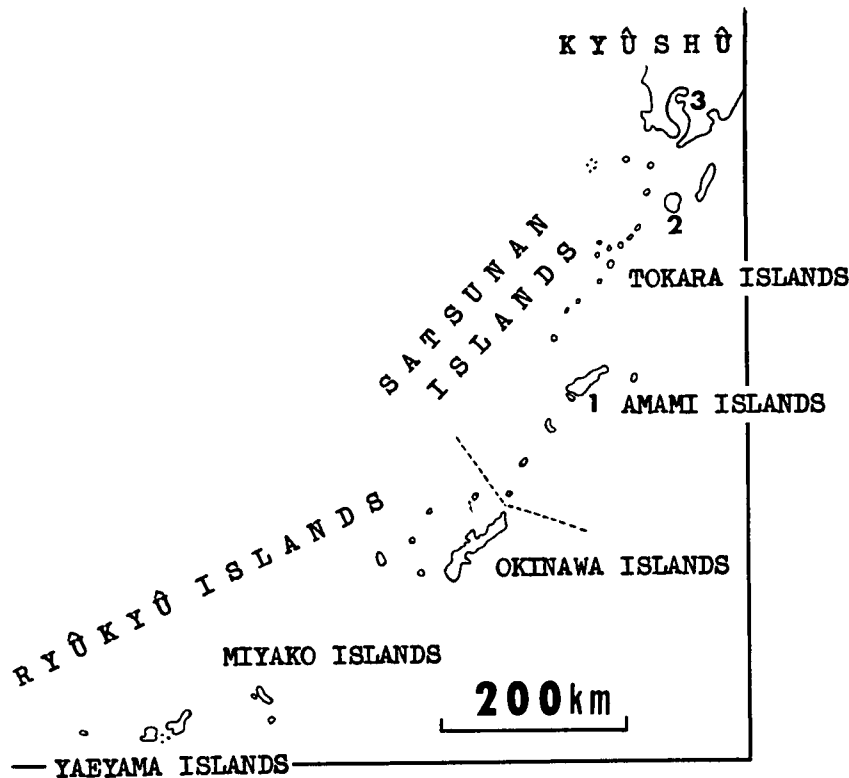


Fig. 1. Map of the Satsunan Islands in South Japan and the Ryūkyū Islands (see also ICHIKAWA & KAWAKATSU 1967, p. 177, Fig. 1).

1, Amami-Ōshima Island; 2, Yakushima Island; 3, Kagoshima City.

M. KAWAKATSU and Mr. Y. TARUI.

#### C. Kagoshima City

No. 5. A brook at Ikegami-chō, Kagoshima City. Altitude, 20 m. November 12, 1953. Water temp. 20 °C, pH 6.0. About 500 mature and immature specimens of *Dugesia japonica* were collected (cf. KAWAKATSU & TARUI 1955; OKUGAWA & KAWAKATSU 1954, p. 45, foot-note 3). Five fully mature specimens fixed in Bouin's fluid (preserved in 80% ethyl alcohol) were examined (15-18 mm long and 2 mm broad). Specimen No. 40a-e. Coll. M. KAWAKATSU and Mr. Y. TARUI.

#### *DUGESIA* SP. FROM AMAMI-ŌSHIMA ISLAND

The appearance of the preserved specimens from the Island is shown in Figure 2 (A and B). The large asexual specimen in preserved condition reaches a length of 12 mm. The head has much the same shape as that of typical *Dugesia japonica*. The auricles are conspicuous. The color of the dorsal side is brown to dark brown; the ventral side is lighter colored. There are two eyes in the usual positions with white areas. The sensory organ, a pair of pigmentfree areas in appearance, is conspicuous. The anterior margin of the body is mottled with distinct white stipples (Fig. 2 A and B); this character is very conspicuous in the specimens of *Dugesia japonica* from Okinawa (cf. ICHIKAWA & KAWAKATSU 1967, p. 176, Fig. 2 I and H, pp. 181-184).

The pharynx is inserted somewhat behind the middle of the body. In histological sections of the Amami-Ōshima specimen, the pharynx is structurally typical of *Dugesia japonica* (cf. ICHIKAWA & KAWAKATSU 1964a, pp. 188-189). The anterior trunk of the intestine bears 13 to 15 lateral branches.

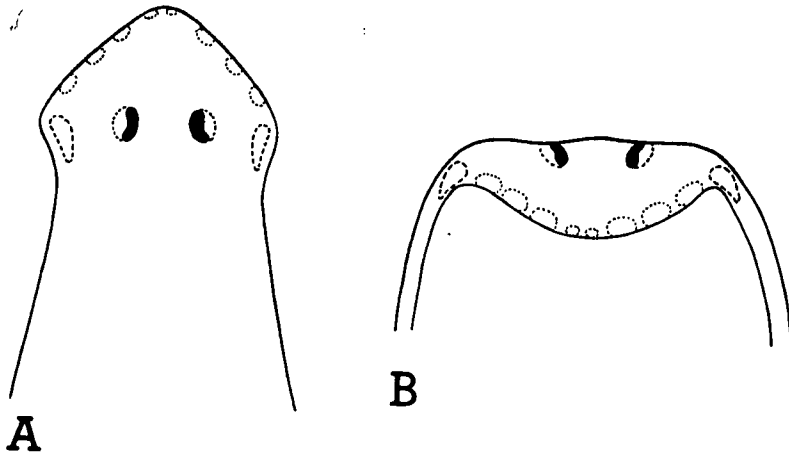


Fig. 2. Sketches of two preserved specimens of *Dugesia* sp. from Amami-Ōshima Island.

Each posterior trunk has 18 to 20 short branches.

The sectioned specimens were found to be not sexually mature.

#### *DUGESIA JAPONICA* ICHIKAWA et KAWAKATSU FROM YAKUSHIMA ISLAND

The first author observed a good number of living specimens of *Dugesia japonica* in the spot. According to the data found on the KAWAKATSU's field notebook, the living specimens may reach a length of 10 to 20 mm. The color of the back of the living specimens is grayish brown to dark brown. Around the eyes there are round light areas. A pair of the non-pigmented auricular sense organ is visible. Unfortunately, we had only limited material of the specimens and none of the animals was fully mature. \*3 In the Yakushima specimens which we examined, the white stipples around the anterior margin of the body were not seen.

In histological sections of the Yakushima specimen (No. 38a) it is impossible to furnish details of the reproductive system. Testes evident in this non-fully mature worm examined. The entire female reproductive system (ovary, yolk gland and oovitelline duct) was not differentiated.

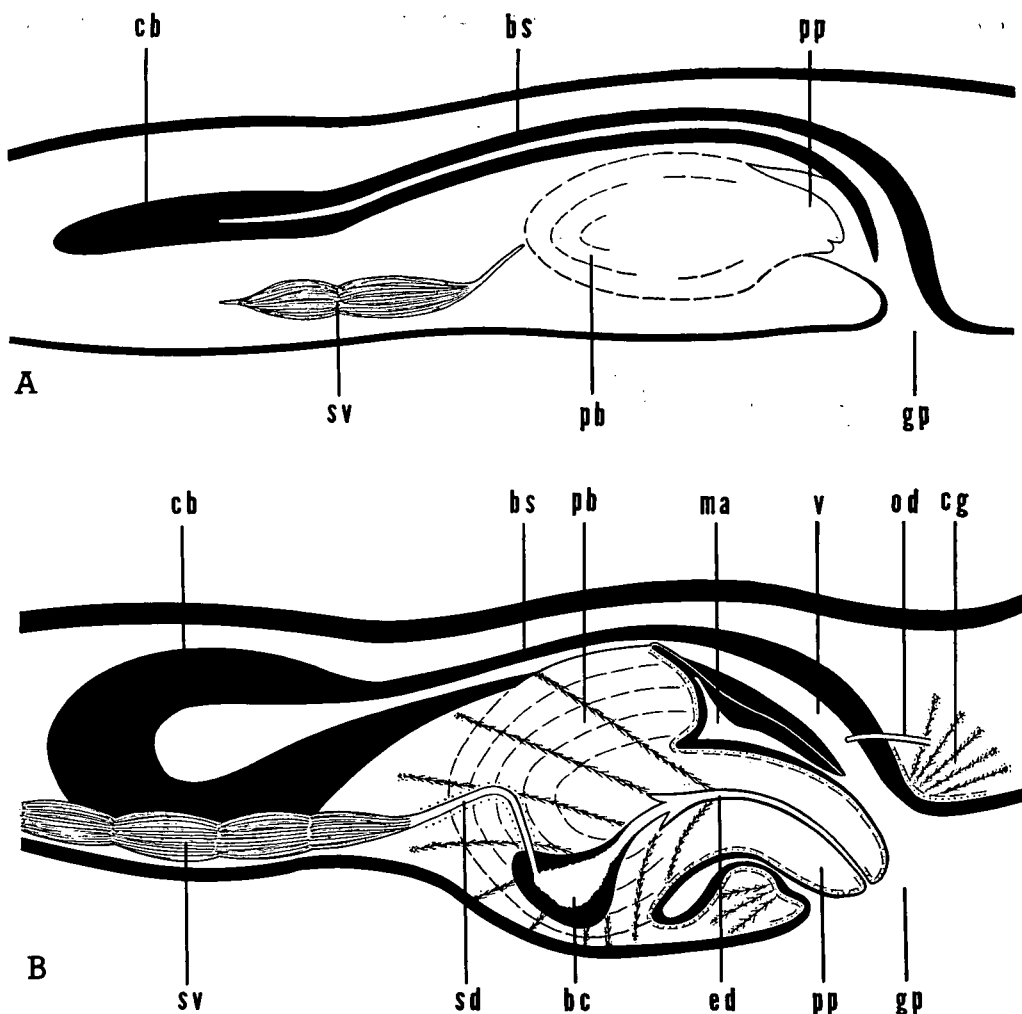
The sagittal view of the copulatory apparatus of the Yakushima specimen is shown in Figure 3 (A). A pair of spermiducal vesicles, situated on each side of the pharynx, is rather well-developed. The copulatory apparatus, especially the penis and the male antrum, proved to be not well-developed. As seen in Figure 3 (A), the penis bulb has an oval shaped form. The under-developed penis papilla lies in the narrow male antrum. There is, in fact, no development of the penis lumen (bulbar cavity and ejaculatory duct) in this specimen. The vagina or terminal part of the female canal is somewhat expanded and lined by a tall epithelium. Antero-dorsally, it is continuous with a narrow bursal canal and terminating in a small sac, the copulatory bursa, situated immediately posterior to the pharyngeal chamber.

#### *DUGESIA JAPONICA* ICHIKAWA et KAWAKATSU FROM KAGOSHIMA

According to the first author's observation, the living sexually mature specimens were brownish in color, 18 to 20 mm long, with the typical appearance of *Dugesia japonica*. The anterior intestinal trunk bears 13 to 16 lateral branches; each posterior trunk bears 15 to 18 short branches.

The general histology of *Dugesia japonica* is so well known (cf. ICHIKAWA & KAWAKATSU 1964a, 1967; KAWAKATSU, IWAKI & KIM 1967; KAWAKATSU & KIM 1966, 1967) that the account of the other internal anatomy will be confined to the copulatory apparatus. The five sexual specimens were

\*3. A considerable number of the Yakushima specimens had been cultured in the laboratory in Kyōto (Nov. 1953 -Dec. 1955). During this period of the low temperature culture, one of them attained a length of about 80 mm and a width of 3 mm. However, all attempts for obtaining sexual specimens have met with unsuccess.



**Fig. 3.** Diagrams showing the sagittal view of the copulatory apparatus of *Dugesia japonica* ICHIKAWA et KAWAKATSU from Yakushima Island (A: Specimen No. 38a, non-fully mature specimen) and Kagoshima in South Kyūshū (B: Specimen No. 40c).

**bc**, bulbar cavity; **bs**, bursa stalk; **cb**, copulatory bursa; **cg**, cement glands; **ed**, ejaculatory duct; **gp**, genital pore; **ma**, male antrum; **od**, ovovitelline duct; **pb**, penis bulb; **pp**, penis papilla; **sd**, sperm duct; **sv**, spermiducal vesicle; **v**, vagina.

sectioned sagittally, transversally and horizontally; all of them were found to be in full sexual condition.

Sagittal view of the copulatory apparatus is shown in Figure 3 (B). The characters are: penis bulb large in size and strongly muscular with a wide bulbar cavity into which sperm ducts enter separately; asymmetric penis papilla large with a well-developed valve or diaphragm at its basal part; separation of the bulbar cavity and ejaculatory duct by a plain diaphragm; copulatory bursa large, lined by a tall epithelium, with a wide bursal canal which opens into the common antrum; vagina developed into which ovovitelline ducts enter separately.

REMARKS ON *DUGESIA JAPONICA* ICHIKAWA et KAWAKATSU FROM THE SATSUNAN  
ISLANDS AND KAGOSHIMA

A detailed description of the distribution ranges of *Dugesia japonica* is available in the following references: ICHIKAWA & KAWAKATSU 1967 (pp. 185-186) and KAWAKATSU 1965a (p. 352, Fig. 1). *Dugesia japonica* is also common in Taiwan (KAWAKATSU's unpublished data). *Dugesia* sp. from Amami-Ōshima Island which we have described in the present paper may be *Dugesia japonica*.

As was already pointed out in the previous paper (ICHIKAWA & KAWAKATSU 1967, p. 185), the presence of the valve or diaphragm at the basal part of the penis papilla in *Dugesia japonica* was only observed in the specimens from Okinawa, China (Hangchow) and Kagoshima in South Kyūshū. Since none of the animals was fully mature, in the Yakushima specimen, this feature in the penial anatomy of the species was not conspicuous. The above-mentioned feature of penis papilla was not observed in the Korean specimens and almost all specimens from the Japanese Islands of *Dugesia japonica* (cf. ICHIKAWA & KAWAKATSU 1964a; KAWAKATSU, IWAKI & KIM 1967; KAWAKATSU & KIM 1966, 1967). More light would be thrown on the problem of geographical variation of copulatory apparatus in *Dugesia japonica* by a more thorough study of the comparative penial anatomy of the specimens from the Japanese Islands and Taiwan.

REFERENCES

HEINE, W. 1858-59. Die Expedition in die Seen von China, Japan und Ochotsk, etc. I-III, Suppl. Hermann Gost noble, Leipzig.

ICHIKAWA, A. & KAWAKATSU, M. 1964a. A new freshwater planaria, *Dugesia japonica*, commonly but erroneously known as *Dugesia gonocephala* (DUGÈS.). Annot. Zool. Japon., 37: 185-194. 1964b. On *Dugesia gonocephala* (yōroppa-nami-uzumushi) and *Dugesia japonica* (nami-uzumushi). Zool. Mag. (Tokyo), 73: 305. (Jap.) 1967. Report on freshwater planaria from the East China Sea area. Nature and Life in Southeast Asia, V: 175-188.

KAWAKATSU, M. 1965a. On the ecology and distribution of freshwater planarians in the Japanese Islands, with special reference to their vertical distribution. Hydrobiologia, 26: 349-408. 1965b. The outline of the investigations of ecology, taxonomy and chorology made on freshwater planarians in Japan. Shinoda Osamu Sensei Taikan Kinen-ronbunshū (Seikatsu-Bunka-Kenkyū, No. 13): 53-68. Kyōto. (Jap.) 1965c. Notes on *Dugesia japonica* ICHIKAWA et KAWAKATSU. The Heredity (Tokyo), 19 (10): 31-37. (Jap.) 1965a. Japanese freshwater planarians. Ibid., 20 (4): 54-57. (Jap.) 1966b. Synopsis of the known species of freshwater planarians in Japan. Eull. Biogeogr. Soc. Japan, 24: 9-28. (Jap.)

KAWAKATSU, M., IWAKI, S. & KIM, WUN-JAI 1967. Report on freshwater planaria from Quelpart (Cheju) Island, Korea. Zool. Mag. (Tokyo), 76: 187-189. (Jap. with Eng. summ.)

KAWAKATSU, M. & KIM, WUN-JAI 1966. Morphological studies on the freshwater planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU, from Korea. Zool. Mag. (Tokyo), 75: 103-107. (Jap. with Eng. summ.) 1967. Results of the Speleological Survey in South Korea 1966. VI. Freshwater planarians from limestone caves in South Korea. Bull. Nat. Sci. Mus. Tokyo, 10: 247-258+Pls. 1-3.

KAWAKATSU, M. & TARUI, Y. 1955. Planarians, insects and snails collected from the Island of Ynku. Collecting & Breeding (Tokyo), 17: 267-273. (Jap.)

OKUGAWA, K. I. 1938. Report on the limnological survey in the Loochoo Islands. Botany & Zoology (Tokyo), 6: 1855-1865. (Jap.) 1947. Freshwater planarians. In "Illustrated Encyclopedia of the Fauna of Japan (Rev. Ed.)", pp. 1481-1487 (Figs. 4187-4191). Hokuryūkan, Tokyo. (Jap.) 1953. A monograph of Turbellaria (Acoela, Rhabdocoela, Alloeocoela and Tricladida) of Japan and its adjacent regions. Bull. Kyoto Gakugei Univ., B, 3: 20-43. 1960. Freshwater planarians. In "Encyclopedia Zoologica Illustrated in Colours", IV, p. 147, Pl. 87 (Figs. 10-15). Hokuryūkan, Tokyo. (Jap.) 1965. Freshwater planarians. In "New Illustrated Encyclopedia of the Fauna of Japan" I, pp. 319-321 (Figs. 32-41). Hokuryūkan, Tokyo. (Jap.)

OKUGAWA, K. I. & KAWAKATSU, M. 1954. Studies on the fission of Japanese freshwater planaria, *Dugesia*

*gonocphala* (DUGÈS). III Comparative studies on breeding and fission frequencies of sexual and assumed asexual races which had been collected in ten localities in Japan, with an additional study on the fission plane. Bull. Kyoto Gakugei Univ., B, 5: 42-52. (Jap. with Eng. summ.) 1956. Studies on the vertical distribution of Japanese freshwater planaria. IV. Yaku and Tsushima Islands. Ibid., B, 9: 30-46. (Jap. with Eng. summ.)

STIMPSON, W. 1857. Prodrômus descriptionis animalium evertibratorum quae in Expeditione ad Oceanum, Pacificum, Septentrionalem a Republica Federata missa, JOHANNES RODGERS Duce, observavit et descripsit. Pars I. Turbellaria Dendrocoela. Proc. Acad. Nat. Sci. Philad., 9: 19-31.

TANAKA, I., UNTEN, M. & UNTEN, K. 1965. Notes on freshwater planaria from Okinawa (with an appendix written by M. KAWAKATSU). Collecting & Breeding (Tokyo), 27: 425-428. (Jap.)

### *Address of the authors :*

Dr. M. KAWAKATSU, Professor of Biology, Fuji Women's College, Kita-16, Nishi-2, Sapporo (Hokkaidô), Japan.  
Sister S. IWAKI, Associate Professor of Biology, Fuji Women's College, Kita-16, Nishi-2, Sapporo (Hokkaidô), Japan.