

STUDIES ON THE MORPHOLOGY, KARYOLOGY AND TAXONOMY OF
THE JAPANESE FRESHWATER PLANARIAN *DUGESIA JAPONICA*
ICHIKAWA ET KAWAKATSU, WITH A DESCRIPTION OF
A NEW SUBSPECIES, *DUGESIA JAPONICA RYUKYUENSIS*
SUBSPEC. NOV. ¹⁾

by

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I. INTRODUCTION

Dugesia japonica ICHIKAWA et KAWAKATSU, 1964, is the commonest Japanese freshwater planarian found everywhere both in running and standing waters including shallow underground habitats. When the species was originally described, the specimens collected from a spring-fed stream in Matsumoto City in Central Japan, Honshû, were employed as the type-series (cf. ICHIKAWA et KAWAKATSU, 1964). During the past twelve years, the morphological variation of the genital anatomy of this polymorphic species from various localities in the Japanese Islands including the Southwest Islands of Japan (i.e., the Satsunan Islands and the Ryûkyû Islands) and the neighbouring countries in the Far East (i.e., Taiwan, China, Hong Kong, and Korea) was studied by KAWAKATSU and his co-researchers. The principal literature on the taxonomy of this species are: ICHIKAWA & KAWAKATSU, 1967; KAWAKATSU, 1971; KAWAKATSU, HORIKOSHI & AKAMA, 1972; KAWAKATSU & IWAKI, 1967 b, 1968; KAWAKATSU, IWAKI & KIM, 1967; KAWAKATSU & KANG, 1969; KAWAKATSU & KIM, 1966, 1967; KAWAKATSU & MACK-FIRÅ, 1975; KAWAKATSU & MIYAZAKI, 1972; KAWAKATSU, MORITA & IWAKI, 1967; KAWAKATSU & Tanaka, 1971, 1976; KAWAKATSU & WONG, 1975; MACK-FIRÅ & KAWAKATSU, 1972. The distributional ecology of this species was discussed and reviewed in the serial articles by KAWAKATSU (1965, 1967, 1970, 1974).

DAHM (1963) who studied the karyotype of *Dugesia japonica* from the type locality (he mentioned the species as *Dugesia* species, "Matsumoto stock"; cf. pp. 60-62) demonstrated that the chromosome number of the sexual specimens was found to be $2n = 16$ and during meiosis 8 completely paired bivalents appeared. He also mentioned the differences of the karyotypes between the Japanese species and European *Dugesia gonocephala* (DUGÈS). DAHM's (op. cit.) observation was ratified by TESHIROGI & ITAGAKI (1965) who studied the karyotypes of the Japanese species from four different localities: Otaru in the south-central part of Hokkaidô, Hirosaki in the northern part of Honshû, Kyôto in the central part of Honshû, and Matsuyama in Shikoku. Their observation was made in the mitotic cells of neoblasts in regenerating pieces (see also BENAZZI & BENAZZI-LENTATI, 1976, pp. 99-100).

Recently, the chromosome observation of *Dugesia japonica* from several localities of Central Japan has been studied by SUGINO and his co-researchers (SUGINO, HIROSE & KATÔ, 1973; HIROSE,

1). Preliminary reports of some of this work were presented at the 46th Annual Meeting of the Zoological Society of Japan, Kyôto, October 1975 (KAWAKATSU, 1975), and at the 47th Annual Meeting of the Zoological Society of Japan, Hiroshima, October 1976 (OKI, TAMURA, KAWAKATSU & SUGINO, 1976; KAWAKATSU, OKI, TAMURA & SUGINO, 1976).

KATÔ & SUGINO, 1974) and OKI & TAMURA (1974, 1975 a, b). Although the animals from almost all of the populations investigated by them have a chromosome number of $2n = 16$, it has been found out that the variation of chromosome numbers of animals occurs in some populations. According to them, the chromosome number of the specimens from a stream at Kurama in the northern part of Kyôto is 25 (cf. SUGINO, HIROSE & KATÔ, 1973). Moreover, it was found out that the specimens from three localities near Ôsaka (the Kinokawa River at Kokawa in Wakayama Pref., a brook at Nozaki-kan'non, the northern part of the Ikoma Mountains, Daitô City, and the Mino'o River at Segawa, Mino'o City, in Ôsaka Pref.) have heterogeneous cells with two different numbers of chromosomes in one body. Namely, the tissue of many asexual specimens examined from these localities consists of two types of somatic cells intermingled: $2n = 16$ and $3n = 24$ (cf. HIROSE, KATÔ & SUGINO, 1974; OKI & TAMURA, 1974, 1975 a). OKI & TAMURA (1975b) also reported the occurrence of a number of sexual specimens in the Mino'o locality ($n = 8$ and $2n = 16$; somatic cells, $2n = 16$ and $3n = 24$).

The recent chromosomal findings of *Dugesia japonica* mentioned above led the authors to give a reconsideration to the taxonomy of this species based upon the morphological, anatomical and karyological data. According to this line of the authors' cooperative investigations, KAWAKATSU reexamined the slides of *Dugesia japonica* from various localities including the type-series which were preserved in his laboratory; the chromosomal observation of the specimens from Japan (Mino'o in Ôsaka Pref. and Urasoe in Okinawa Pref.) and Korea (Wooyi-dong and Mt. Kangnac in Seoul) for comparison with the karyotype of the specimens recollected in the type-locality was investigated by OKI, TAMURA and SUGINO. From these studies the authors have come to the conclusion that *Dugesia japonica* should be subdivided into two subspecies, one nominative and the other new one.

In the present paper, the results of the morphological, anatomical and karyological observations with materials of *Dugesia japonica* from several localities including the type-locality, as well as a re-description of the nominative subspecies and an original description of the new subspecies, are described, together with some remarks about the taxonomy and karyotype of this widely distributed, polymorphic species.

II. LIST OF LOCALITIES

The animals collected from the following seven localities in Japan and two localities in Korea were used in the present study. The Specimen Lot Number given for each group is the number registered in KAWAKATSU's fixing notebook according to his permanent recording system.

No. 1. Specimen Lot Nos. 102 and 286 groups (the type-series of *Dugesia japonica* ICHIKAWA et KAWAKATSU, 1964). A spring-fed stream at Genchi, Matsumoto City, Nagano Pref., Honshû, Japan (alt. 600 m). Cf. ICHIKAWA & KAWAKATSU (1964, p. 193); remarks on the life-history of the specimens from the Matsumoto population in OKUGAWA & KAWAKATSU (1954-1958); remarks on the ecological data of the type-locality in KAWAKATSU & IWAKI (1967), KAWAKATSU, MURAYAMA & NIMURA (1971), KAWAKATSU, NIMURA & AOKI (1975), and OKUGAWA, KAWAKATSU & TARUI (1955).

Additional sexual specimens from the type-locality used in the present study were collected by Mr. F. NIMURA several times from March to May, 1976. Both histological (Specimen Lot No. 1385 group) and chromosomal examinations were made.

No. 2. Specimen Lot No. 1358 group. A spring-fed stream near the First Sôenbashi Bridge of the Mino'o River at Segawa, Mino'o City, Ôsaka Pref., Honshû, Japan (alt. 43 m). A considerable number of sexual and asexual specimens (mostly asexual) were collected and cultured by OKI and TAMURA since 1963. Water temperature, 16~21°C. Cf. OKI & TAMURA (1972, 1974, 1975 a, b; TAMURA (=YOSHIDA) & OKI, 1969). Both histological and chromosomal examinations were made.

No. 3. Specimen Lot No. 68 group. A spring-fed stream near Masumizu-hara Hütte, the western foot of Mt. Daisen (Masumizu slope), Tottori Pref., Honshû, Japan (alt. 720 m). A considerable number of specimens, both sexual and asexual, were collected by KAWAKATSU on April 27, 1958. Water temperature, 9.3 °C. This locality was discovered by KAWAKATSU and Mr. Y. TARUI on July 4, 1954 (cf. KAWAKATSU, 1955, p. 46, Fig. 1, st. 18; KAWAKATSU & ÔGAWARA 1969). Only histological examination was made.

No. 4. Specimen Lot Nos. 1379, 1386, 1387, and 1388 groups. A stream at Nakamayama-gawara, Urasoe City (about 5 km northeast of Naha), Okinawa Island, Okinawa Pref., Japan (alt. 20 m). A considerable number of specimens, both sexual and asexual, were collected by Mr. I. TANAKA several times from April to May, 1976. Water temperature, 18 - 20 °C. Both histological and chromosomal examinations were made. This is the type-locality of the new subspecies of *Dugesia japonica* which will be described in the present paper.

No. 5. A stream at Wooyi-dong, the northeastern part of Seoul, Korea. Twelve live specimens (including only one sexual specimen) collected by Mr. W. K. LEE late in April, 1976, were received. Water temperature, 6 - 8 °C. Only chromosomal examination was made. The ecological nature and the taxonomic description of the specimens from this locality were found in KIM (1964) and KAWAKATSU & KIM (1966).

No. 6. A stream near the gate of the New Campus of Seoul National University, the southern part of Seoul (between the Han River and Mt. Kangnac), Korea. Nine asexual specimens collected by Dr. S. W. KANG early in May, 1976, were received (the animals injured when they were arrived). Water temperature, 10 - 15 °C. Only chromosomal examination was made. Although the sexual specimen was not obtained from this locality, the genital anatomy of the animals from several populations in the vicinity of this locality is found in KAWAKATSU & KIM (1966).

No. 7. Specimen Lot Nos. 384 and 391 groups. A stream at Hangchow, Che-Kiang, China. A considerable number of specimens were obtained by courtesy of Dr. WANG Yu-Lan and Dr. CHIANG Shi-Ming. Cf. ICHIKAWA & KAWAKATSU (1967). Only histological examination was made.

III. METHODS

For general observation of animals, both live specimens and whole mounts (animals killed by SUGINO's method were fixed in NOZAWA's fluid and were stained in borax-carmin as a whole mount) have been used. Animals fixed in BOUIN's fluid were used for histological examination. Serial sagittal sections of several orientations (7 - 8 micra in thickness) were stained with DELAFIELD's haematoxylin and eosin (sometimes erythrosin was used). Some of the sections were stained with MALLORY's triple stain.

For chromosomal studies, the animals were acclimatized to the laboratory culture condition. They were kept in culture pans with tap water (boiled and then aerated after cooling) and were fed with chicken liver. Then the healthy animals were starved for more than 4 days before cutting. The procedures of the samples used for chromosomal studies are as follows :

1) The animals cut transversely at the posterior level of the mouth were kept in the culture pans (water temp., $16 \pm 2^\circ\text{C}$); the sexual animals were cut at the middle level between the mouth and the genital pore. 2) After 2 to 4 days of culture, the anterior portions of the regenerated pieces were cut transversely and then longitudinally into 2 small pieces (each piece measures less than 1 mm³ in volume). 3) The pieces were immersed in 5ml of 10^{-6}M colchicine (Merck) for 1 to 3 hours ($16 \pm 2^\circ\text{C}$). 4) The treated pieces were retransferred to 5ml of 0.1% potassium chloride for about

30 minutes ($16 \pm 2^\circ\text{C}$). 5) Then each piece transferred onto a slide glass was stained in aceto-orcein (ca. 1%) for 10 to 30 minutes. 6) The stained pieces were squashed under a cover glass and were sealed by paraffine-balsam.

A more detailed technique of chromosomal studies employed will be found in the authors' Japanese article (OKI, TAMURA & KAWAKATSU, 1976).

IV. PRESENTATION OF RESULTS

Order TRICLADIDA

Suborder PALUDICOLA or PROBURSALIA

Family Planariidae

Genus *Dugesia* GIRARD, 1850

Dugesia japonica ICHIKAWA et KAWAKATSU, 1964

[Japanese name : Nami-uzumushi ナミウズムシ]

Dugesia japonica japonica ICHIKAWA et KAWAKATSU, 1964

Dugesia japonica ICHIKAWA et KAWAKATSU, 1964. Annot. Zool. Japon., 37 : 185 - 194, Figs. 1-4
Original description.

Dugesia japonica should be subdivided into two subspecies (see the original description of the new subspecies which will be described in the present paper) and the nominative form then becomes *Dugesia japonica japonica*.

1. Specimens from the Matsumoto Population, Honshû, Japan.

External characters. The general appearance of the sexual specimens from the Matsumoto population was given by ICHIKAWA & KAWAKATSU (1964). The animals are moderately large in size and dark brown in color with many light colored splotches of varying size on the dorsal side; non-splotchy animals are also common.²⁾ Photographs and sketches showing the typical appearance of the animal are found in previous articles (cf. ICHIKAWA & KAWAKATSU, 1964, p. 188, Fig. 1 A-C; see also ICHIKAWA & KAWAKATSU, 1961, Pl. I, Fig. 1; KAWAKATSU, 1968 b, p. 42, Pl. Fig. 1-a, 1969 b, p. 89, Pl. VII, Fig. 1-a, 1973, Pl. Fig. 1-a, 1974, p. 295, Fig. 2 a-1).

The photographs of living specimens are shown in Figure 1 (A - D).

Internal characters. The distinctive histological and anatomical characteristics of the Matsumoto specimens have already been described by ICHIKAWA & KAWAKATSU (1964). The authors wish to add here only some additional observations concerning the genital anatomy of the animals based upon the slides of the type-series and of the newly prepared ones.

The photomicrographs of the sagittal and horizontal sections of the copulatory apparatus are shown in Figures 1 (E) and 2 (A - C). The sagittal view of the copulatory apparatus, reconstructed from several sets of fully sexually mature animals including the holotype (Specimen No. 103c), is also shown in Figure 3 (see also ICHIKAWA & KAWAKATSU, 1964, p. 190, Fig. 3, p. 191, Fig. 4 A).

The penis of the Matsumoto specimens has a large, semiovoidal bulb and a large conical papilla of a highly asymmetrical form. It is strongly muscular in nature. A wide bulbar cavity (seminal vesicle) with a more or less irregular outline is lined by a highly glandular, nucleate epithelium. The two sperm ducts open into the bulbar cavity separately. The dorsal lip of the papilla is larger than the ventral one. The outer wall of the papilla is lined with a nucleate cubical epithelium (it is thick on the

2). According to Mr. F. NĪMURA's recent data in the Matsumoto locality (August, 1976), the rate of occurrence of splotchy animals was 38.1 %.

dorsal lip). Below the epithelium there are two layers of muscle fibres, one thick circular and the other thin longitudinal. A rather wide ejaculatory duct, which is separated from the bulbar cavity by a well-developed valve or diaphragm, opens into the male genital antrum on the ventral side of the papilla. Its lining glandular epithelium consists of cubical cells and contains numerous eosinophilous granules.

The genital antrum of the present form is divided into two cavities, i. e., a wide male antrum and a rather narrow common antrum which connects with the terminal part of the bursal canal or the vagina. The former is lined by a nucleate, very thick epithelium. There are two layers of the subepithelial muscle fibres, the inner thick circular and the outer thin longitudinal. Usually, a glandular fold or a slit accompanying eosinophilous glands is conspicuous on the floor of the male antrum near the genital pore.

The present form has a large copulatory bursa and a wide, rather long bursa stalk, of which the cavity (bursal canal) opens into the common genital antrum. The bursa stalk is divided into two parts: a wide anterior section which connects with the copulatory bursa and a posterior slightly narrow but thick-walled section (i. e., the vagina). After a close reexamination of the newly prepared serial sections of the Matsumoto specimens, it has been found out that the bursa stalk has a thick glandular epithelium of nucleate type (cf. ICHIKAWA & KAWAKATSU, 1964, p. 192). The muscle coat surrounding the bursa stalk consists of three layers of fibres, i. e., a thin layer of longitudinal, a wide layer of circular, and a thin layer of longitudinal. In the posterior two-third section, the middle circular and the outer longitudinal layers of the muscle fibres become thicker than those of the anterior one-third section and slightly intermingled at the regions of the vagina and of the posterior wall of the common genital antrum. As shown in the photomicrograph (Fig. 2 B), the vagina is surrounded by a very wide halo-like structure. Histologically, it consists of mesenchymal tissue traversed by several coarse rows of longitudinal muscles and less-developed radial ones. The wall of the vagina is pierced by numerous ducts of strongly eosinophilic glands and the cyanophilic gland ducts which open into the cavity. The two ovovitelline ducts accompanying strongly eosinophilic glands open into the vagina. Weakly eosinophilous cement glands open into the common antrum near the genital pore.

Cytological observation. As already mentioned, DAHM (1963) studied the karyotype of *Dugesia* species, "Matsumoto stock", which was later described under *Dugesia japonica* ICHIKAWA et KAWAKATSU. In two sexually mature specimens examined cytologically 100 mitoses ($2n = 16$) and 22 meioses ($n = 8$) were observed (Fig. 15 A and B). The karyotype consists of 8 pairs of metacentric chromosomes in descending order of size. The chromosome labelled 4 seemed to be slightly submetacentric (Fig. 18-a A). The present examination of the chromosomes of *Dugesia japonica japonica* from the type-locality is coincident with DAHM's description (1963, pp. 60-62, Figs. 19 and 20; see also TESHIROGI & ITAGAKI, 1965). See also Table 1.

Differential diagnoses of Dugesia japonica and Dugesia japonica japonica. The differential diagnosis of *Dugesia japonica* (cf. ICHIKAWA & KAWAKATSU, 1964, p.193) should be revised as follows: living animals moderate to large; head triangular with a rather short, bluntly pointed but definite auricles; eyes two (supernumerary eyes may occur); colored but highly variable, sometimes with spots on the dorsal surface; external muscle layers of the pharynx consist of outer longitudinal and inner circular fibres (additional inner longitudinal fibres may occur); testes numerous and dorsal, extending in two lateral rows throughout the body; penis bulb moderate to large and strongly muscular with a wide retort-shaped bulbar cavity into which sperm ducts enter without previous union (spermiducal vesicles well-developed); highly asymmetric muscular penis papilla large and conical; separation of the bulbar cavity and ejaculatory duct by a well-developed diaphragm and external opening of the

Table 1 Variation of the chromosome numbers and karyotypes of *Dugesia japonica* (*Dugesia japonica japonica* and *Dugesia japonica ryukyuensis* subsp. nov.) from 5 localities in Japan and Korea.

Two subspecies & their localities		No. of specimens examined cytologically			Chromosome nos. & the no. of cells studied in parentheses	
		Total	Sexual** specimens	Asexual specimens	Germ cell (meiosis)	Somatic cell (mitosis)
<i>Dugesia japonica japonica</i>	MATSUMOTO, JAPAN*	2	2	—	n = 8 (22)	2n = 16 (100)
	MINO'O, JAPAN	72	1	—	n = 8 (11)	2n = 16 (41)
			2	—	—	2n = 16 (85)
			1	—	n = 8 (26)	{ 2n = 16 (91) & 3n = 24 (3)
			6	—	—	{ 2n = 16 (630) & 3n = 24 (450)
—	10	—	—	2n = 16 (1064)		
—	51	—	—	{ 2n = 16 (1767) & 3n = 24 (1362)		
—	1	—	—	3n = 24 (30)		
<i>Dugesia japonica japonica</i>	WOYI-DONG, SEOUL, KOREA	6	1	—	n = 8 (5)	2n = 16 (32)
	Mt. GWNAC, SEOUL, KOREA	6	—	3	—	{ 2n = 16 (95) & 3n = 24 (115)
			—	2	—	{ Chr. no. 25 (46) & Chr. no. 26 (46)
<i>D. j. ryukyuensis</i>	URASOE, OKINAWA, JAPAN	12	—	3	—	{ 2n = 16 (61) & 3n = 24 (57)
			—	3	—	3n = 24 (100)
			2	—	n = 7 (8)	2n = 14 (117)
			1	—	—	2n = 14 (33)
			1	—	—	2n + 1 = 14 + 1 (44)
—	2	—	—	2n = 14 (47)		
—	6	—	—	—	3n + α = 21 + α (141)	

* The type-locality of *Dugesia japonica*.

** The sexual condition of the animals was determined according to the presence of the genital pore and/or sperms.

Fig. 1. *Dugesia japonica japonica* ICHIKAWA et KAWAKATSU, 1964, from the Matsumoto locality (the type-locality). A - C: Three living sexually mature specimens. D: Head of a living sexually mature specimen. No. 1385 group. E: Photomicrograph of the parts of the copulatory apparatus (horizontal section, No. 1385 j).

bc, bulbar cavity; cb, copulatory bursa; od, ovovitelline duct; pp, penis papilla; sv, spermiducal vesicle.

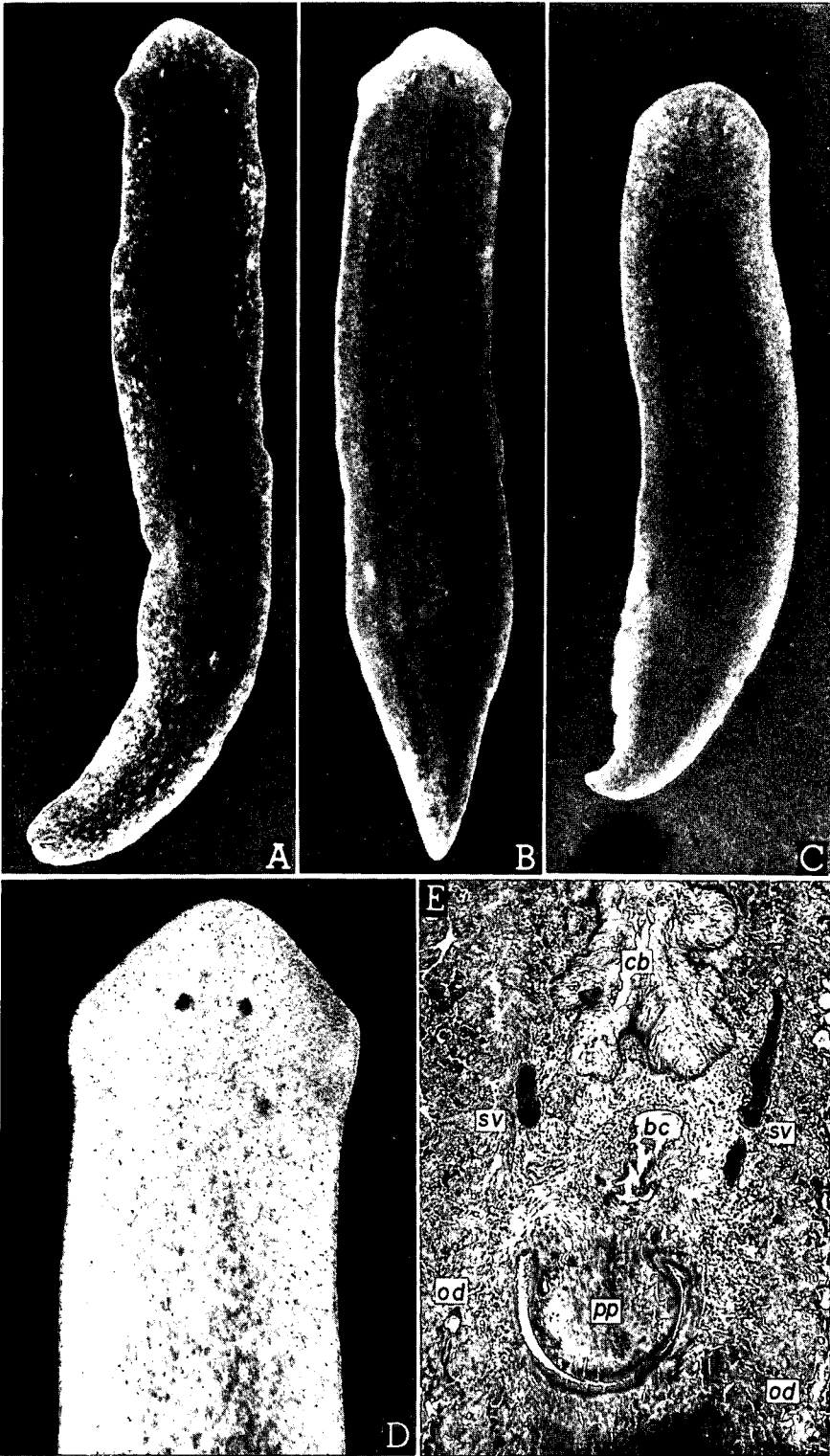
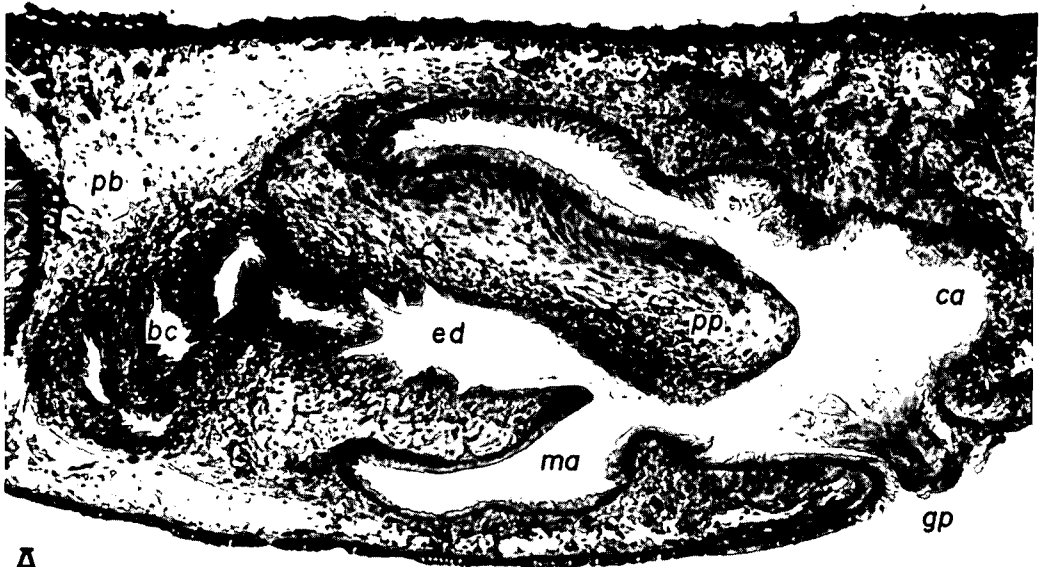
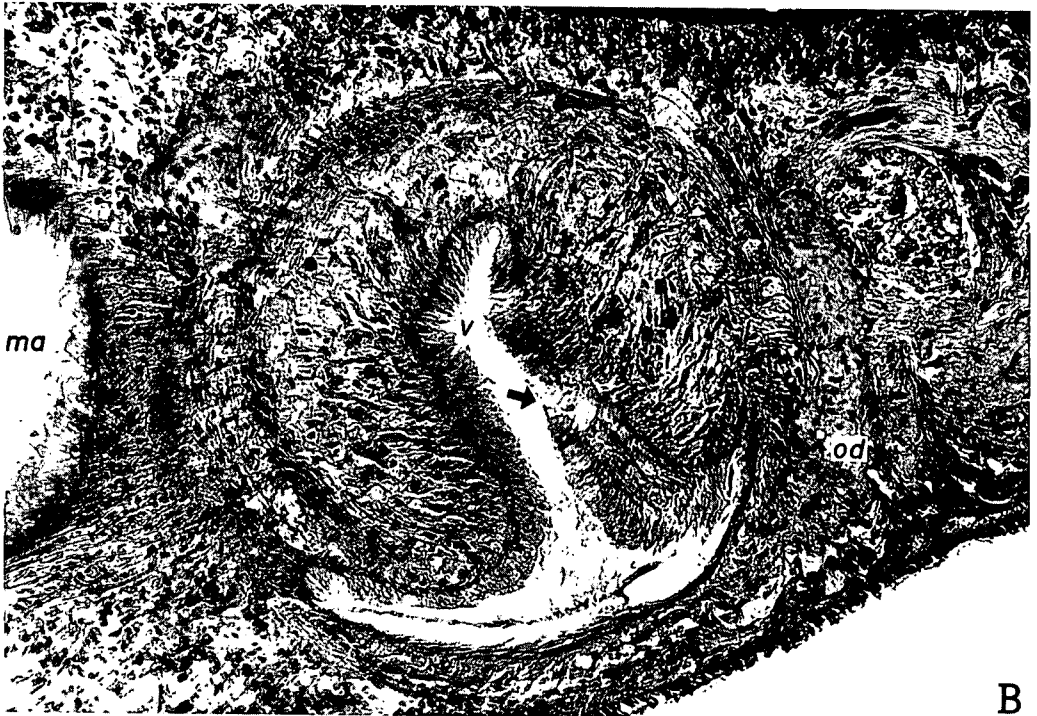


Fig. 1



A



B

Fig. 2. (A and B). Photomicrographs of the copulatory apparatus of *Dugesia japonica japonica* from the Matsumoto locality. A : Penis of the holotype (sagittal section, No. 102 c). B : Vagina of the holotype (sagittal section, No. 102 c). Arrow indicates the opening of the ovovitelline duct. See ICHIKAWA & KAWAKATSU (1964, p. 191, Fig. 4 A and D).
 bc, bulbar cavity ; ca, common antrum ; ed, ejaculatory duct ; gp, genital pore ; ma, male antrum ; od, ovovitelline duct ; pb, penis bulb ; pp, penis papilla ; v, vagina.

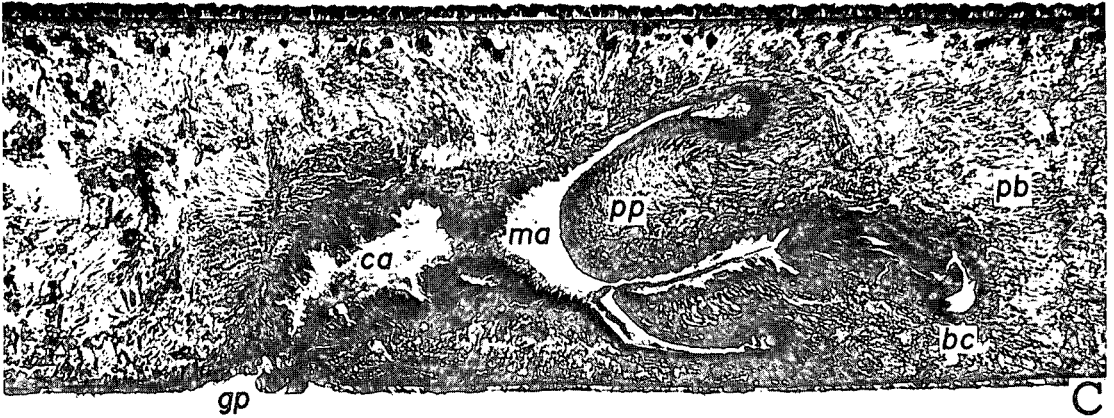


Fig. 2 (C). Photomicrograph of the copulatory apparatus of *Dugesia japonica japonica* from the Matsumoto locality (sagittal section, No. 1385 g). Abbreviations, see Fig. 2 (A and B).

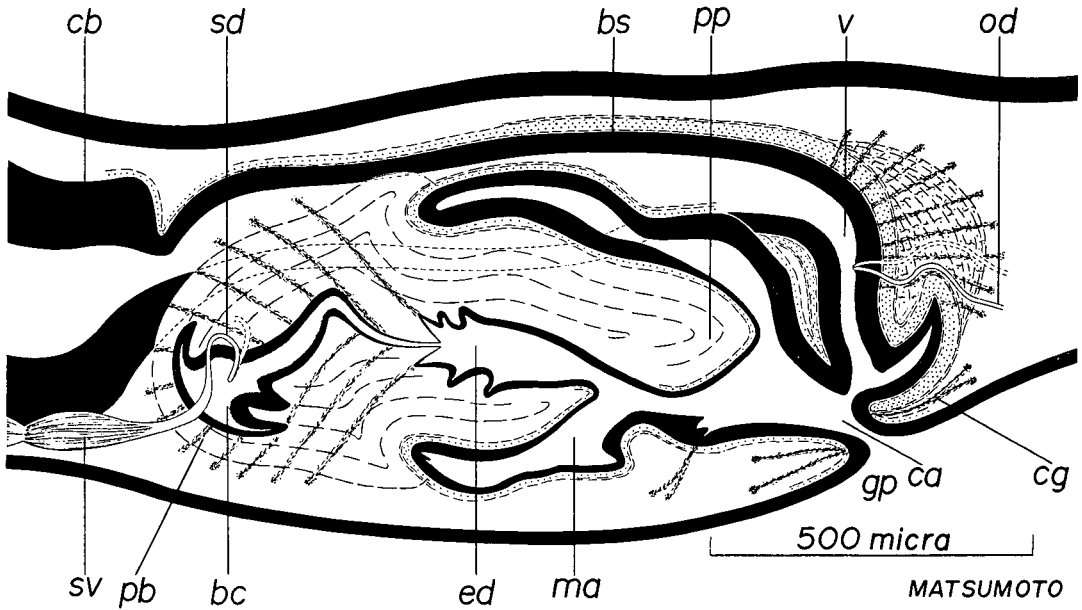


Fig. 3. Diagram showing the sagittal view of the copulatory apparatus of *Dugesia japonica japonica* from the Matsumoto locality (redrawn from the slides of the holotype, No. 102 c).
 bc, bulbar cavity ; bs, bursa stalk ; ca, common antrum ; cb, copulatory bursa ; cg, cement gland ; ed, ejaculatory duct ; gp, genital pore ; ma, male antrum ; od, ovovitelline duct ; pb, penis bulb ; pp, penis papilla ; sd, sperm duct ; sv, spermiducal vesicle ; v, vagina.

ejaculatory duct on the under side of the penis; copulatory bursa large, folded, with a wide bursal canal which opens into the common antrum near the genital pore; vagina well-developed (typically, it is surrounded by a wide halo-like structure) into which ovovitelline ducts enter separately; cocoon spherical in shape and stalked.

The nominative subspecies, *Dugesia japonica japonica*, is characterized in having a penis papilla without a well-developed valve surrounding its basal part and also in having a well-developed vagina. This subspecies has a chromosome number of $n = 8$ and $2n = 16$. The chromosome number of 24 ($3n$) is also found in the asexual specimens from certain localities.

Type-series. Holotype—One set of serial sagittal sections (Specimen No. 102c, 3 slides) will be deposited in the Department of Zoology, National Science Museum, Tôkyô. Two paratypes (Nos. 102 e and 286 f) and one set of additional serial sagittal sections and one whole mount of the animals from the type-locality (No. 1385g, k) will be deposited in the same Museum. The remaining slides including the paratypes and several whole mounts are retained in KAWAKATSU's collection (KAWAKATSU's laboratory, Fuji Women's College, Sapporo). Cf. ICHIKAWA & KAWAKATSU (1964, p. 193); KAWAKATSU (1969 b, p. 50).

Type-locality. A spring-fed stream at Genchi, Matsumoto City, Nagano Pref. (Chûbu Region), Honshû, Japan. Altitude, about 600m. Collected by M. KAWAKATSU on November 4, 1954 (holotype). Cf. ICHIKAWA & KAWAKATSU (1964, p. 193).

The distribution of *Dugesia japonica japonica* will follow in the section "Taxonomic and Zoogeographical Remarks".

2. Specimens from the Mino'o Population, Honshû, Japan.

External characters. The sexually mature specimens were rare in the Mino'o population. The specimens may attain about 25 mm in length and 4 mm in width. The animals are of a light brownish color (cf. OKI & TAMURA, 1975 a).

Internal characters. Only one sexual specimen was available for histological examination. The musculature of the pharynx shows the typical arrangement of *Dugesia japonica* (cf. ICHIKAWA & KAWAKATSU, 1964, p. 189).

The testes, ovaries and yolk glands have been observed in the slides examined. It is, however, very interesting that the ovaries are extraordinary large in size and occupy almost all the dorso-ventral space at the usual anterior level of the body.³⁾

The photomicrographs of the copulatory apparatus are shown in Figure 4 (A and B); see also Figure 5. The Mino'o specimen shows the typical genital anatomy of *Dugesia japonica japonica*. But the halo-like structure surrounding the vagina in the Mino'o specimen shows a slightly low degree of differentiation compared with that of the animals from the type locality.

Cytological observation. The karyotype of the animals belonging to this population was reported in a preliminary form by OKI & TAMURA (1974, 1975 a, b). In the present study the result of the cytological examination of additional specimens, both sexual and asexual, are included.

The authors have examined 10 sexual specimens. One hundred and twenty-six mitoses in 3 of them revealed a chromosome number of $2n = 16$. During meiosis 8 bivalents were found. No apparent differences in the morphology of the karyotype could be observed between the sexual specimens from the Mino'o population and the Matsumoto population. From the study of the somatic cells of 7 sexual

3) SUGINO (1969, p. 297, Fig. 26; see also SUGINO, 1971, p. 12, Fig. 26) described an extraordinary large ovaries induced in the body of the asexual form of *Dugesia japonica* (Kyûsû stock) when the anterior piece of the asexual form and the posterior piece of the sexual form (Mt. Shigisan stock) had been united by a transplantation technique.

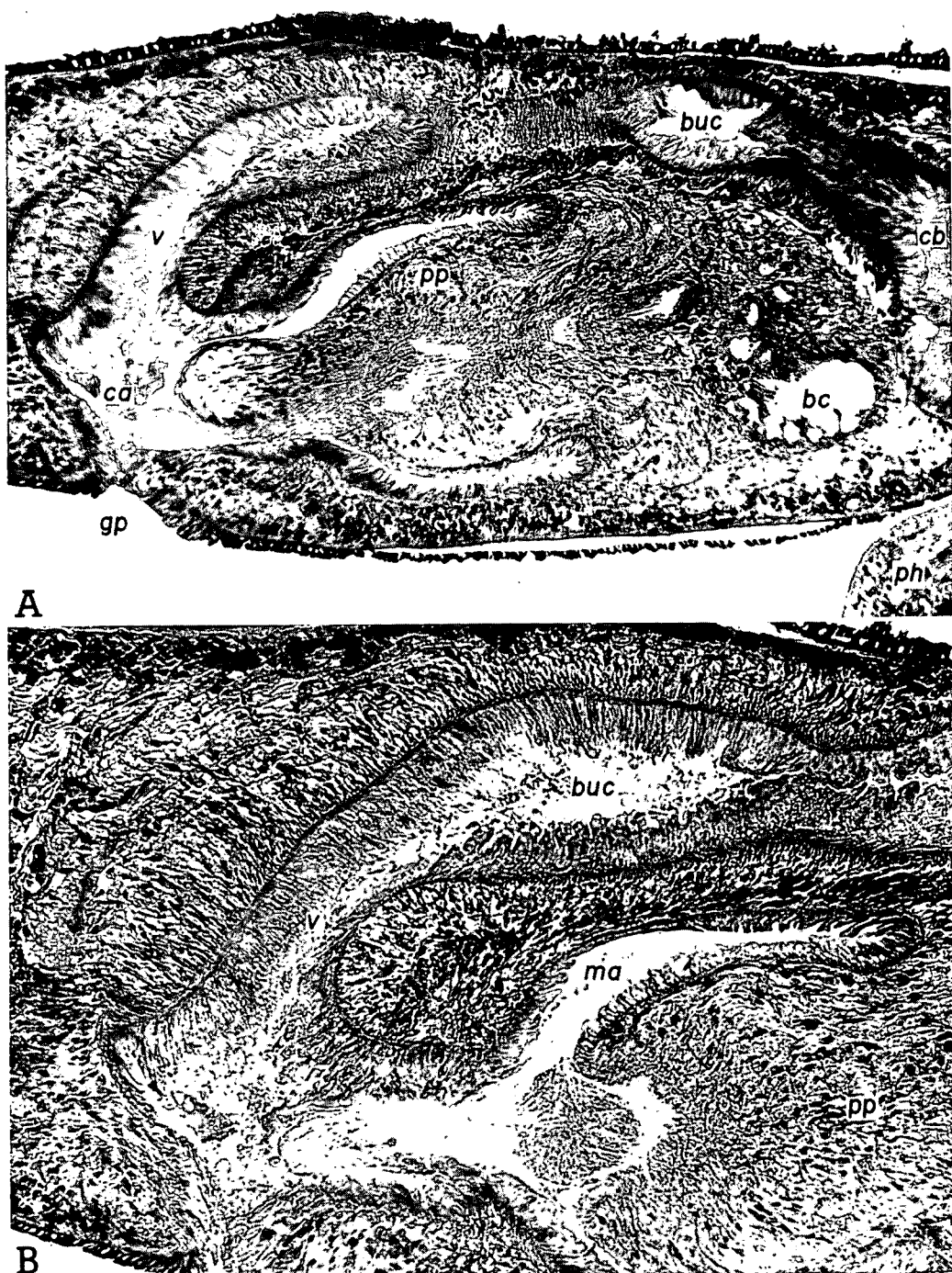


Fig. 4. Photomicrographs of the copulatory apparatus of *Dugesia japonica japonica* from the Mino'o locality. A : Penis (sagittal section, No. 1358 a). B : Vagina (sagittal section, No. 1358 a).
 bc, bulbar cavity ; buc, bursal canal ; ca, common antrum ; cb, copulatory bursa ; gp, genital pore ; ma, male antrum ; ph, pharynx ; pp, penis papilla ; v, vagina.

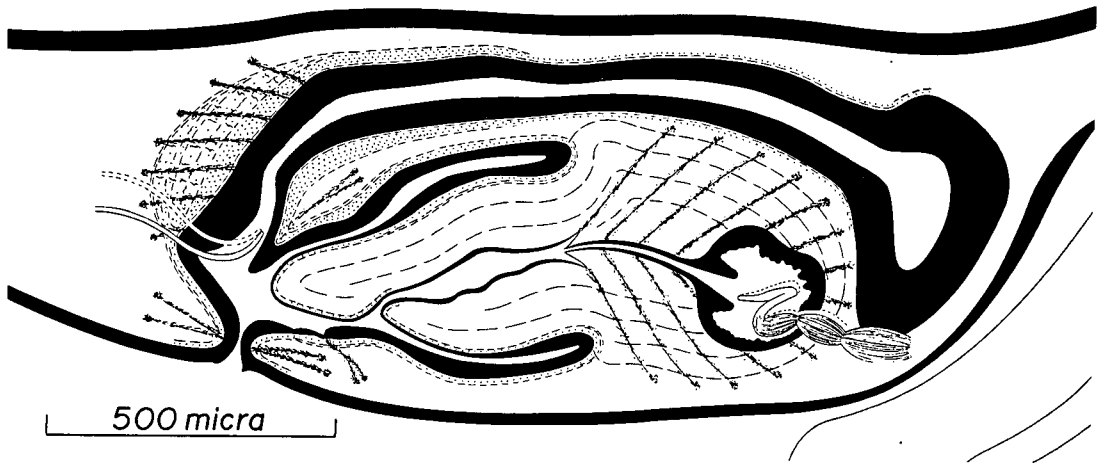


Fig. 5. Diagram showing the sagittal view of the copulatory apparatus of *Dugesia japonica japonica* from the Mino'o locality (No. 1358 a).

specimens the occurrence of two different types of cells intermingled in one animal was observed. The first type of cells had 16 chromosomes, while the second type had 24 (Fig. 15 C and D). In one of them, 8 bivalents during meiosis were found.

Three kinds of the asexual specimens having different karyotypes were found in the Mino'o population. They were: the diploid specimens ($2n = 16$), the specimens with the chromosome number of 16 and 24 in one animal ($2n = 16$ and $3n = 24$), and the triploid specimen ($3n = 24$). See also Figure 18-a (B and C) and Table 1.

Material. One set of serial sagittal sections (Specimen No. 1358 a) is retained in KAWAKATSU'S laboratory, Fuji Women's College, Sapporo.

Locality. See "List of Localities".

3. Specimens from the Mt. Daisen Population, Honshû, Japan.

External characters. The sexually mature specimens of this population are very large in size. The animals may attain over-35mm in length and 5 to 7mm in width. They are of a brownish color. Photographs of the preserved specimens including bicephalous animal taken from a lot of regeneration experiments are shown in Figure 6 (A-C).

Internal characters. In histological sections, it was observed that the arrangement of the pharynx musculature of the Mt. Daisen specimens is different from the typical arrangement of *Dugesia japonica*. Namely, its outer musculature consists of three layers, i. e., the outer thin longitudinal, the middle thick circular, and the inner thin longitudinal; the inner musculature shows the typical arrangement (Fig. 6D).

There are no histological peculiarities about the testes, ovaries and yolk glands.

The photomicrographs of the copulatory apparatus are shown in Figure 7 (A and B). The sagittal view of the copulatory apparatus, reconstructed from several sets of sections, is shown in Figure 8. In the penial anatomy, the Mt. Daisen specimens of *Dugesia japonica japonica* have a small valve at the basal part of the dorsal lip of the penis papilla. This character is found in all of the five specimens examined. The halo-like structure surrounding the vagina is well-developed.

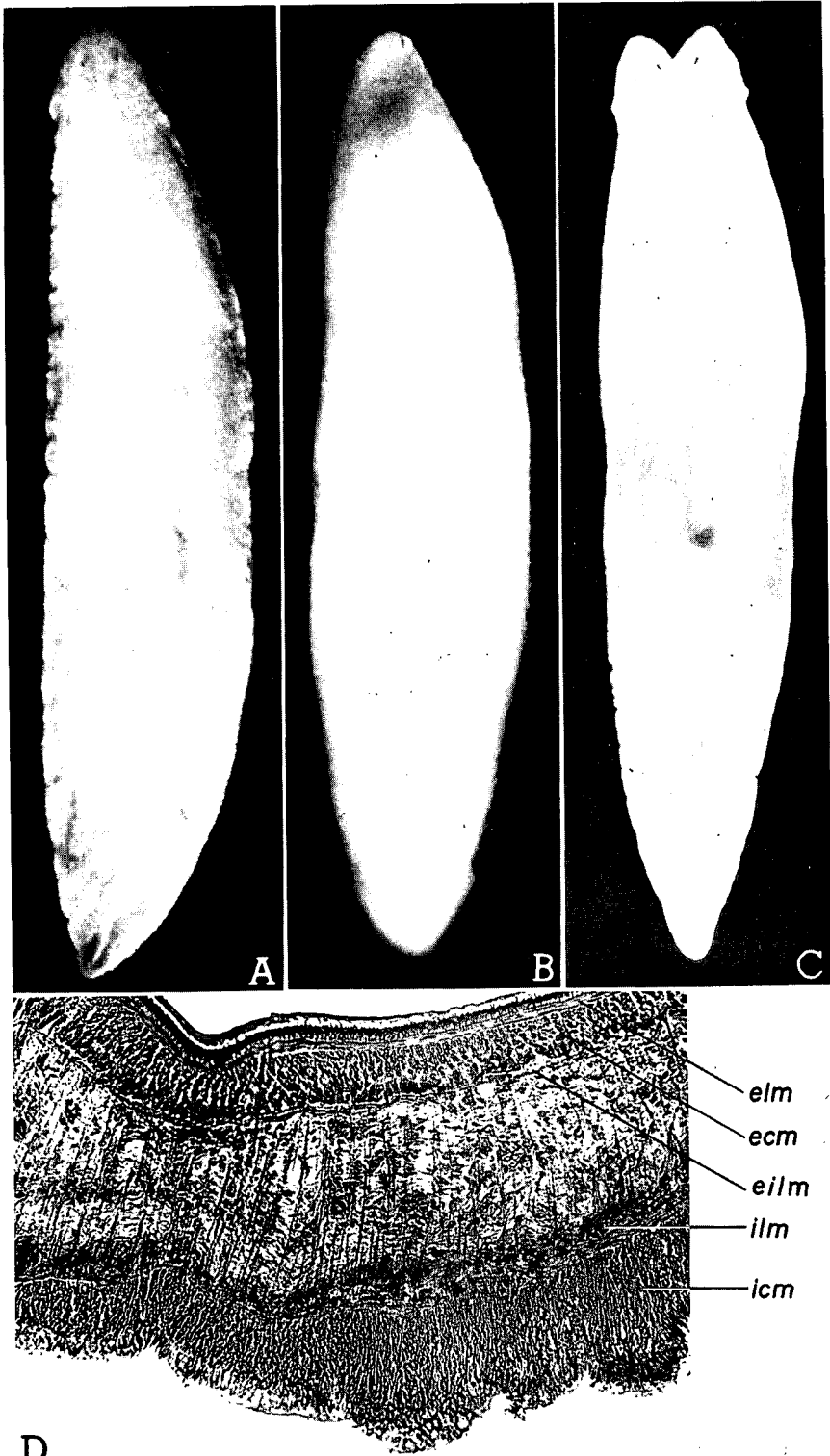


Fig. 6. *Dugesia japonica japonica* from the Mt. Daisen locality. A: Preserved sexually mature specimen. B: Ventral view of the specimen A. C: Preserved bicephalic specimen. No. 68 group. D: Photomicrograph of the sagittal section of the part of the pharynx (No. 68 a). *ecm*, external circular muscle layer; *eilm*, external irregular longitudinal muscle layer; *elm*, external longitudinal muscle layer; *icm*, internal circular muscle layer; *ilm*, internal longitudinal muscle layer.

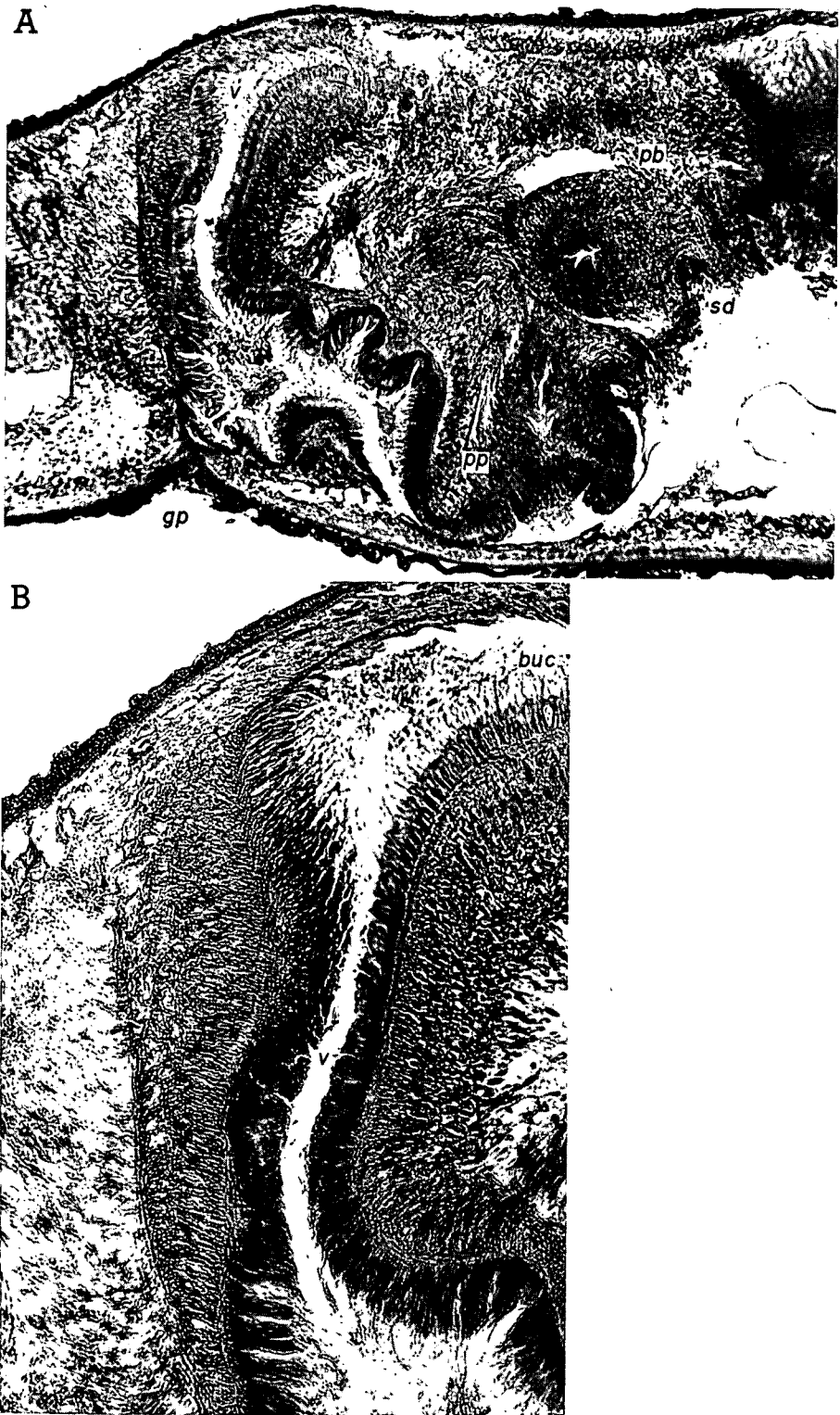


Fig. 7. Photomicrographs of the copulatory apparatus of *Dugesia japonica japonica* from the Mt. Daisen locality. A : Penis (sagittal section, No. 68 c). B : Vagina (sagittal section, No. 68 c). **buc**, bursal canal ; **gp**, genital pore ; **pb**, penis bulb ; **pp**, penis papilla ; **sd**, sperm duct ; **v**, vagina.

MT. DAISEN

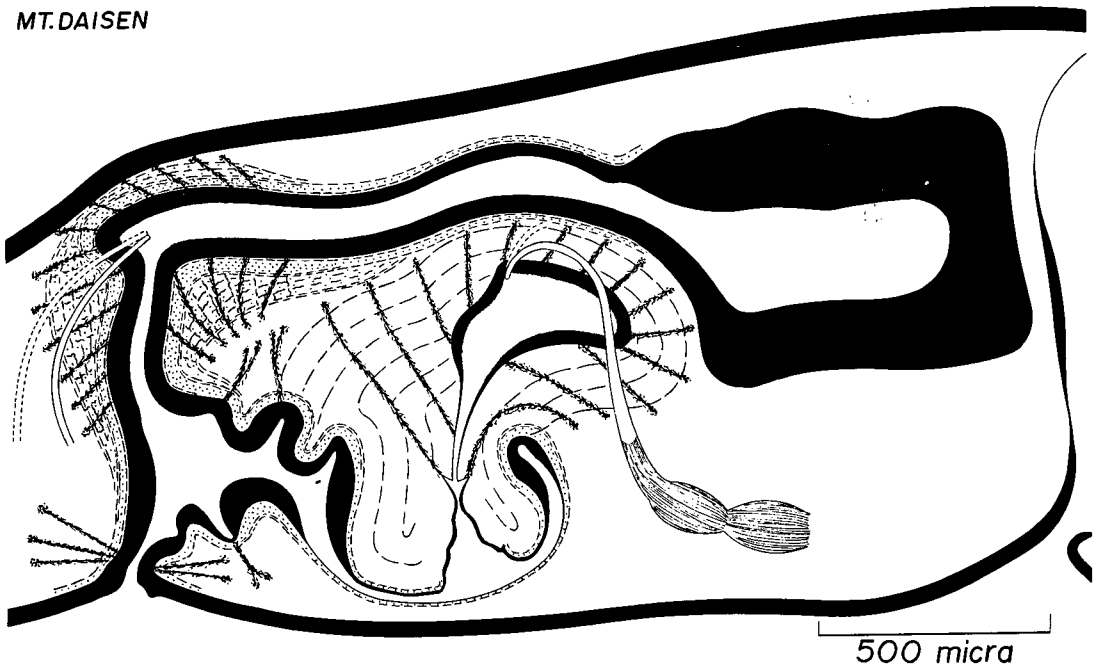


Fig. 8. Diagram showing the sagittal view of the copulatory apparatus of *Dugesia japonica japonica* from the Mt. Daisen locality (No. 68 c).

Material. Five sets of serial sagittal sections (Specimen No. 68 a-e) are retained in KAWAKATSU'S laboratory, Fuji Women's College, Sapporo.

Locality. See "List of Localities".

4. Specimens from the Wooyi-dong Population, Seoul, Korea.

External characters. The sexual specimen of this population may attain about 15mm in length and 2 mm in width. The animal is of a dark brownish color with an indistinct light brownish longitudinal band along the median line of the body. The anterior margin of the body is mottled with indistinct sensory spots. Photographs of the preserved specimens from the Wooyi-dong population are found in KIM (1964, p. 261, Fig. 1 A and B) and KAWAKATSU & KIM (1966, p. 104, Fig. 1 A).

Internal characters. The description of the genital anatomy of the specimens from the Wooyi-dong population was described in the previous paper (cf. KAWAKATSU & KIM, 1966, p. 105, Fig. 3 B). After reexamination of the slides (Specimen No. 403 group), it must be said that the histological details and the anatomical characters of the copulatory apparatus of the Korean specimens are coincident with those of *Dugesia japonica japonica* from the type-locality. The halo-like structure surrounding the vagina in the Wooyi-dong specimens shows a slightly low degree of differentiation.

Cytological observation. One sexual and 5 asexual specimens were examined cytologically. In the sexual specimen the chromosome number is $2n = 16$ in 32 mitoses. The genom consisted of 8 metacentric chromosomes, of which no. 4 seemed to be slightly submetacentric. In meiosis 8 bivalents were formed (Fig. 16 A). The karyotype of the present material is very similar to that of the Matsu-moto specimens.

In the asexual specimens, two kinds of karyotypes were found. The three specimens had the cells with 16 chromosomes and 24 chromosomes in one animal ($2n = 16$ and $3n = 24$) (Fig. 16 A). The remaining 2 specimens showed a peculiar karyotype. Namely, they had two types of cells with the chromosome number of 25 and 26 in one animal. It was observed that the cells with the chromosome number of 25 contained one acrocentric chromosome in addition to the usual karyotype of the triploid specimens (Fig. 16 B). The cells with 26 chromosomes were fundamentally triploid except no. 2 which consisted of two chromosomes. In addition to these chromosomes, extra three chromosomes were found. They were acrocentric or telocentric (Fig. 16 C). See also Figure 18-a (D - G) and Table I.

Material. Only used for karyological examination. The serial sagittal sections of the Wooyi-dong specimens used in the previous study (cf. KAWAKATSU & KIM, 1966; Specimen Nos. 403 a and b, 404 a) are retained in KAWAKATSU's laboratory, Fuji Women's College, Sapporo.

Locality. See "List of Localities".

5. Specimens from the Seoul (Mt. Kangnac) Population, Seoul, Korea.

External characters. The general appearance of the asexual specimens from the Seoul population is very similar to that of the specimens from the Wooyi-dong population. The animals are about 10 mm in length and 1.5 mm in width.

Cytological examination. Six asexual specimens were examined cytologically. The three specimens had the cells with 16 chromosomes and 24 chromosomes in one animal ($2n = 16$ and $3n = 24$) (Fig. 16 D). The remaining 3 specimens had only triploid cells ($3n = 24$). No diploid specimens were found in this population. See also Figure 18-a (H and I) and Table I.

Material. Only used for karyological examination.

Locality. See "List of Localities".

Dugesia japonica ryukyuensis KAWAKATSU. **subspec. nov.**

Dugesia japonica: in ICHIKAWA & KAWAKATSU, 1967. Nature & Life in SE Asia, V: 180-185, Figs. 3 (A - C), 4 (A - H). Taxonomic descriptions of the animals from Okinawa and China.

Dugesia japonica: in KAWAKATSU & Tanaka, 1971. Biol. Mag. Okinawa (Naha), 8: 48 - 52, Figs. 2 (A and B), Pls. I (Figs. A - I), II (A - E). Taxonomic descriptions of the animals from the Ryûkyû Islands (Oki-no-erabu-jima Island, Okinawa Island, Kume-jima Island, and Ishigaki-jima Island).

Dugesia japonica: in KAWAKATSU & Tanaka, 1976. Zool. Mag. (Tôkyô), 85: 73 - 77, Figs. 1 (D), 2 (B), 3 (C). Taxonomic description of the animals from the Ryûkyû Islands (Takabanare-jima Island, Okinawa Island, Miyako-jima Island, and Ishigaki-jima Island).

Dugesia japonica: in KAWAKATSU, HAUSER & FRIEDRICH, 1976. Bull. Natn. Sci. Mus., Ser. A (Zool.), 2: 205 - 223. Ecological notes on the breeding of the animals from the Adaniya population in Okinawa Island (based upon the data by TANAKA, 1965, and TANAKA, UNTEN & UNTEN, 1965).

The original description of *Dugesia japonica ryukyuensis* subspec. nov. will be given below based upon the material from the Urasoe population in Okinawa.

1. Specimens from the Urasoe Population, Okinawa, Japan.

External characters. The general appearance of both live and preserved specimens from the Urasoe locality is shown in photographs in Figure 9 (A - H). Externally, the animals are indistinguishable from the nominative subspecies. The sexually mature specimens attain 10 to 15 mm in length

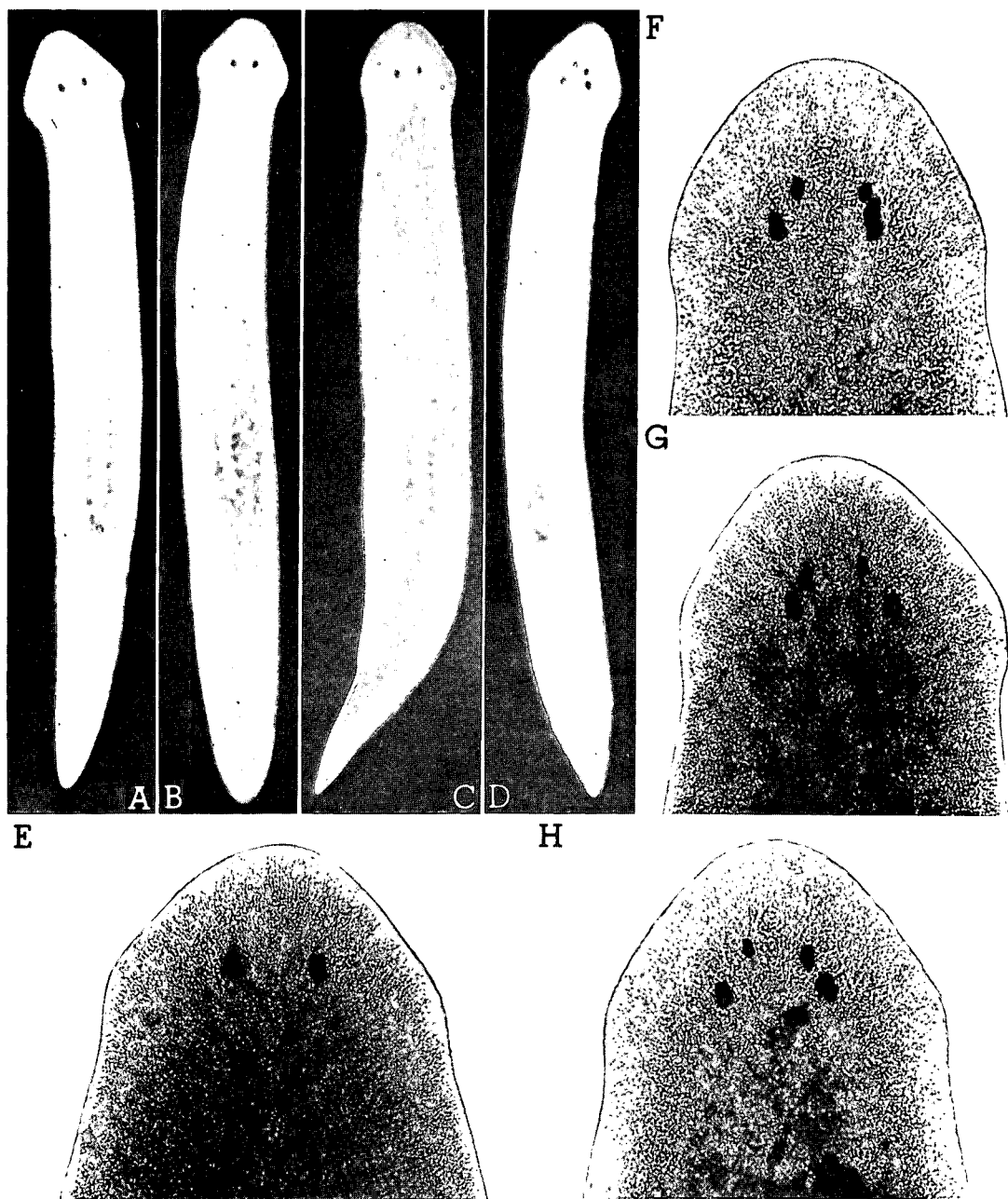


Fig. 9. *Dugesia japonica ryukyuensis* subsp. nov. from the Urasoe locality (the type-locality). A - D : Four living sexually mature specimens. D, A specimen with 4 eyes. E - H : Head of four preserved specimens. Notice the supernumerary eyes. No. 1386 group.

and 1.5 to 2 mm in width. The two eyes (irregularities may occur) with usual rounded clear areas are situated on the dorsal side of the head. The pharynx is inserted somewhat behind the middle of the body. The genital pore opens at the slightly anterior level of the halfway between the mouth and the posterior end of the body.

The general color of the live specimens is light brown to grayish brown on the dorsal surface with numerous dark brown to blackish brown pigments or small granules. The body margin and the areas above the pharynx and copulatory apparatus are of a lighter hue. The auricular sense organ which is a small, elongated leaf shape is indistinctly visible on each side of the head. In the *Urasoe* specimens examined, no sensory spots were observed at the anterior margin of the head.⁴⁾

Internal characters. In large specimens the anterior intestinal trunk bears 8 to 12 lateral branches; each posterior trunk has 12 to 15 or more short lateral branches. It was observed in the histological sections that the outer musculature of the pharynx consists of two layers, the outer thin longitudinal and the inner thick circular muscle fibres.

The ovaries, dorsal testes and yolk glands are conspicuous in every sexually mature specimen examined. A pair of well-developed spermiducal vesicles is seen in the usual position.

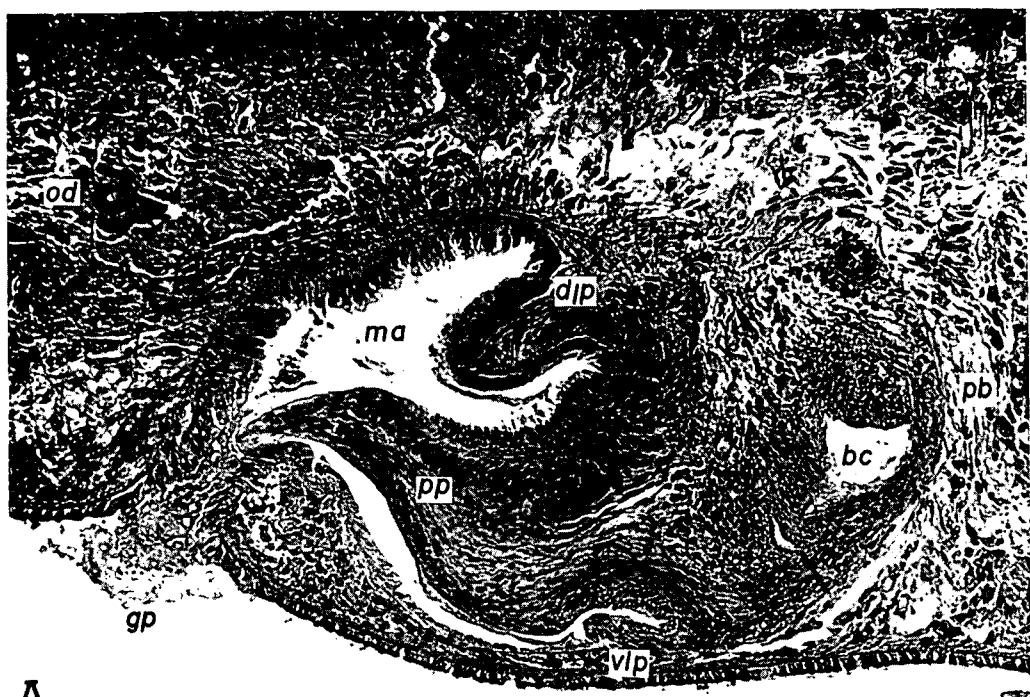
The photomicrographs of the copulatory apparatus are shown in Figures 10 (A and B) and 11 (A-F). The sagittal view of the copulatory apparatus of the well-extended specimen (Specimen No. 1379a; holotype) is shown in Figure 12.

The penis bulb is large and hemispherical in shape and is strongly muscular in nature. It contains a rather wide retort-shaped cavity which is lined by a thick, nucleate epithelium. The two sperm ducts open into the bulbar cavity separately. The bulb is pierced by numerous ducts of penis glands. The secretion of these ducts consists of pale eosinophilous granules. The penis papilla having a strong constriction at its basal part is rather long, conical and highly asymmetrical in shape. It contains a narrow long ejaculatory duct which opens into the male genital antrum on the ventral side of the papilla. A well-developed diaphragm is present in the penis lumen at the beginning of the ejaculatory duct. The outer wall of the papilla (and the valves of the papilla) is lined with a nucleate epithelium. Below the epithelium there are two layers of muscle fibres, one circular and the other longitudinal. The male genital antrum is lined by a glandular nucleate epithelium. The subepithelial muscle fibres show the same arrangement as those of the papilla. A small glandular fold or a slit is differentiated on the floor of the male genital antrum near the genital pore.

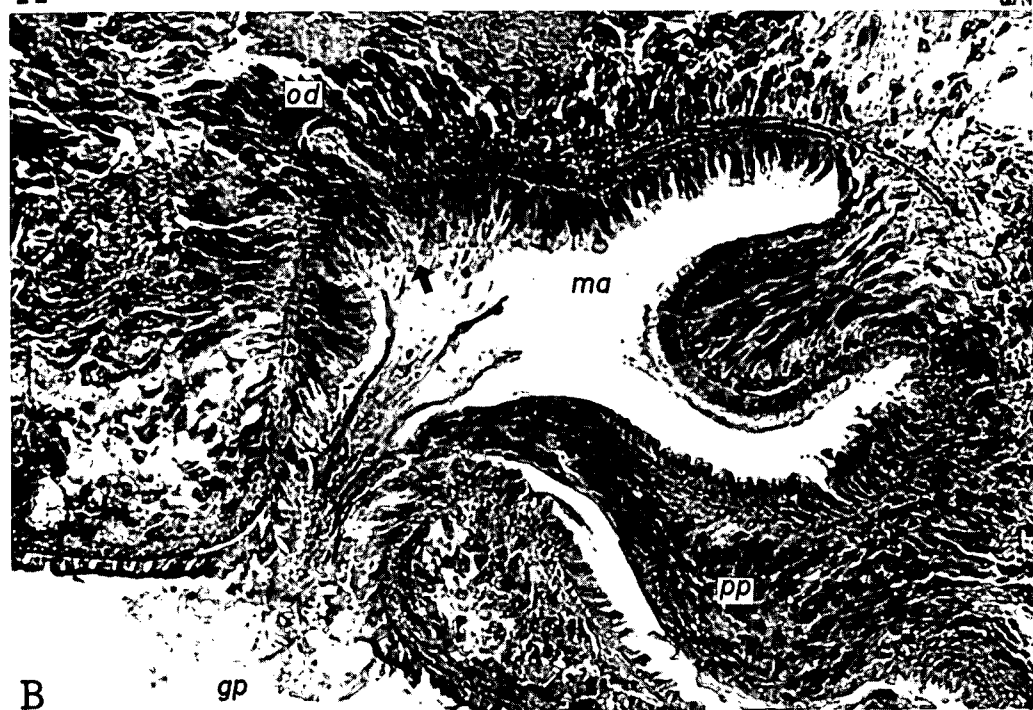
The constriction or the valve surrounding the basal part of the penis papilla is the most important taxonomic character which separates the present new subspecies from the nominative form. As will be seen in Figures 10 (A and B) and 12, the dorsal lip of the valve is larger than the ventral one. The valves (especially the dorsal valve) contain numerous ducts of eosinophilic glands. The secretion of these ducts consists of heavily stained granules with erythrosin.

The copulatory bursa is moderate to large in size. The bursa stalk which is a rather wide and long duct opens into the narrow common genital antrum near the genital pore (common antrum is usually narrow in the present new subspecies). The bursal canal has a glandular nucleate epithelium. At the anterior two-third of the bursa stalk, there are two layers of muscle fibres, the inner thick circular and the outer thin longitudinal. The posterior one-third of the stalk become thick and to form the less-developed vagina. In this part the subepithelial muscle fibres consist of three layers: the

4), In many specimens from several localities of the Ryûkyû Islands, the anterior margin of the head is mottled with indistinct white stipples (cf. ICHIKAWA & KAWAKATSU, 1967, pp. 179-180, Fig. 2 H and I; KAWAKATSU & TANAKA 1971, p. 49, 1975, p. 74, Fig. 1 B-D)



A



B

Fig. 10. Photomicrographs of the copulatory apparatus of *Dugesia japonica ryukyuensis* subsp. nov. from the Urasoe locality. A: Penis of the holotype (sagittal section, No. 1379 a). B: Vagina of the holotype (sagittal section, No. 1379 a). Arrow indicates the opening of the ovovitelline duct.

bc, bulbar cavity ; dip, dorsal lip of the penis papilla ; gp, genital pore ; ma, male antrum ; od, ovovitelline duct ; pb, penis bulb ; pp, penis papilla ; vip, ventral lip of the penis papilla.

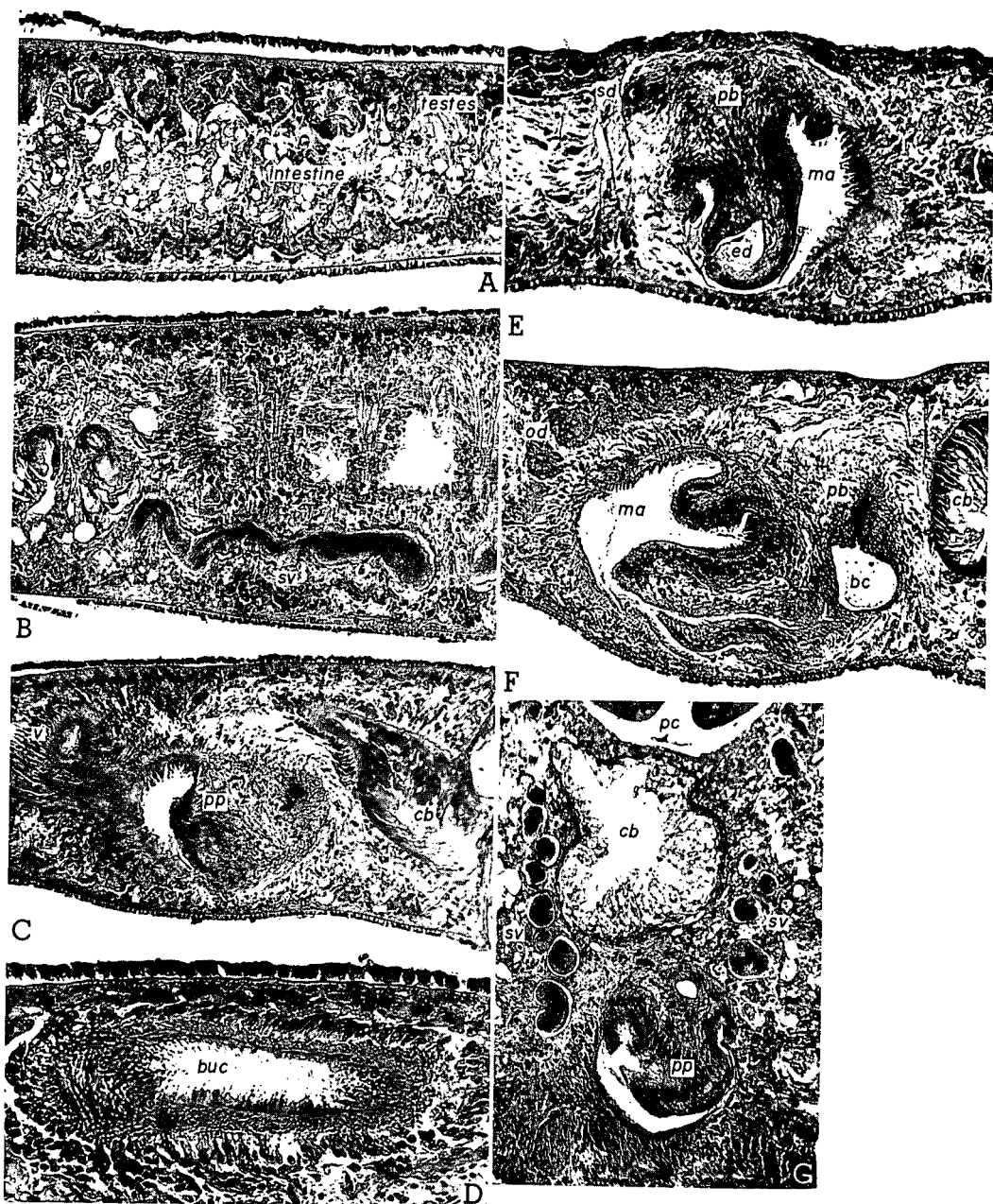


Fig. 11. Photomicrographs showing the parts of the copulatory apparatus of *Dugesia japonica ryukyuensis* subsp. nov. from the Urasoe locality. A : Sagittal section of a part of the prepharyngeal region (No. 1379 a). Notice the arrangement of the dorsal testes. B : Sagittal section of a part of the postpharyngeal region (No. 1379 a). C : Near mid-sagittal section of the copulatory apparatus (No. 1379 a). D : Sagittal section through the middle part of the bursal canal (No. 1379 a). E : Penis (sagittal section, No. 1379 b). F : Penis (sagittal section, No. 1379 f). G : Penis (horizontal section, No. 1379 h).
 bc, bulbar cavity ; buc, bursal canal ; cb, copulatory bursa ; ed, ejaculatory duct ; ma, male antrum ; pb, penis bulb ; pc, pharyngeal chamber ; pp, penis papilla ; sv, spermiducal vesicle.

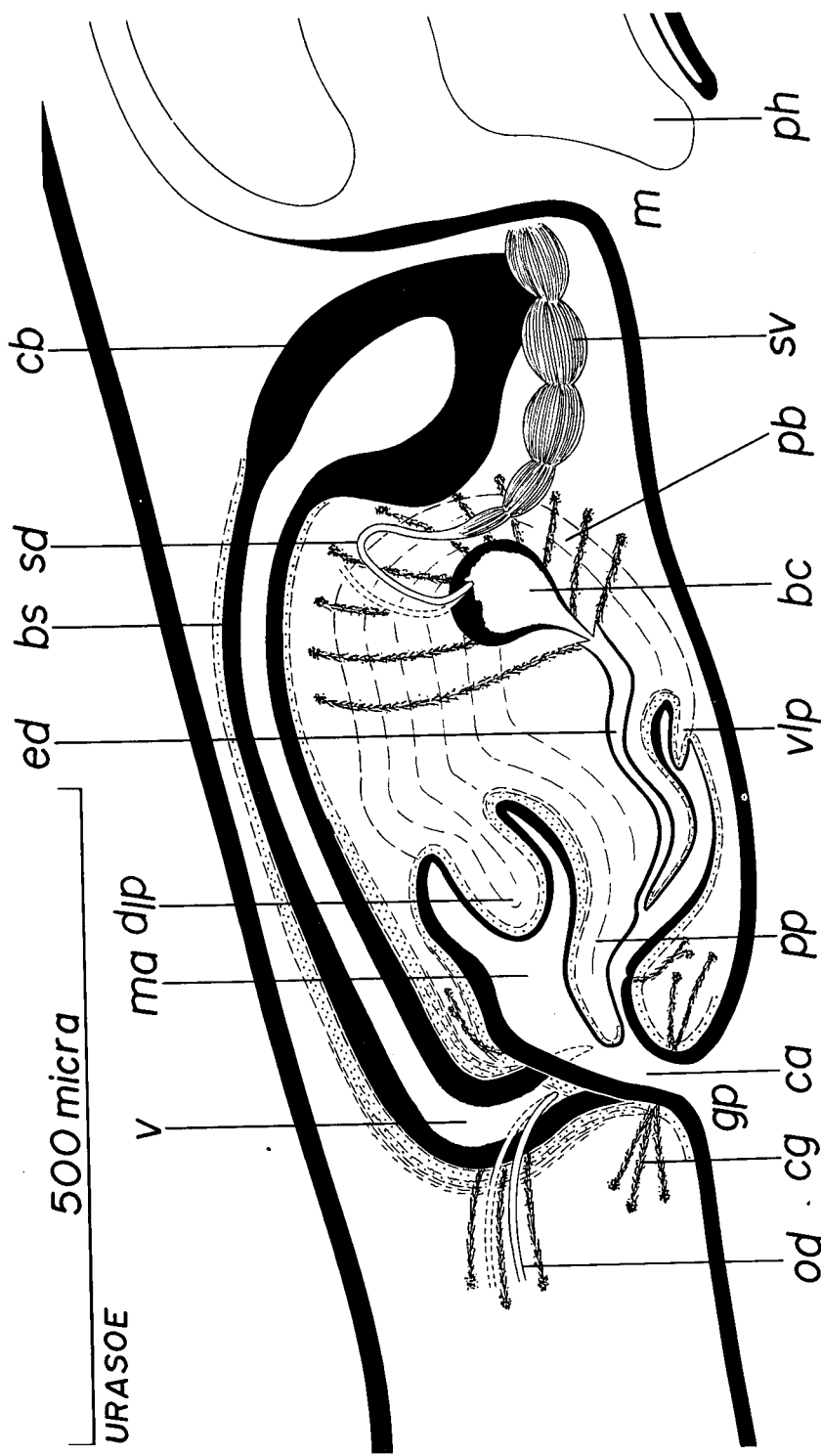


Fig. 12. Diagram showing the sagittal view of the copulatory apparatus of *Dugesia japonica ryukyensis* subsp. nov. from the Urasoe locality (holotype, No. 1379 a).
bc, bulbar cavity ; **bs**, bursa stalk ; **ca**, common antrum ; **cb**, copulatory bursa ; **cg**, cement gland ; **dip**, dorsal lip of the penis papilla ; **ed**, ejaculatory duct ; **gp**, genital pore ; **ma**, male antrum ; **od**, ovovitelline duct ; **pb**, penis bulb ; **ph**, pharynx ; **pp**, penis papilla ; **sd**, sperm duct ; **sv**, spermiducal vesicle ; **v**, vagina ; **vlp**, ventral lip of the penis papilla.

inner thin longitudinal, the middle thick circular, and the several coarse rows of the outer longitudinal. It is observed that the second and the third muscle layers are slightly intermingled with each other. The wall of the vagina is pierced by numerous ducts of eosinophilic and cyanophilic gland ducts. Two oovitelline ducts open into the terminal part of the vagina. Weakly eosinophilous cement glands open into the common genital antrum near the genital pore.

The cocoon is spherical in shape and stalked.

Cytological examination. Four sexual and 8 asexual specimens were examined cytologically. One hundred and seventeen mitoses in 2 sexual specimens revealed a chromosome number of $2n = 14$. During meiosis 7 bivalents were found (Fig. 17 A). The genom consisted of 6 metacentric chromosomes and one acrocentric chromosome (Fig. 17 B). The third sexual specimen had the somatic with same mitotic plate described above. It was however observed in the fourth sexual specimen that a small excess chromosome existed in addition to the diploid components ($2n + 1 = 14 + 1$) (Fig. 17 C). Although the sperms were found in this specimen, no mitotic plate was observed in the germ cells.

In the asexual specimen examined, two kinds of karyotypes were found. The two specimens had the cells with 6 pairs of metacentric chromosomes and one pair of acrocentric chromosomes ($2n = 14$). The remaining 6 asexual specimens were clearly the triploid forms. However, some variations were observed in their chromosome numbers and the karyotypes. Namely, their mitotic plates showed the chromosome number of $3n = 21$, $3n + 1 = 21 + 1$, $3n + 2 = 21 + 2$, and $3n + 3 = 21 + 3$, respectively. The excess chromosomes (1 to 3 in numbers) were small in size and morphologically similar to that of the fourth sexual specimen described above (Fig. 17 D). See also Figure 18-b (J-L) and Table 1.

Differential diagnosis of Dugesia japonica ryukyuensis. The present new subspecies, *Dugesia japonica ryukyuensis*, differs from the nominative subspecies in the following characters of the genital anatomy: penis papilla with a well-developed valve surrounding its basal part; vagina less-developed. The specimens from the type-locality have a chromosome number of $n = 7$ and $2n = 14$. The chromosome number of 21 ($3n$) is also found in the asexual specimens from the type-locality.

Type-series. Holotype — One set of serial sections (Specimen No. 1379a, 3 slides) will be deposited in the Department of Zoology, National Science Museum, Tôkyô. Two paratypes (No. 1379 g, h) and two whole mounts (No. 1386 a, b) will also be deposited in the same Museum. The remaining slides including the paratypes and several whole mounts are retained in KAWAKATSU's collection (KAWAKATSU's laboratory, Fuji Women's College, Sapporo).

Type-locality. A stream at Nakamayama-gawara, Urasoe City, Okinawa, Japan. Altitude, about 20 m. Collected by Mr. I. TANAKA on April 20, 1976 (holotype).

The distribution of *Dugesia japonica ryukyuensis* will follow in the section "Taxonomic and Zoogeographical Notes"

2. Specimens from the Hangchow Population, Che-Kiang, China.

Although the description of the specimens from the Hanchow populations was given in a previous paper (cf. ICHIKAWA & KAWAKATSU, 1967), the result of the reexamination of them will be given below.

External characters. See ICHIKAWA & KAWAKATSU (1967, pp. 178 - 179, Fig. 2 J, pp. 184 - 185).

Internal characters. Serial sagittal sections of the only one fully sexually mature specimen (Specimen No. 391 a) was available for this study. The outer musculature of the pharynx consists of two layers.

The testes, ovaries and yolk glands have been observed in the slides examined. The photomicrograph of the copulatory apparatus is shown in Figure 13. The sagittal view of the copulatory

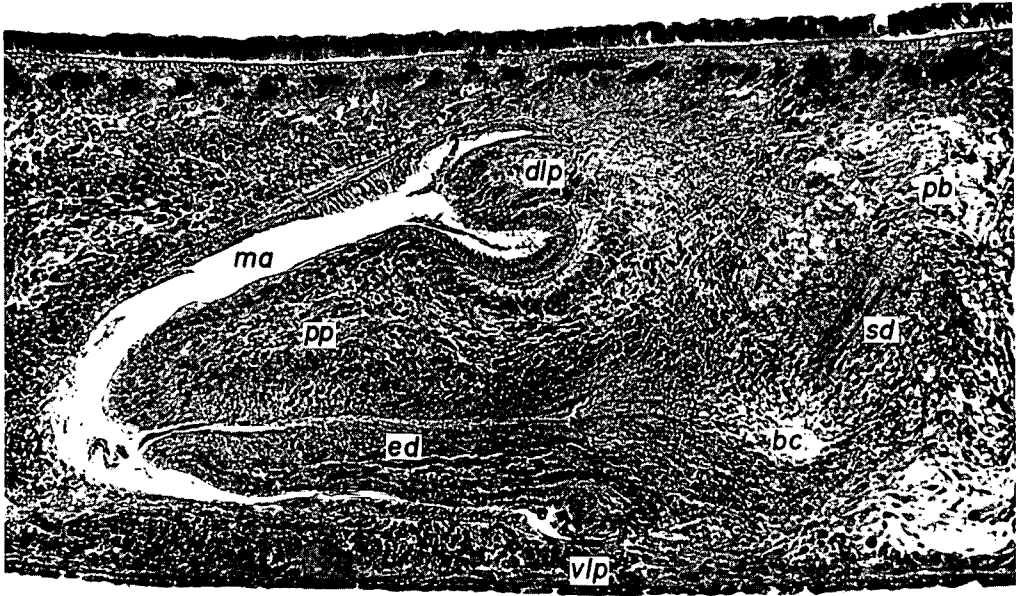


Fig. 13. Photomicrograph of the copulatory apparatus of *Dugesia japonica ryukyuensis* subsp. nov. from the Hangchow locality, China (No. 391 a). After ICHIKAWA & KAWAKATSU (1967, p. 183, Fig. 4 H).

bc, bulbar cavity ; dip, dorsal lip of the penis papilla ; ed, ejaculatory duct ; ma, male antrum ; pb, penis bulb ; pp, penis papilla ; sd, sperm duct ; vlp, ventral lip of the penis papilla.

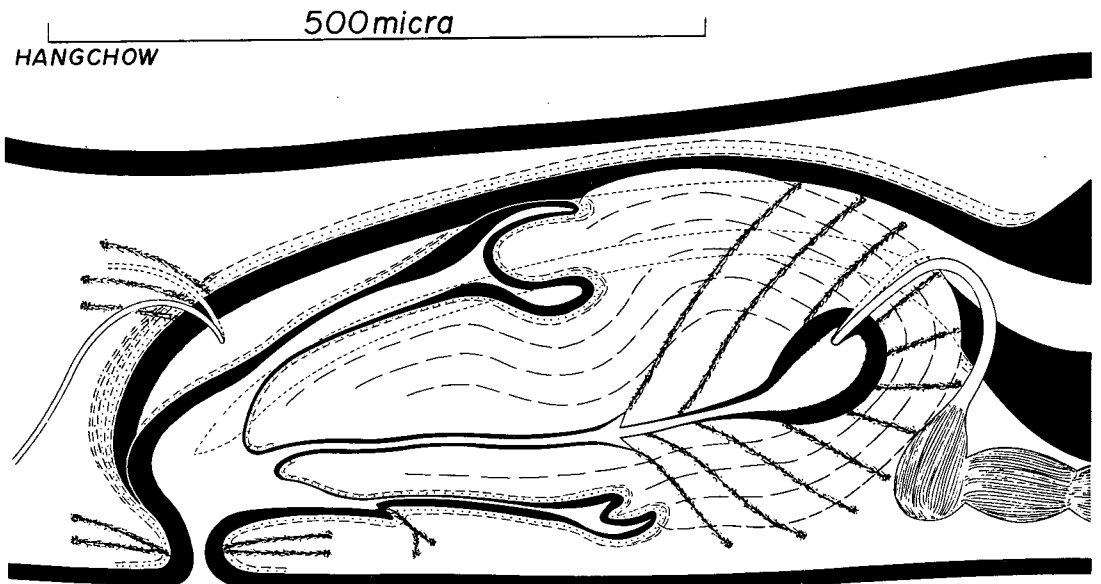


Fig. 14. Diagram showing the sagittal view of the copulatory apparatus of *Dugesia japonica ryukyuensis* subsp. nov. from the Hangchow locality, China (redrawn from the slides of the specimen No. 391 a). See ICHIKAWA & KAWAKATSU (1967, p. 182, Fig. 3 C).

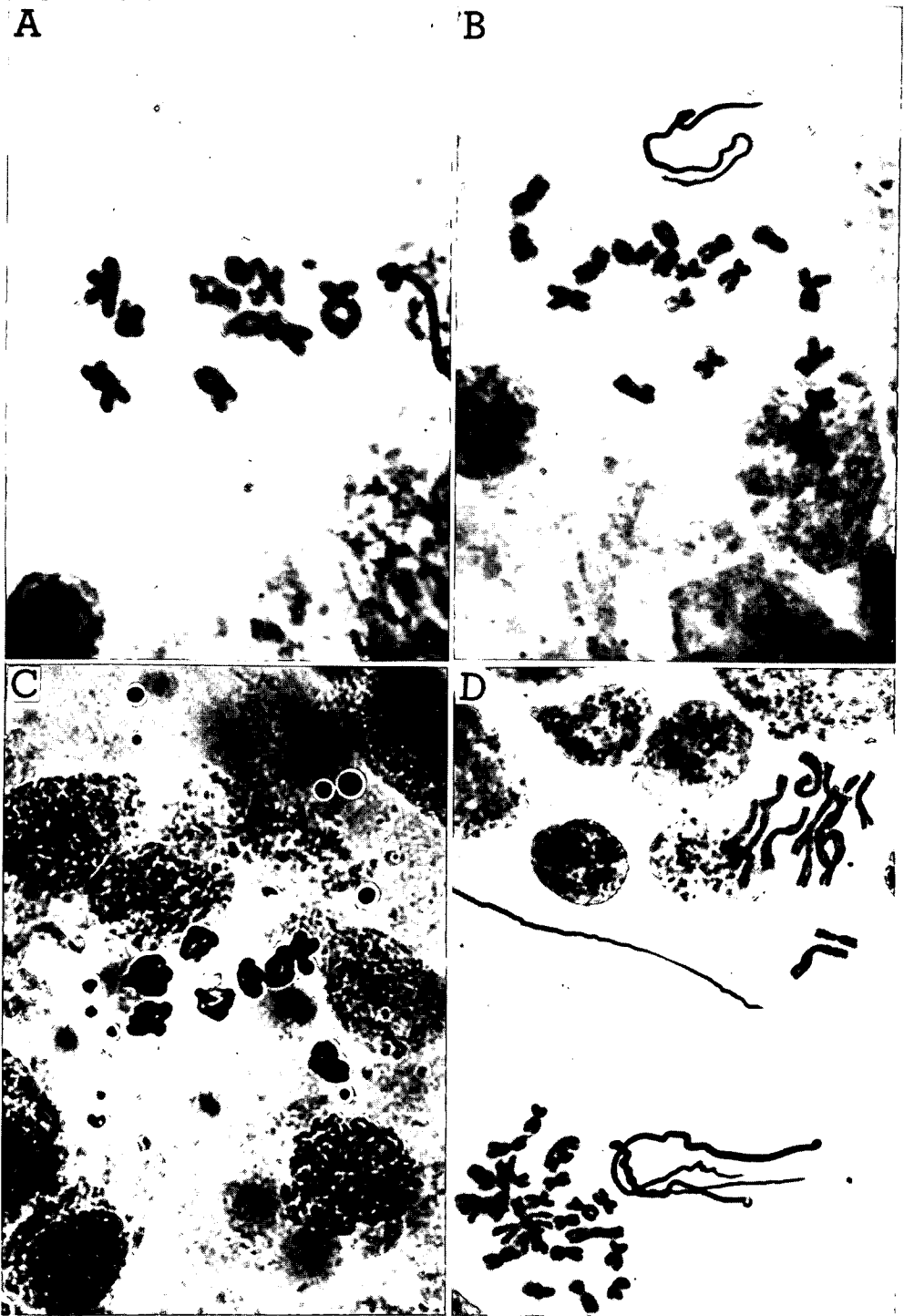


Fig. 15. Photomicrographs of the chromosomes of *Dugesia japonica japonica* from Japan. Ca. $\times 1000$. A and B: Matsumoto (the type-locality). A, Meiosis ($n=8$). B, Mitosis ($2n=16$). Notice the sperm. C and D: Mino'o. C, Meiosis ($n=8$). D, Mitoses ($2n=16$ and $3n=24$). Notice the sperms.

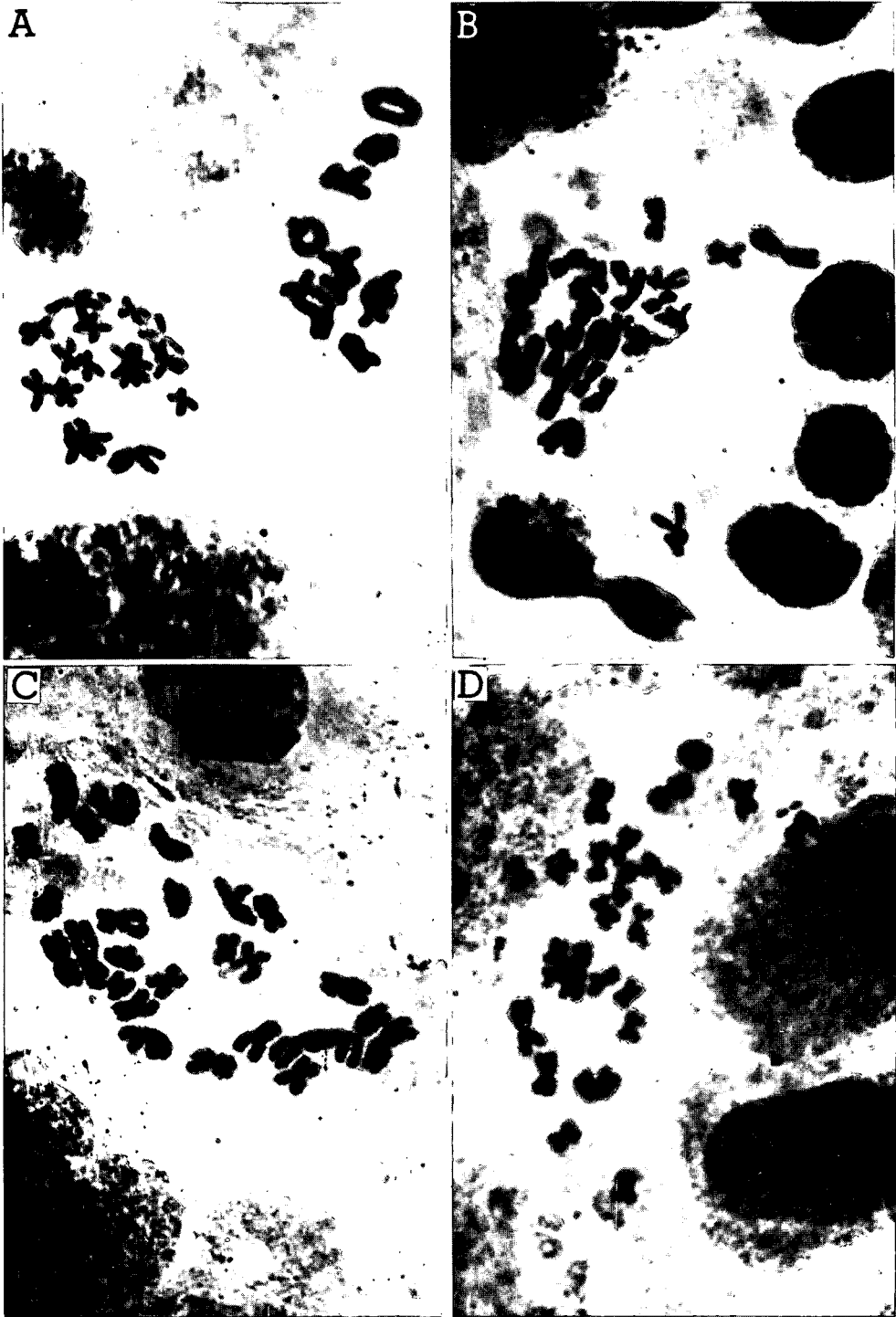


Fig. 16. Photomicrographs of the chromosomes of *Dugesia japonica japonica* from Korea. Ca. $\times 1000$. A - C : Wooyi-dong, Seoul. A, Meiosis ($n=8$) and mitosis ($2n=16$). B, Mitosis (chromosome nos. 25). C, Mitosis (chromosome nos. 26). D : Mt. Kangnac, Seoul. Mitosis ($3n=24$).

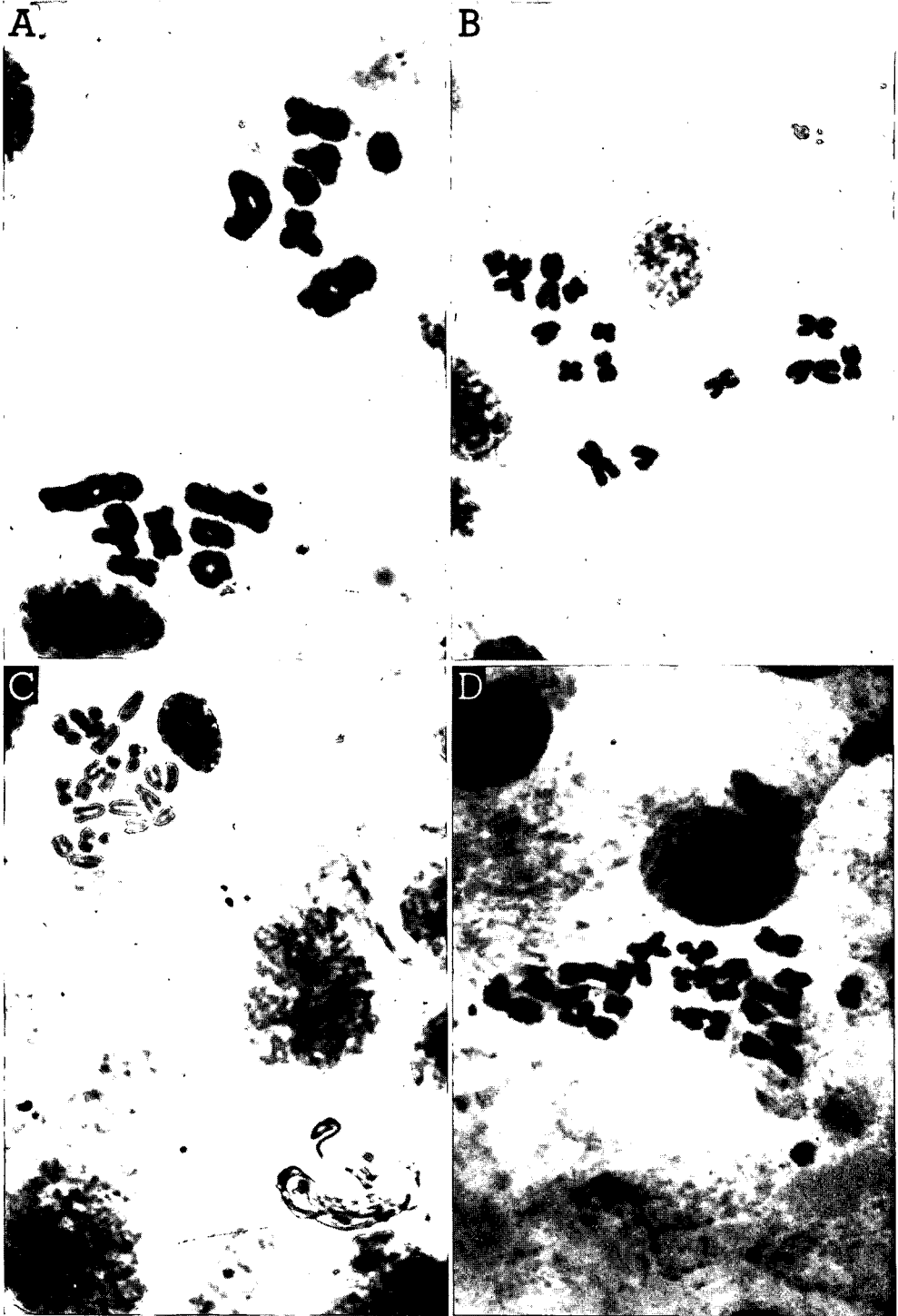
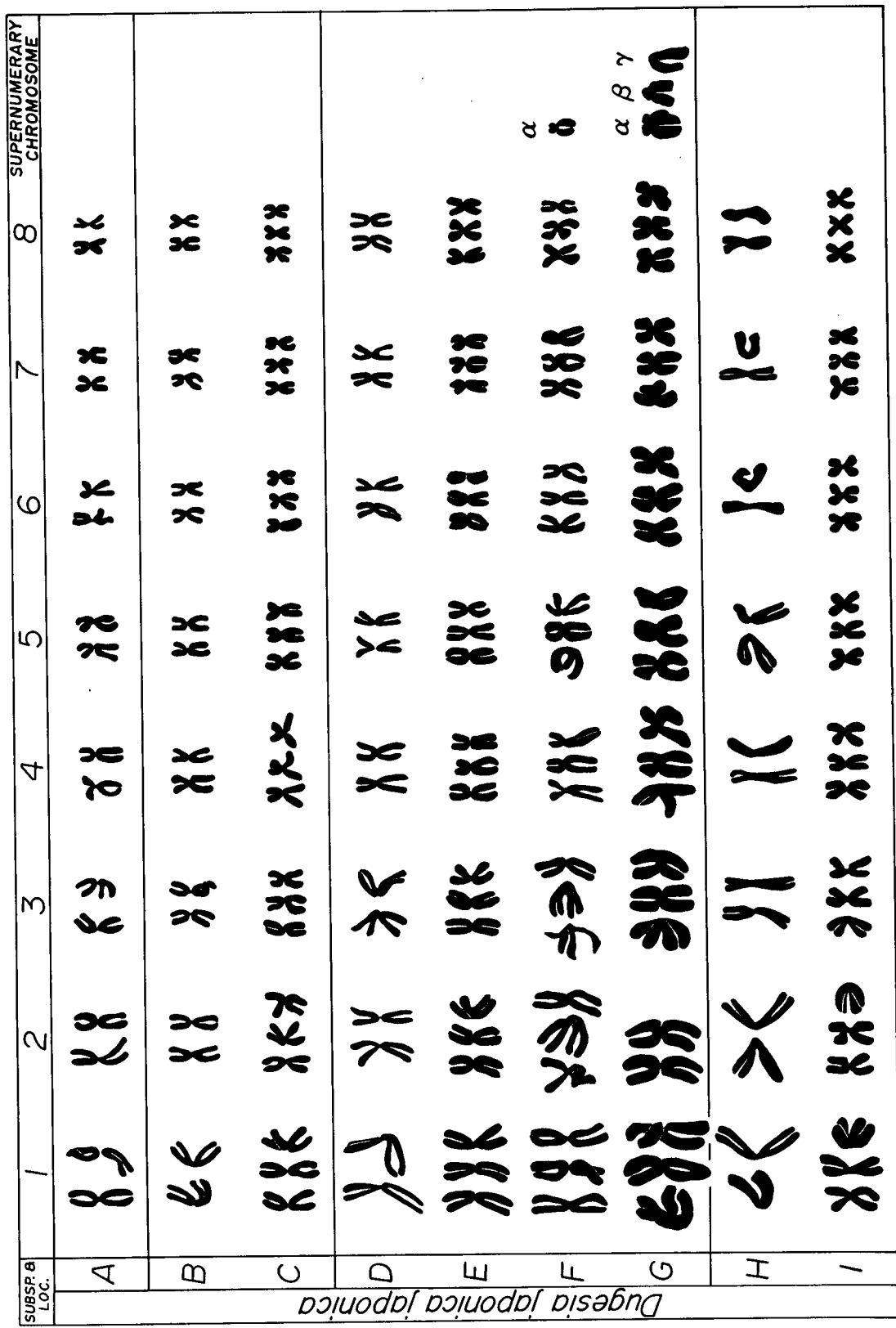


Fig. 17. Photomicrographs of the chromosomes of *Dugesia japonica ryukyuensis* subsp. nov. from Okinawa, Japan. Ca. $\times 1000$. A-D: Urasoe (the type-locality). A, Meiosis ($n=7$). B, Mitosis ($2n=14$). C, Mitosis ($2n+1=14+1$). Notice the sperms. D, Mitosis ($3n+1=21+1$).



Dugesia japonica japonica

α β γ

Fig. 18-a

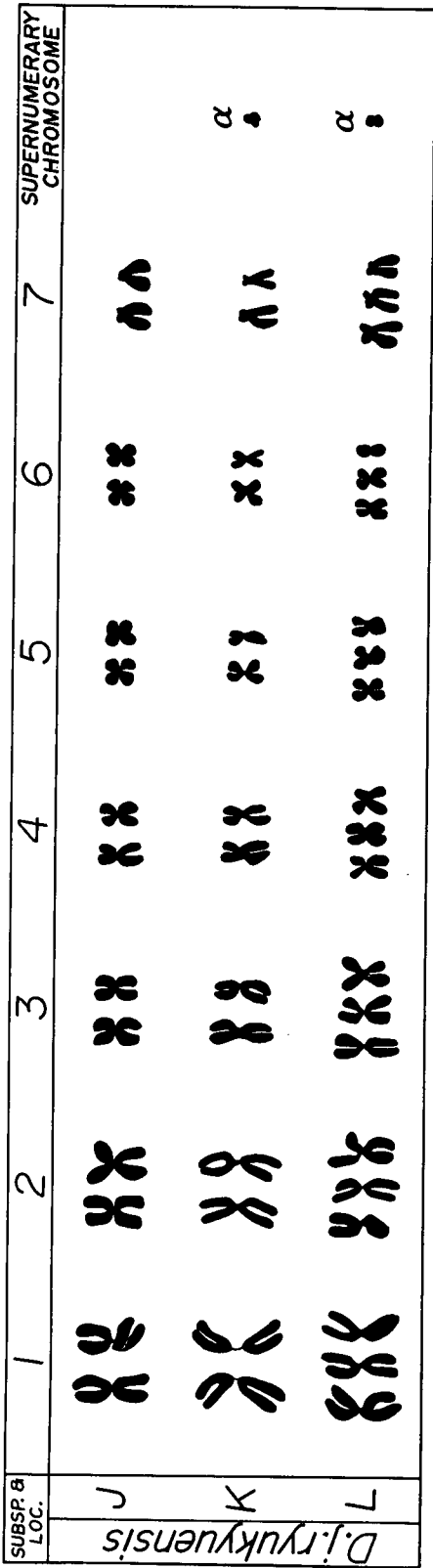


Fig. 18 - a (on page 107). Idiogram analysis of the metaphase plates of *Dugesia japonica japonica* from Japan (A - C) and Korea (D - I). A : Matsumoto (the type - locality), $2n = 16$. B and C : Mino'o. B, $2n = 16$. C, $3n = 24$. D - G : Wooyi-dong, Seoul. D, $2n = 16$. E, $3n = 24$. F, Chromosome nos. 25. G, Chromosome nos. 26. H and I : Mt. Kangnac, Seoul. H, $2n = 16$. I, $3n = 24$.

Fig. 18 - b (on page 108). Idiogram analysis of the metaphase plates of *Dugesia japonica ryukyensis* subsp. nov. from Okinawa, Japan. J - L : Urasoe (the type - locality). J, $2n = 14$. K, $2n + 1 = 14 + 1$. L, $3n + 1 = 21 + 1$.

Fig. 18 - b

apparatus redrawn from the slides (Specimen No. 391 a) is also shown in Figure 14 (cf. ICHIKAWA & KAWAKATSU, 1967, pp. 182 - 183, Fig. 3C and 4H). The Hangchow specimen show the typical genital anatomy of *Dugesia japonica ryukyensis*. The epithelia of the penis papilla, the male genital antrum and the bursal canal are the nucleate type. The constriction or the valve surrounding the basal part of the papilla is conspicuous (the ventral lip of the valve is very small). The histological structure of the vagina is similar to that of the specimens from the type-locality of *Dugesia japonica ryukyensis*.

Material. Ten sets of serial sagittal sections (Specimen No. 391 a - j) including one sexually mature specimen are retained in KAWAKATSU's laboratory, Fuji Women's College, Sapporo.

Locality. See "List of Localities"

V. TAXONOMIC AND ZOOGEOGRAPHICAL NOTES

As regards the taxonomy and distribution of *Dugesia japonica*, a frequent mention was made in the previous articles published by KAWAKATSU and his coresearchers (see "Introduction"). This commonest and a wide-distributed species in the Far East including the Japanese Islands shows a considerable degree of variation in its morphology and anatomy. Physiologically, the species can be classified into two main groups or so-called physiological races according to the differences of the mode of reproduction: the sexual and the asexual races (cf. KAWAKATSU, 1965, 1967, 1971, 1974; OKUGAWA, 1955, 1957; OKUGAWA & KAWAKATSU, 1954 - 1958). SUGINO (1959, 1960, 1962, 1969, 1971) also demonstrated that *Dugesia japonica* may consist of many biotypes if classified based upon the physiological and ecological natures. The animals from different localities have shown the various degrees of physiological endurance for the physico-chemical conditions of cultures (see also KAWAKATSU's note including in the paper by SUGINO, 1969, pp. 302 - 303; KAWAKATSU, 1971).

In the comparative genital anatomy of *Dugesia japonica* from various localities in Japan and its neighbouring countries, the most noticeable variation has been found in the shape of the penis papilla and the degree of development of the vagina. The animals from the type-locality in Middle Japan have a large and highly asymmetrical penis papilla and a well-developed vagina surrounded by thick musculatures. These anatomical and histological characters are more or less conspicuous in the specimens from every known localities in Japan, Korea and Taiwan. On the other hand, a well-developed constriction or the valve surrounding the basal part of the penis papilla was found in the specimens from the Ryûkyû (Loochoo) Islands in Southwest Japan and Hangchow in Middle China. It is usually observed that their vagina is somewhat poorly developed compared with than that of the specimens from the other geographical areas (cf. ICHIKAWA & KAWAKATSU, 1967; KAWAKATSU, 1971; KAWAKATSU & TANAKA, 1971, 1976). When *Dugesia japonica* was described as a new species, the animals from Okinawa and China were also identified as the same species after some hesitation (cf. ICHIKAWA & KAWAKATSU, 1964, pp. 186 - 187, footnote 2). The only root reason of this identification was that the sharp separation of the species into two forms based upon a little difference in the penial anatomy seemed to be unjustifiable because a transitional form was found in Kagoshima, the southernmost part of Kyûshû, in Japan. Namely, a considerably large valve was found at the basal part of the dorsal lip of the penis papilla in the animals from the Kagoshima population (cf. KAWAKATSU & IWAKI, 1967 b, pp. 182 - 184, Fig. 3).

BALL (1970), who studied the taxonomy of several *Dugesia* species from the Oriental Region, discussed the taxonomic status of *Dugesia japonica* in comparison of the "atrial fold" (cf. KAWAKATSU, 1972 b, p. 342) found in the *Dugesia japonica*-*Dugesia batuensis* complex (see also Fig. 7 on page 283 of his paper). Conclusively, he expressed the opinion as follows: "On the available data it seems

desirable that this form of *D. japonica* with the atrial fold should be given separate status, at least at the level of the subspecies" (op. cit., pp. 283 - 284). Dr. BALL's proposal was not accepted by KAWAKATSU, for which the reason was mentioned above (cf. KAWAKATSU, 1971; KAWAKATSU, HORIKOSHI & AKAMA, 1972, p. 125; KAWAKATSU & MACK-FIRÅ, 1975, p. 81; KAWAKATSU & TANAKA, 1971, p. 49).

The discovery of the occurrence of the different karyotypes in the animals of the *Dugesia japonica* populations in the Far East might support a possibility of subdivision of this polymorphic species into two subspecies based upon the morphological and anatomical characters. From the result of the comparative reexamination of the KAWAKATSU's slides of *Dugesia japonica* from various localities, it has been found out that the degree of development of the valve surrounding at the basal part of the penis papilla shows a wide variation. A rather wide variation is also found in the anatomy of the vagina.

The distribution of the animals of *Dugesia japonica* in the Far East has been plotted in Figure 19 which is based on the anatomical data of the valve of the penis papilla. This structure in the penial anatomy is classified into 8 degrees as follows: 1) without any valve; 2) with a slightly developed valve at the dorsal lip; 3) with a slightly developed valve at the ventral lip; 4) with slightly developed valves at both the dorsal and ventral lips; 5) with a moderately developed valve at the dorsal lip; 6) with moderately developed valves at both the dorsal and ventral lips; 7) with a well-developed valve surrounding the basal part of the papilla but less-developed at the ventral lip; 8) with a well-developed valve surrounding the basal part of the papilla (usually the valve of the ventral lip is smaller than that of the dorsal lip).

As will be seen in the map of Figure 19, the animals without any valve at the basal part of the penis papilla are distributed in North China (Judged from the figures of the copulatory apparatus in HSIAO, 1934, TU, 1934 and KATÔ, 1944), Taiwan (including KAWAKATSU's unpublished data), Korea including Quelpart (Cheju) Island, and Honshû, Shikoku and Hokkaidô in the Japanese Islands. The animals with a small valve at the basal part of the penis papilla (located dorsally and/or ventrally of the papilla) are distributed in Hong Kong, Taiwan (including KAWAKATSU's unpublished data), Korea, and the southwestern and the central areas of the Japanese Islands (i. e., the Tsushima Islands, Kyûshû, and the Chûgoku, the Kinki, the Hokuriku, and the Kantô Regions in Honshû; including KAWAKATSU's unpublished data). A well-developed or a rather well-developed vagina is differentiated in the animals from these geographical areas.

It must be said from the penial anatomy of *Dugesia japonica* that a well-developed valve surrounding the part of the penis papilla like a collar is a general character in the penial anatomy of the animals from the Ryûkyû Islands — the genital anatomy has been studied in the animals from Oki-no-erabu-jima Island, Okinawa Island, Miyako-jima Island, and Ishigaki-jima Island —, the Mt. Arisan district in the central part of Taiwan (Kawakatsu's unpublished data), and Hangchow in Middle China (cf. ICHIKAWA & KAWAKATSU, 1967; KAWAKATSU & TANAKA, 1971, 1976). In some Asiatic species of *Dugesia* with a valve surrounding the penis papilla, a narrow space between the under surface of the dorsal valve and the upper surface of the dorsal lip of the penis papilla forms a glandular cavity or a hollow adenodactyl-like structure (cf. KAWAKATSU, 1973 a, p. 100). This character is not clear in the animals of *Dugesia japonica* from the Ryûkyû Islands, Taiwan and Middle China. Although the function of the valve of the penis papilla is not known, it is supposed that the valve may carry out the elastic movement of the penis when the animals are copulated. A less-developed vagina is found commonly in them.

Among the Asiatic *Dugesia* species, *Dugesia japonica* is an only species investigated karyologically. According to the information of cytologists of Panjab University, the chromosome number of *Dugesia lindbergi* from North India (cf. Kawakatsu & Ôgawara, 1974) is $2n=16$, but their study has not yet

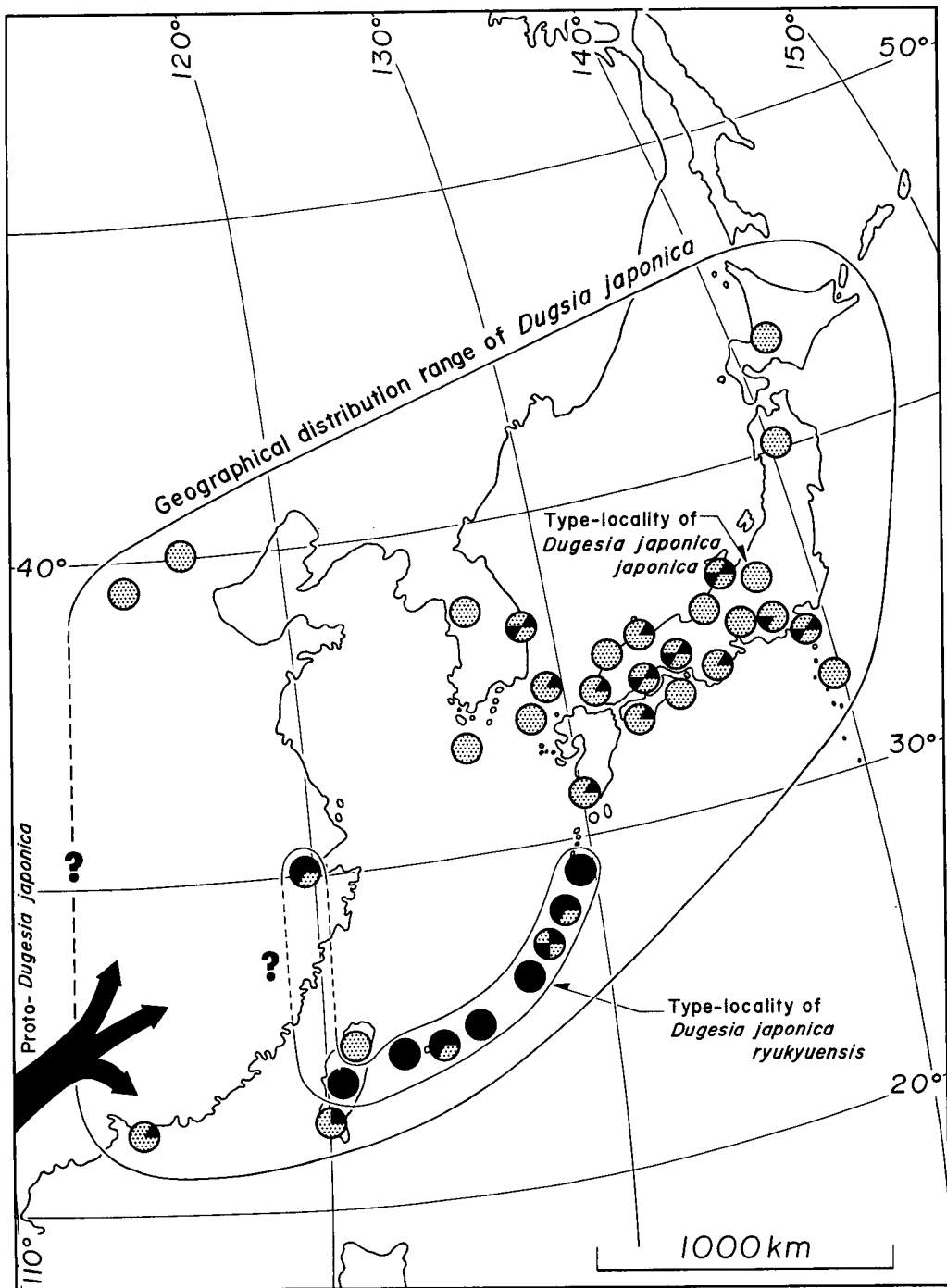


Fig. 19. Map of the Far East, showing the geographical distribution range of *Dugesia japonica* (*Dugesia japonica japonica* and *Dugesia japonica ryukyuensis* subsp. nov.). Symbols represent the degree of development of the valve at the basal part of the penis papilla.

○: Without any valve; ◐: With a slightly developed valve at the dorsal lip; ◑: With a slightly developed valve at the ventral lip; ◒: With slightly developed valves at both the dorsal and ventral lips; ◓: With a moderately developed valve at the dorsal lip; ◔: With moderately developed valves at both the dorsal and ventral lips; ◕: With a well-developed valve surrounding the basal part of the papilla but less-developed at the ventral lip; ●: With a well-developed valve surrounding the basal part of the papilla.

been completed (in litt.). It is true that the karyological data for *Dugesia japonica* are very limited at present and we need to know the karyotypes of this species from various populations of Japan, especially, the populations of Southwest Japan including the Ryûkyû Islands, Taiwan, Hong Kong, China and Korea. But the following speculation concerning the chromosomal variations of *Dugesia japonica* may be interesting for the future studies.

Typically, the chromosome number of the diploid specimens of *Dugesia japonica japonica* is $2n = 16$. On the contrary, the diploid specimens of *Dugesia japonica ryukyuensis* from the Urasoe population in Okinawa have the chromosome number of $2n = 14$. Their karyotype consists of 6 pairs of metacentric chromosomes and one pair of acrocentric chromosomes. Moreover, a number of small excess chromosomes (supernumerary chromosome or microchromosome) are found in some of both diploid and triploid specimens examined. For making a comparison of the idiograms between the Urasoe specimens ($2n = 14$) and the Matsumoto specimens ($2n = 16$), the authors assume that a pair of acrocentric chromosomes in the former probably correspond with the fourth pair of chromosomes in the latter; one pair of chromosomes which will correspond with the sixth pair of chromosomes in the specimens having $2n = 16$ chromosomes seems to be missing in the Urasoe specimens (Fig. 21, Table I).

The interesting karyotypes are found in two triploid specimens from the Wooyi-dong population in Korea. They have cells with the chromosome number of 25 and 26 in one animal. In cells with 25 chromosomes, one additional acrocentric chromosome is found. In cells with 26 chromosomes, extra three chromosomes are found. The authors speculate that two of these chromosomes, when they are united, seem to be classified as a component of the second set of chromosomes. In other words one component of the second set may have been divided into two extra chromosomes (Fig. 20 α and β), while the remaining one may correspond to extra acrocentric chromosome represented in the preceding figure (Fig. 20 γ).

What is the origin and the karyological significance of the acrocentric chromosomes found in the animals of *Dugesia japonica* from certain localities in Okinawa and Korea? At present the authors have no sufficient data for discussing the problem, only to emphasize that the occurrence of these excess chromosomes in some specimens of *Dugesia japonica japonica* from Korea and *Dugesia japonica ryukyuensis* from Okinawa may indicate their intraspecific near relationship in a widely distributed, polymorphic species *Dugesia japonica*.

Considerations about the geographical distribution of *Dugesia japonica* based upon the topographical and the geological data around the East China Sea area may also be interesting for the analysis of the subspeciation of this species. Both of the Yellow Sea (less than 50 meters in depth) and the East China Sea (less than 200 meters in depth) are characterized as the continental shelves of the Asiatic Continent. The Southwest Islands of Japan, which consist of many small islands, can be classified into three topographical groups. They are: 1) the Ôsumi Islands (Tanegashima Island, Yakushima Island, etc.) and the Tokara Islands; 2) the Amami Islands (Amami-Ôshima Island, etc.) and the Okinawa Islands (Oki-no-erabu-jima Island, Okinawa Island, etc.); 3) the Sakishima Islands (Miyako-jima Island, Ishigaki-jima Island, Iriomote-jima Island, Yonaguni Island, etc.). Topographically, the Okinawa Islands and the Sakishima Islands are called the Ryûkyû Islands.

The depth of the straits of the East China Sea and its neighbouring areas is as follows: about 140 meters at the Korean Straits (between the Korean Peninsula and the Tsushima Islands); about 120 meters at the Tsushima Straits (between the Tsushima Islands and Kyûshû); about 200 meters at the Ôsumi Straits (between Kyûshû and Tanegashima-Yakushima Islands); about 1000 meters at the Amami Straits (between the Tokara Islands and Amami-Ôshima Island); about 1000 meters at the Okinawa Straits (between Okinawa Island and Miyako-jima Island), about 1000 meters at the straits between

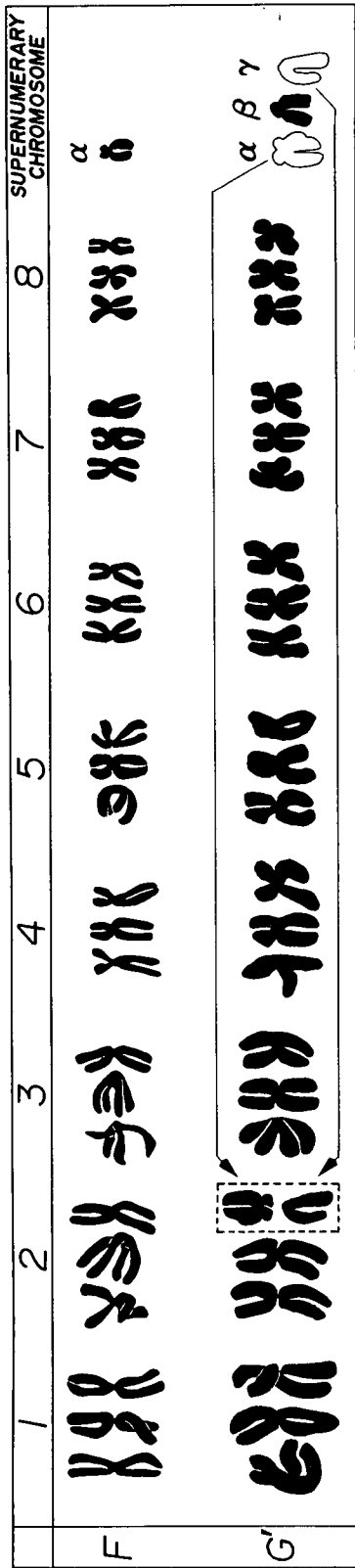


Fig. 20. Explanatory idiograms of the Korean *Dugesia japonica japonica* from the Wooyi-dong locality. F: Chromosome nos. 25 (see Fig. 18-a, F). G': Chromosome nos. 26 (see Fig. 18-a, G). Explanation in the text.

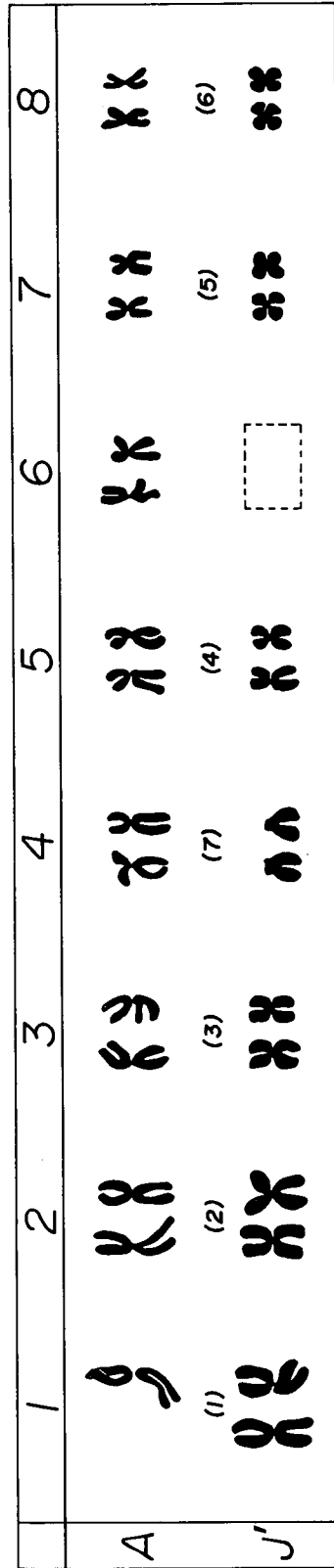


Fig. 21. Explanatory idiogram of *Dugesia japonica ryukyensis* subsp. nov. with the chromosomes of $2n=14$ (J') in comparison with the idiogram of *Dugesia japonica japonica* from the type-locality. (A, $2n=16$; the Matsumoto specimen). The numbers in parentheses of the bottom row correspond with the numbers shown in Fig. 18-b. Explanation in the text.

Yonaguni Island and Taiwan; about 35 meters at the Taiwan (Formosan) Straits (between Taiwan and Fukien in China). The Bashi Channel is about 1850 meters in the deepest part (between the South Cape of Taiwan and Luzon Island of the Philippines).

According to the previous studies by geologists, geographers and palaeo-climatologists, the Japanese Islands constituted a part of the northeastern edge of the Asiatic Continent until the middle of the Oligocene in the Palaeogene Tertiary (ca. 25 m. y. ago). The climate of the Palaeogene Period in that latitude seemed to be tropical or subtropical and humid. In the Miocene of the Neogene Tertiary, the Old Sea of Japan was depressed and the greater part of Japan had sunk beneath the waves except for the Southwest Japan and the central parts of Middle and North Japan (ca. 19-9 m. y. ago). During this age the Old Japanese Islands seemed to be under a benign climate. In the Pliocene of the Neogene Tertiary, or perhaps, even in the earliest Pleistocene of the Quaternary Period, the land-mass of the Old Japanese Islands were mostly united with the northeastern edge of the Continent except for the areas around the Old Sea of Japan. The Yellow Sea and the East China Sea did not exist in that age (ca. 6-2 m. y. ago). From the late Miocene and the middle Pliocene, the climate may have become rather cold; in the late Pliocene it might become warmer. The separation of the Old Southwest Islands into several groups of islands by the openings of straits might begin in the late Pliocene or the early Pleistocene (ca. 2-0.8 m. y. ago). The formation of the Old East China Sea might also be in progress. But the openings of the Taiwan Straits, the Korean Straits and the Tsushima Straits seemed to occur later — probably not until the late Pleistocene (ca. 0.15 m. y. ago). The Yellow Sea might appear gradually in that Epoch. In the Quaternary Period, the Northern Hemisphere had been attacked by the glaciations — Günz (ca. 0.6 - 0.5 m. y. ago), Mindel (ca. 0.48 - 0.38 m. y. ago), Riss (ca. 0.25 - 0.15 m. y. ago), and Würm W I - W IV (ca. 0.07 - 0.01 m. y. ago), and the eustatic movement had often been repeated. The climate of the second interglacial epoch (i. e., the Mindel-Riss interglacial epoch) seems to have been very temperate. The climate of the subinterglacial epochs in the Würm Glaciation seems to have been rather colder than that of the present. The present shoreline of the Japanese Islands which consist of four main islands (Kyûshû, Shikoku, Honshû, and Hokkaidô) and many small islands belonging to them may have been completed in the early Holocene (ca. 0.15 - 0.01 m. y. ago). The final opening of the Tsugaru Straits (the BLAKISTON's Line) between Honshû and Hokkaidô seems to have been about 0.18 million years ago (cf. MINATO et al., 1973; and others). The local flora and fauna of the Japanese Islands were effected by the repeated submersion of the ocean, the volcanic activity, and the change of climates during the Cainozoic Era.

KAWAKATSU (1965, pp. 375 - 377; see also 1967) considered from the geological history and zoogeography of the triclad turbellarians that the Old Japanese Islands were invaded by the proto-species of *Dugesia japonica* which came through the southern transmigrating route. And then, the species may have extended its distribution from south to north during the Pliocene or the Pleistocene. He supposed the transmigrating route of the species as follows: From South China to Taiwan (Formosa) and the Loochoo Islands and Kyûshû in South Japan; and from Middle China to Korea and Kyûshû (cf. KAWAKATSU, 1974, pp. 301 - 307). KAWAKATSU's hypothesis mentioned above is quite tenable due to the occurrence of *Dugesia japonica* in Hong kong (cf. KAWAKATSU & WONG, 1975) and several islands in the Ryûkyû Islands (cf. KAWAKATSU & TANAKA, 1971, 1976).

Dugesia japonica is a eurythermic species adapted to the warm waters and is distributed widely in the Far East. Judging from the evidences of the geological history and the palaeoclimatological data of the Far East, there is a high possibility that the arrival of the old proto-species of *Dugesia japonica* to the Old Japanese Islands is earlier than KAWAKATSU's previous supposition cited above. At its earliest, it can be retroacted to the Palaeocene in the Palaeogene Tertiary (ca. 65 - 45 m. y. ago). At that

age the present North Japan was under a tropical or subtropical climate (a fossil freshwater mud-snail, *Cipangopaludina ishikariensis* and, a bivalve, *Lanceolaria pisciformis*, were common in the strata of this age in Hokkaidô). Some of the animals of the old proto-species could survive free of the waves in the Miocene and glacial periods in the Quaternary Period even in Middle and North Japan. The invaded animals of the proto-species which had invaded into the Old Southwest Islands through the southern route were gradually isolated in that area since the early Pleistocene. On the other hand, the transmigrations of the animals of the proto-species of the other groups were possible from the Continent to Taiwan, North China, Korea, and the Old Japanese Islands across the land of the Old Yellow Sea. It seems to be that the complete separation of the faunal elements between Korea and North Kyûshû in Japan (and between South Kyûshû and the Ôsumi Islands) may have not occurred before the early Holocene.

Considerations about the zoogeography and the comparative genital anatomy of the Asiatic species of the genus *Dugesia* will be discussed here. Figure 22 shows the world-wide distribution of the species of the "*Dugesia gonocephala* group"; the possible transmigrating routes of them are also illustrated in Figure 23 (for details, see KAWAKATSU & ÔGAWARA, 1974, pp. 89 - 93; see also BALL, 1975). All of the Asiatic *Dugesia* species belong to this group. And they can be divided into four groups by the characters of the penial anatomy. Namely :

1). A group having a symmetrical penis papilla; with a less-developed diaphragm in the penis lumen; with adenodactyl(s) : *Dugesia iranica* (LIVANOW, 1951), from Iran (cf. DE BEAUCHAMP, 1963); *Dugesia bactriana* DE BEAUCHAMP, 1959, from Afghanistan (cf. DE BEAUCHAMP, 1963) and Pakistan (cf. KAWAKATSU, 1973); *Dugesia izuensis* KATÔ, 1943, from Middle Japan (cf. KATÔ, 1950; KAWAKATSU, HORIKOSHI & AKAMA, 1972).

Only *Dugesia izuensis* lacks a diaphragm in the penis lumen.

2). A group having an asymmetrical penis papilla; with a diaphragm in the penis lumen; without a valve at the basal part of the penis papilla; without adenodactyl : *Dugesia indica* KAWAKATSU, 1969, from Middle India; *Dugesia nannophallus* BALL, 1970, from Sri Lanka (= Ceylon; cf. KAWAKATSU & ÔGAWARA, 1974); *Dugesia andamanensis* (KABURAKI, 1925) from the Andaman Islands; *Dugesia burmaensis* (KABURAKI, 1918) from Burma; *Dugesia borneana* KAWAKATSU, 1972, from North Borneo (cf. KAWAKATSU & ÔGAWARA, 1974); *Dugesia novoguineana* KAWAKATSU, 1976, from New Guinea.

Dugesia anmandalei (KABURAKI, 1918) from Burma has a symmetrical penis papilla and lacks a diaphragm in the penis lumen. But reexamination of this uncertain species should be necessary for the taxonomic discussion.

3). A group having an asymmetrical penis papilla; with a diaphragm in the penis lumen; with a valve at the basal part of the penis papilla; without adenodactyl : *Dugesia lindbergi* DE BEAUCHAMP, 1959, from Afghanistan, Pakistan (cf. KAWAKATSU, 1973) and North India (cf. KAWAKATSU & ÔGAWARA, 1974); *Dugesia krishnaswamyi* KAWAKATSU, 1975, from South India; *Dugesia batuensis* BALL, 1970, from Malaya (cf. KAWAKATSU, 1972 a, b); *Dugesia indonesiana* KAWAKATSU, 1973, from Indonesia (Sumatra and Java); *Dugesia hymanae* (ŠIVICKIS, 1928) from the Philippines (cf. KAWAKATSU, 1972).

4). A group having an asymmetrical penis papilla; with a diaphragm in the penis lumen; with or without a valve at the basal part of the penis papilla (a wide variation is found in this character); without adenodactyl : *Dugesia japonica* ICHIKAWA et KAWAKATSU, 1964, from the Far East including the Japanese Islands (for literature, see foregoing sections).

Of these four groups of the Asiatic *Dugesia* species, the phylogenetical relation of the first groups seems to be rather distant. But there may be a deep relationship among the second, the third and the fourth groups. Generally the genital anatomy of each species of the second group is very

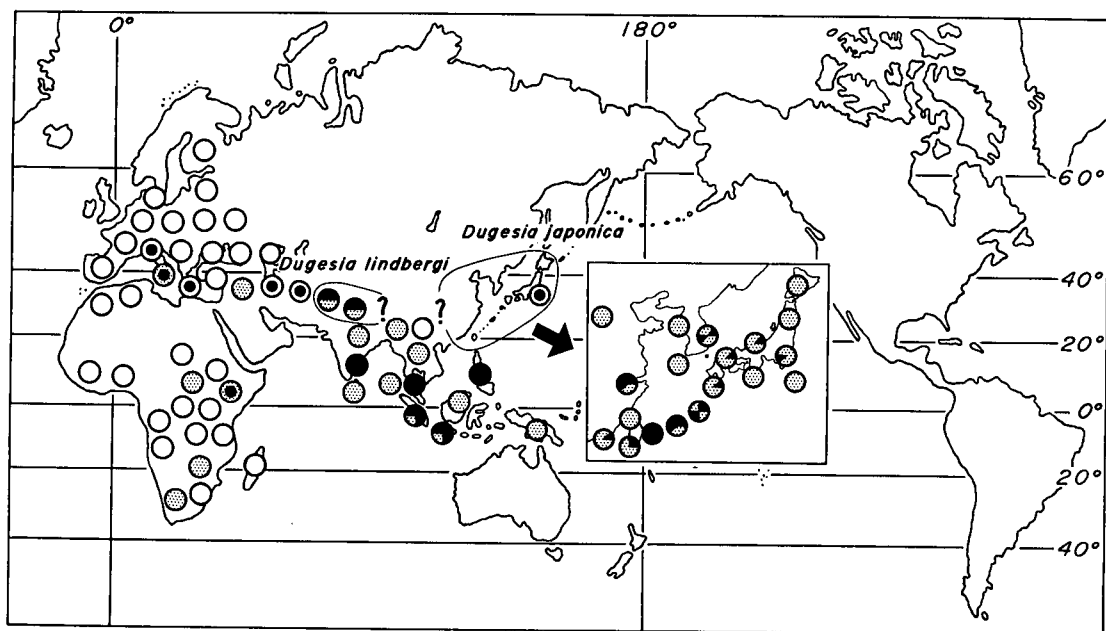
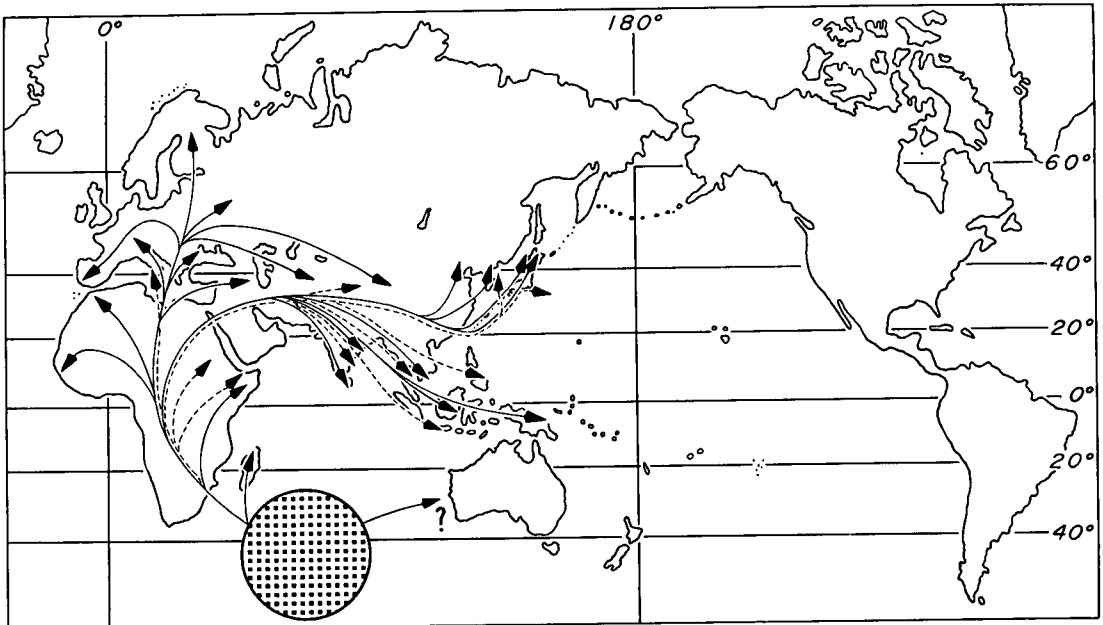


Fig. 22. The distribution of the species of the *Dugesia gonocephala* group. The geographical distribution ranges of *Dugesia lindbergi* and *Dugesia japonica* are also shown. Symbols represent the anatomical characters of the male couplatory organs.

○: Penis papilla symmetrical, without adenodactyl (s); ●: Penis papilla symmetrical, with adenodactyl (s); ◐: Penis papilla asymmetrical, with adenodactyl (s).

The other symbols represent the species having an asymmetrical penis papilla and without adenodactyl(s). They are classified into ten groups according to the degree of development of the valve at the basal part of the penis papilla.

◑: Without any valve; ◒: With a slightly developed valve at the dorsal lip; ◓: With a slightly developed valve at the ventral lip; ◔: With slightly developed valves at both the dorsal and ventral lips; ◕: With a moderately developed valve at the dorsal lip; ◖: With a well-developed valve at the dorsal lip; ◗: With moderately developed valves at both the dorsal and ventral lips; ◘: With a well-developed valve surrounding the basal part of the papilla but less-developed at the ventral lip; ◙: With a well-developed valve surrounding the basal part of the papilla but moderately developed at the ventral lip; ◚: With a well-developed valve surrounding the basal part of the papilla.



ANCESTRAL FORM OF TRICLADIDA

Fig. 23. The distribution and dispersal of the species of the *Dugesia gonocephala* group. The solid lines represent the proto-*Dugesia* group without the valve at the basal part of the penis papilla. The broken lines represent the proto-*Dugesia* group with the valve at the basal part of the penis papilla. See Fig. 22.

Fig. 24. Phylogenetic diagram of the known Asiatic *Dugesia* species. 1: A group having a symmetrical penis papilla; with adenodactyl(s). 2: A group having an asymmetrical penis papilla; with a diaphragm in the penis lumen; without a valve at the basal part of the penis papilla; without adenodactyl(s). 3: A group having an asymmetrical penis papilla; with a diaphragm in the penis lumen; with a valve at the basal part of the penis papilla; without adenodactyl(s). 4: A group having an asymmetrical penis papilla; with a diaphragm in the penis lumen; with or without a valve at the basal part of the penis papilla; without adenodactyl(s). Explanation in the text.

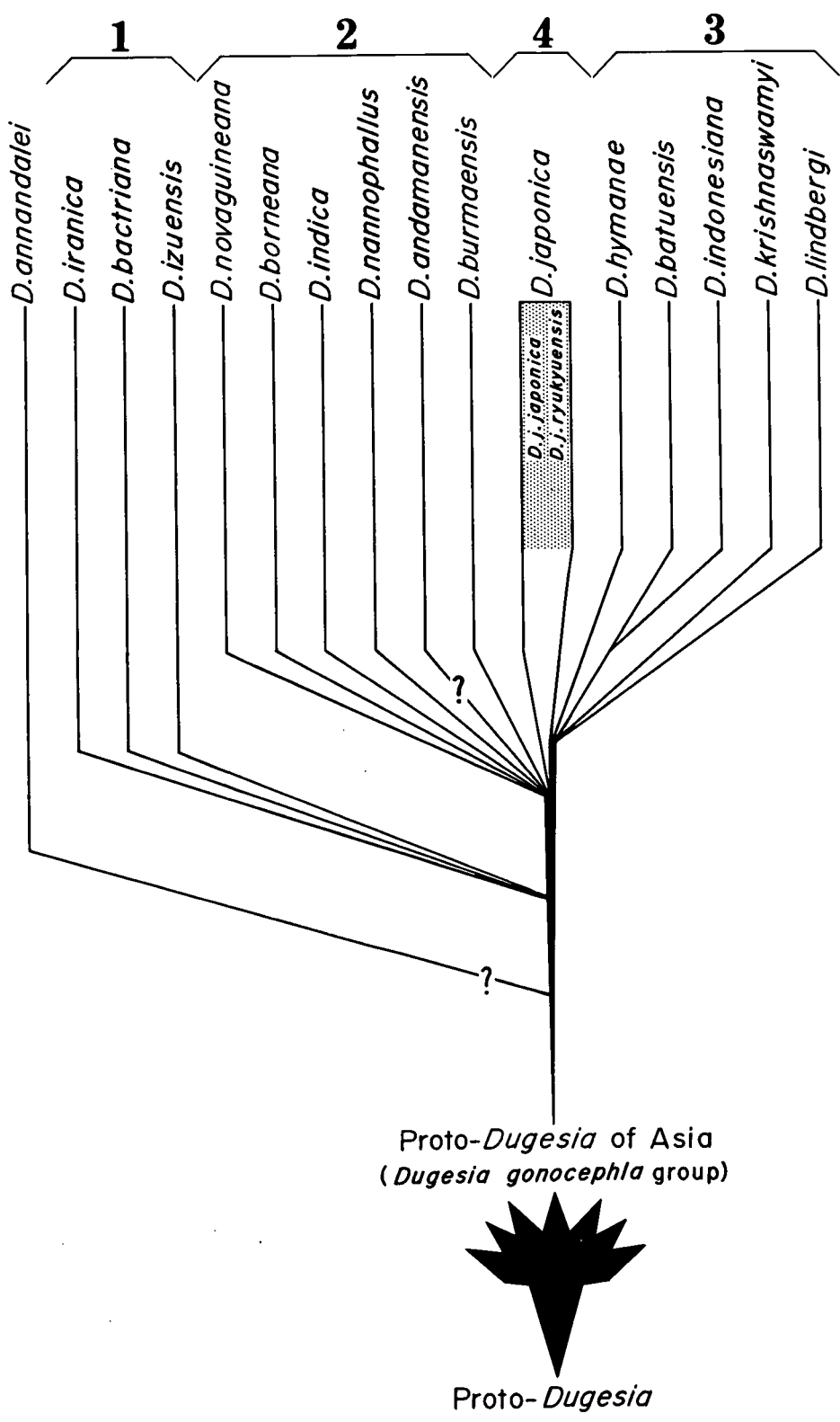


Fig. 24

similar to that of *Dugesia japonica* from many populations in Taiwan, North China, Korea, and Japan (Shikoku, Honshû including the type-locality and Hokkaidô). Among the species of the third group, the valve at the basal part of the dorsal lip of the penis papilla is only found in *Dugesia lindbergi*. This character is also found in *Dugesia japonica* from some localities, such as Hong Kong, Taiwan, Korea, and Japan (Kyûshû and the south and central areas of Honshû). In the other species of this group, i. e., *Dugesia batuensis*, *Dugesia indonesiana*, *Dugesia hymanae*, and especially *Dugesia kryshnaswamyi*, a well-developed valve surrounding the basal part of the penis papilla like a collar is differentiated. The same character in the penial anatomy is also found in *Dugesia japonica* from Middle China, Taiwan, and the Ryûkyû Islands in Southwest Japan.

Judging from the similarity in the morphological and anatomical characters of the Asiatic *Dugesia* species, the following speculation can be possible for the understanding of the speciation and subspeciation of *Dugesia japonica* as a polymorphic species. We may first suggest that the old land-mass of Japan was invaded by some of the earlier proto-species of the second group (without valve at the basal part of the penis papilla). At that age the Old Ryûkyû Islands was not existent. We must admit the possibility that there were slow and repeated northward movements of the proto-species through the Southeast Asia when various sea barriers were removed even in the early Pleistocene according to the repeated eustasy. At that age the Malay Peninsula, Indonesia, Borneo, the Philippines, and Taiwan were connected with each other. In the late Miocene or the early Pliocene, it seems to be that the proto-species of the *Dugesia lindbergi* type in the third group (with a valve only at the basal part of the dorsal lip of the penis papilla) may also have arrived at the Old Ryûkyû Islands and the south and the central areas of the Old Japanese Islands through the southern and south-eastern transmigrating routes. This proto-species may have adapted themselves to a rather cold-water habitat in the third group.

In the middle Pliocene, some of the proto-species of the third group (with a well-developed valve surrounding the basal part of the penis papilla) may have arrived at Taiwan, Middle China and the Old Ryûkyû Islands through the southern migration route as the new comers. They might be the warm-water inhabitants. Although their farthest northern outpost seems to have been the land of the Old Yellow Sea (which is now the continental shelf) and the western area of the Korean Peninsula, their rapid northeastward migration may have been obstructed by the cold climate of the middle Pliocene and the isolation of the Old Ryûkyû Islands in the late Pliocene or the early Pleistocene.

In conclusion, the authors suppose from the foregoing considerations that the proto-species of *Dugesia japonica* must have been originated from the ancestral forms of the second and the third groups of the Asiatic *Dugesia* species. The crossing of the animals of the proto-species of the second group and of the *Dugesia lindbergi* type in the third group may have accelerated the subspeciation of *Dugesia japonica japonica*. The subspeciation of *Dugesia japonica ryukyuensis* may have been accelerated by the crossing of the animals of the proto-species of the second and the third groups including the new comers which might be differentiated in Southeast Asia.

The above discussed schema is illustrated in Figures 24 and 25. More light could be thrown on the problem by the further study of the probursalian fauna of the Himalaya-Tibet-China area.

From the foregoing considerations, the geographical distribution ranges of two subspecies of *Dugesia japonica* will be defined as follows:

Dugesia japonica japonica ICHIKAWA et KAWAKATSU: Hong Kong, Taiwan (probably entire region), North China, Korea, and Kyûshû (including the Satsunan Islands), Shikoku, Honshû, Hokkaidô, and many small islands in the Japanese Islands.

Dugesia japonica ryukyuensis KAWAKATSU subsp. nov.: Taiwan (probably limited in the

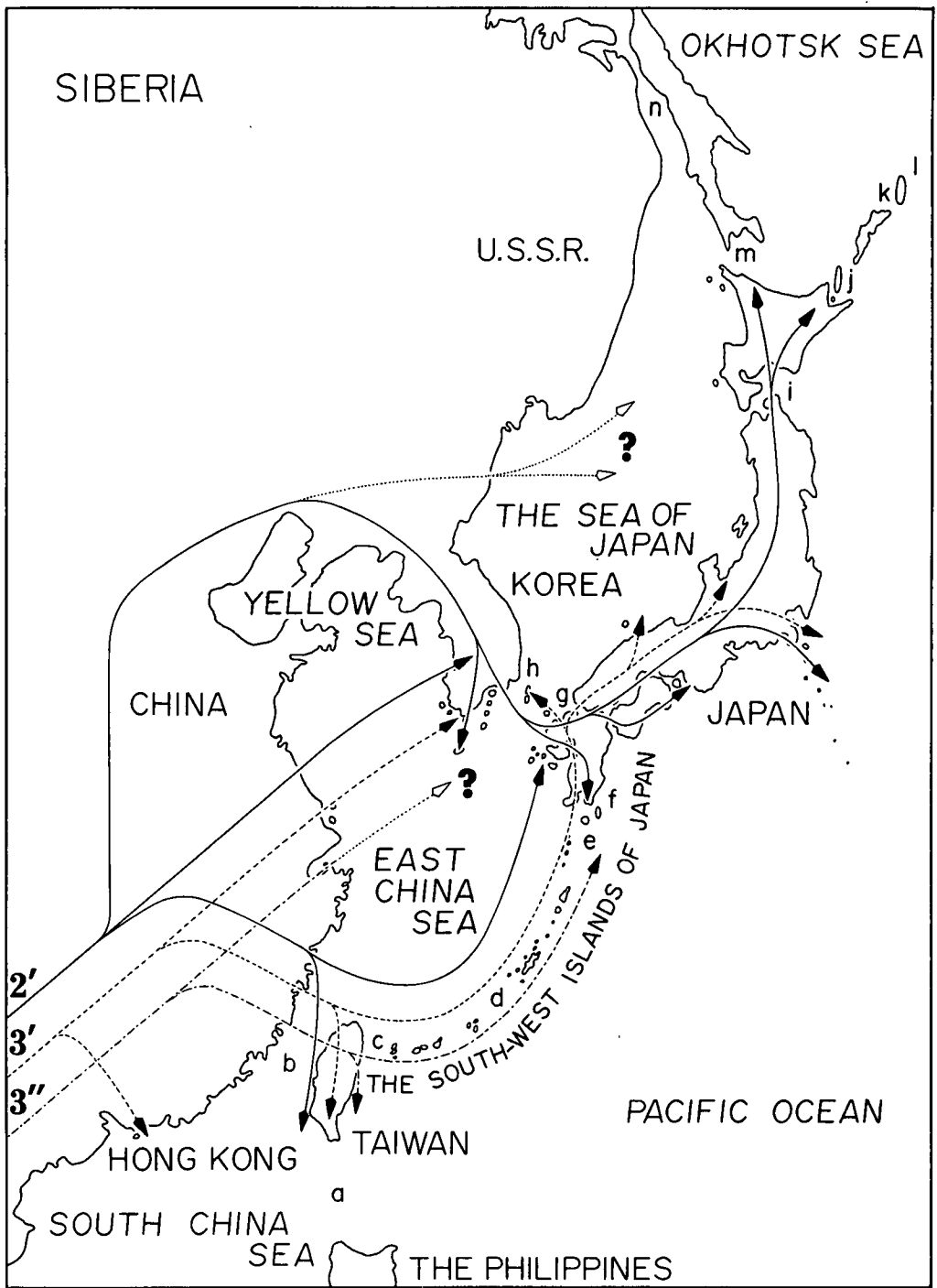


Fig. 25. The distribution and dispersal of *Dugesia japonica*. The solid lines (2') represent the proto-*Dugesia japonica* without the valve at the basal part of the penis papilla. The broken lines (3') represent the proto-*Dugesia japonica* with the valve at the basal part of the dorsal lip of the penis papilla. The chain lines (3'') represent the proto-*Dugesia japonica* with the valve surrounding the basal part of the penis papilla. See also Fig. 19. Explanation in the text.

central mountainous area), Middle China (only Hangchow is known at present), and the Ryûkyû Island and the Amami Islands in Southwest Japan.

VI. SUMMARY

The taxonomic revision of a freshwater planarian species *Dugesia japonica* ICHIKAWA et KAWAKATSU, 1964, based upon the morphological, anatomical and karyological data, is described in the present paper. A redescription of the nominative subspecies, *Dugesia japonica japonica* ICHIKAWA et KAWAKATSU, and an original description of a new subspecies, *Dugesia japonica ryukyensis* KAWAKATSU, subsp. nov., are also given. The former is characterized in having a penis papilla without a well-developed valve surrounding its basal part and in having a well-developed vagina (chromosome no. : $n = 8$, $2n = 16$, $3n = 24$; distribution : Hong Kong, Taiwan, North China, Korea, and Japan except for the Ryûkyû Islands). The latter, new subspecies, is characterized in having a penis papilla with a well-developed valve surrounding its basal part and in having a less-developed vagina (chromosome no. : $n = 7$, $2n = 14$, $3n = 21$; distribution : Taiwan, Middle China, and the Ryûkyû Islands and the Amami Islands in Southwest Japan).

The problems concerning the possible transmigrating routes of the proto-species of *Dugesia japonica* and their speciation and subspeciation are discussed from the taxonomic, karyological and the zoogeographical viewpoints. The conclusion is illustrated in Figures 24 and 25.

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REFERENCES

- BALL, I. R., 1970. Freshwater triclads (Turbellaria, Tricladida) from the oriental region. Zool. Jour. Linnean Soc., 49 : 271 - 294 + Pls. 1 - 2. 1974. A contribution to the phylogeny and biogeography of the freshwater triclads (platyhelminthes; Turbellaria). In N. W. RISER & M. P. MORSE (ed.), The HYMAN Memorial Volume — Biology of the Turbellaria, pp. 339 - 401. McGraw - Hill Book Co., New York, etc. 1975. Nature and formulation of biogeographical hypotheses. Syst. Zool., 24 : 407 - 430.
- BENAZZI, M. & BENAZZI-LENTATI, G., 1976. Platyhelminthes. In B. JOHN (ed.), Animal Cytogenetics, 1. i - vi + 1 - 182 pp. Gebrüder Borntraeger, Berlin u. Stuttgart.

- DE BEAUCHAMP, P., 1959. Triclades paludicoles d' Afghanistan. Kungl. Fysiograf. Sällsk. I Lund Förhandl., 29, (3) : 27 - 43. 1961. Triclades paludicoles d' Afghanistan. (deuxième note). Ibid., 31, (6) : 77 - 85. 1963. Triclades paludicoles d' Afghanistan (troisième note). Ibid., 33, (5) : 45 - 47.
- DAHM, A. G., 1963. The karyotypes of some freshwater triclads from Europe and Japan (Turbellaria Tricladida Paludicola). Arkiv Zool., Ser. 2, 16 (3) : 41 - 67.
- 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.
- HIROSE, E., KATÔ, F. & SUGINO, H., 1974. Chromosomes on freshwater planarian, *Dugesia japonica*, II. Zool. Mag., 83 : 442. (In Japanese)
- HSIAO, S. D., 1935. A preliminary study of the seasonal changes in the reproductive system of *Planaria gonocephala* DUGÈS. Bull. Nat. Hist. Peking, 9 : 161 - 169.
- ICHIKAWA, A. & KAWAKATSU, M., 1961. Experimental technique for planarian students. Hokkaidô-Daigaku Rigakubu Kagakukyôiku Kenkyûshitsu Shiryô, I : 1 - 19 + Pls. I - IV. Sapporo. (In Japanese) 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 East China Sea Area. In KIRA, T. & K. IWATA (ed.), Nature and Life in Southeast Asia, 5 : 175 - 188. Kyôto.
- KABURAKI, T., 1918. Freshwater triclads from the basin of the Inlé Lake. Rec. Ind. Mus., 14 : 187 - 194 + Pl. XVII. 1925. Planarians from the Andamans. Ibid., 27 : 29 - 32.
- KATÔ, K., 1943. On Japanese fresh-water planarians. Botany & Zoology, 11 : 628 - 630. (In Japanese) 1944. On some Turbellarians from Hangchow (Report on the limnological survey of Central China, XVIII). Shanghai Shizen. Ken Ihô, 14 (5) : 357 - 359. (In Japanese) 1950 a. A new freshwater triclad from Japan. Annot. Zool. Japon., 24 : 45 - 48. 1950 b. On some Turbellarians from Sanshi, North China. Zool. Mag., 59 : 188 - 190. (In Japanese)
- KAWAKATSU, M., 1955. Studies on the vertical distribution of Japanese fresh-water planarian, I. The Daisen district. Bull. Kyôto Gakugei Univ., Ser. B, (7) : 45 - 51. (In Japanese with English summary) 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. 1968 a. On the origin and phylogeny of Turbellarians : Suborder Paludicola. Jap. Soc. Syst. Zool. Circular, (38 - 41) : 11-22. (In Japanese with English explanation of figures) 1968 b. Illustrated list of Japanese fresh-water planarians. Collect. & Breed., 30 : 40 - 45. (In Japanese) 1969 a. Report on freshwater planaria from India. Annot. Zool. Japon., 42 : 210 - 215. 1969 b. An illustrated list of Japanese freshwater planarians in color. Bull. Fuji Women's College, (7), Ser. II : 45 - 91 (+ Pls. I - II). 1970. Further studies on the vertical distribution of freshwater planarians in the Japanese Islands. Amer. Zoologist, 10 : 546. 1971. Problems on the morphological variation and the physiological races of a Japanese freshwater planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU. In KAWAKATSU, M. & M. IBA (ed.), Comm. Compil. Sci. Papers Publ. Occ. Retir. Prof. Hisao SUGINO at the Age of Sixty-five, Ser. Turbellarians, pp. 43 - 52. (In Japanese with English summary) 1972 a. Report on freshwater planaria from Borneo. Contr. Biol. Lab. Kyoto Univ., 23 (3 - 4) : 111 - 122 + Pl. 1. 1972 b. The freshwater planaria from the Batu Caves in Malaya. Bull. Natn. Sci. Mus. Tokyo, 15 : 339 - 346 + Pls. 1 - 2. 1972 c. Report on freshwater planarians from Malaya and Thailand. Contr. Biol. Lab. Kyoto Univ., 24 (1 - 2) : 1 - 7 + Pls. 1 - 2. 1972 d. The freshwater planaria from the Philippines. Annot. Zool. Japon., 45 : 234 - 244. 1972 e. Report on freshwater planarians from South

Africa. Bull. Fuji Women's College, (10), Ser. II : 57 - 79 (+ Pls. I - VI). 1973 a. Report on freshwater planaria from Indonesia (Sumatra and Java). Contr. Biol. Lab. Kyoto Univ., 24 (2) : 87 - 103 + Pls. 1 - 5. 1973 b. Taxonomy and ecology of planarians, 1 - 4. The Nature & Animals (Dôbutsu-to-Shizen), 3 (5) : 9 - 16 + Plate figure ; 3 (6) : 11 - 16 ; 3 (7) : 8 - 11 ; 3 (8) : 7 - 13. (In Japanese) 1973 c. Report on freshwater planarians from Pakistan. Bull. Fuji Women's College, (11), Ser. II : 79 - 95. 1974. Further studies on the vertical distribution of freshwater planarians in the Japanese Islands. In N. W. RISER & M. P. MORSE (ed.), The HYMAN Memorial Volume — Biology of the Turbellaria, pp. 291 - 338. McGraw-Hill Book Co., New York, etc. 1975. Problems on the morphological variation and the taxonomic position of a Japanese freshwater planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU. Zool. Mag., 84 : 444. (In Japanese) 1976. The freshwater planarians from New Guinea and Malaya. Bull. Nat. Sci. Mus., Ser. A (Zool.), 2 : 143 - 152.

KAWAKATSU, M. & BASIL, J. A., 1971. Records of freshwater and land planarians from India. Bull. Fuji Women's College, (11), Ser. II : 41 - 50 (+ Pls. I - II).

KAWAKATSU, M., HAUSER, J. & FRIEDRICH, S. M. G., 1976. The freshwater planaria from South Brasil. Bull. Natn. Sci. Mus., Ser. A (Zool.), 2 : 205 - 223.

KAWAKATSU, M., HORIKOSHI, I. & AKAMA, H., 1972. Report on freshwater planarians from the Izu Peninsula and the Izu Islands in Japan. Zool. Mag., 81 : 119 - 126. (In Japanese with English summary)

KAWAKATSU, M. & IWAKI, S., 1967 a. Studies on the morphology, taxonomy and ecology of freshwater planarian, *Phagocata kawakatsui* OKUGAWA, with remarks on distribution. Jap. Jour. Ecol., 17 : 214 - 224. 1967 b. Report on freshwater planaria from the Satsunan Islands and Kagoshima (Kyûshû) in South Japan. Bull. Fuji Women's College, (5) : 179 - 185. 1968. Report on freshwater planaria from Taiwan (Formosa). Ibid., (6) : 129 - 137.

KAWAKATSU, M., IWAKI, S. & KIM, WUN-JAI, 1967. Report on freshwater planaria from Quelpart (Cheju) Island, Korea. Zool. Mag., 76 : 187 - 189. (In Japanese with English summary)

KAWAKATSU, M. & KANG, SOO-WON, 1969. Annotated bibliography of the Korean Turbellarians. Korean Jour. Limnol., 2 (3 - 4) : 43 - 49. (In Korean with English summary)

KAWAKATSU, M. & KIM, WUN-JAI, 1966. Morphological studies on the freshwater planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU, from Korea. Zool. Mag., 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.

KAWAKATSU, M. & MACK-FIRA, V., 1975. The fauna of the insular lava caves in West Japan. XI. Proseriata et Tricladida (Turbellaria). Bull. Natn. Sci. Mus., Ser. A (Zool.) 1 : 77 - 84 + Pl. 1.

KAWAKATSU, M. & MIYAZAKI, T., 1972. Effect of different fixatives on a common Japanese freshwater planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU. Bull. Fuji Women's College, (10), Ser. II : 81 - 117 (+ Pls. VII - XXXII)

KAWAKATSU, M., MORITA, S.-I. & IWAKI, S., 1967. Report on freshwater planaria from the Danjyo Islands (Kyûshû) in South Japan. Bull. Fuji Women's College, (5) : 187 - 188.

KAWAKATSU, M., MURAYAMA, H. & NIMURA, F., 1971. Report on the ecological survey of freshwater planarians in the Zenkôji-daira Height and its adjacent mountain districts, Honshû. Bull. Fuji Women's College, (9), Ser. II : 51 - 90 (+ Pls. III A-H + 1 folder). (In Japanese with English summary)

KAWAKATSU, M., NIMURA, F. & AOKI, K., 1975. Report on the ecological survey of fresh-

water planarians in the Zenkôji-daira Height, the Matsumoto-daira district, the Inadani Valley, the Suwa-daira district, the southern part of the Hida Mountains, the Kiso Mountains, and the Akaishi Mountains, Honshû. Bull. Fuji Women's College, (13), Ser. II : 59-77 + Pls. I-II. (In Japanese with English summary)

KAWAKATSU, M. & ÔGAWARA, G., 1969. Report on the ecological survey of freshwater planarians in the Chûgoku Mountains, Honshû. Jap. Jour. Limnol., 30 : 151 - 164. (In Japanese with English summary) 1974. Additional report on freshwater planarians from North Borneo, Malaya, Sri Lanka, India, and South Africa. Bull. Fuji Women's College, (12), Ser. II : 69 - 86.

KAWAKATSU, M., OKI, I., TAMURA, S., & SUGINO, H., 1976. Morphological and karyological reexamination of the taxonomy of the freshwater planarian *Dugesia japonica*, II. Considerations about the subdivision of the species into two subspecies, with special reference to their subspeciations and phylogenetical problems. Zool. Mag., 85 : 508. (In Japanese with English summary)

KAWAKATSU, M. & TANAKA, I., 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., 85 : 73 - 77. (In Japanese with English summary)

KAWAKATSU, M. & WONG, M.-H., 1975. The freshwater planaria from Hong Kong. Annot. Zool. Japon., 48 : 262 - 273.

KENK, R., 1974. Index of the genera and species of the freshwater triclads (Turbellaria) of the world. Smithsonian Contrib. Zool., (183) : i-ii + 1 - 90.

KIM, WUM-JAI, 1964. Notes on freshwater planaria from Korea (with an appendix written by M. KAWAKATSU). Collect. & Breed., 26 : 261 - 263. (In Japanese)

LIVANOW, A., 1951. Planarii Kopet-Daga i blizkie vidy Kryma, Kavkaza i Zakavkaz'ia. Trudy Murgabskoi Hidrobiologicheskoi Stantsii, 1 : 103 - 114. (In Russian)

MACK-FIRÄ, V. & KAWAKATSU, M., 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.

MINATO, M. (ed.) et al., 1973. The palaeogeographical and palaeobiological Maps of Japan. 60 sheets. Tukiji-Shokan, Tôkyô. (In Japanese)

MIYAZAKI, T. & KAWAKATSU, M., 1971. Frequency of the occurrence of supplementary eyes in a Japanese freshwater planarian, *Dugesia japonica*, observed in the natural populations. Zool. Mag., 80 : 371 - 377. (In Japanese with English summary)

OKI, I. & TAMURA, S., 1972. Lethal effects of ultraviolet on the planaria (*Dugesia japonica*) (2nd report). — The loss of Na from a planarian —. Ôsaka-furitsu Kôshû-eisei-kenkyû-sho, Kenkyû-hôkoku, (10) : 105 - 108. (In Japanese) 1974. Studies on the chromosome of freshwater planaria lived in the Mino River. Zool. Mag., 83 : 457. (In Japanese) 1975 a. A freshwater planarian with heterogeneous cell populations of two different chromosome numbers. Ibid., 84 : 61 - 63. (In Japanese with English summary) 1975 b. A freshwater planarian with heterogeneous cell populations of two different chromosome numbers. Ibid., 84, 444. (In Japanese)

OKI, I., TAMURA, S., & KAWAKATSU, M., 1976. A technique for the study of planarian chromosomes. The Heredity (Iden), 30, (12) : 32-40. (In Japanese)

OKI, I., TAMURA, S., KAWAKATSU, M., & SUGINO, H., 1976. Morphological and karyological reexamination of the taxonomy of the freshwater planarian *Dugesia japonica*, I. Chromosomal analysis of the animals from different localities in Japan and Korea. Zool. Mag., 85 : 507.

(In Japanese)

OKUGAWA, K. I., 1955. On the supernumerary sexual organs of *Dugesia gonocephala* (DUGÈS), induced by the low temperature. Bull. Kyôto Gakugei Univ., Ser. B, (6): 1 - 14 + Pls. I - II. 1957. An experimental study of sexual induction in the asexual form of Japanese fresh-water planarian, *Dugesia gonocephala* (DUGÈS). Ibid., Ser. B., (11): 8 - 27 + Pls. 1 - 6.

OKUGAWA, K. I. & KAWAKATSU, M., 1954 a. Studies on the fission of Japanese fresh-water planaria, *Dugesia gonocephala* (DUGÈS). I. Comparative studies on fission rates and frequencies of sexual and asexual races influenced by temperatures, starvation and distilled water. Bull. Kyôto Gakugei Univ., Ser. B, (4): 25 - 34. 1954 b. Do. II. On the fission plane and fission pieces. Ibid., Ser. B, (4): 35 - 40 + 1 diagram. 1954 c. Do. 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. Ibid., Ser. B, (5): 42 - 52. 1956 a. Do. IV. Comparative studies on breeding and fission frequencies of sexual and assumed asexual races which were observed in laboratory cultures and natural habitats. Ibid., Ser. B, (8): 23 - 42. 1956 b. V. Do. On the influence of fission frequencies of the animals of sexual and asexual races by means of head removed operation. Ibid., Ser. B, (8): 43 - 59. 1957. Do. VI. Comparative studies on breeding and fission frequencies of sexual and asexual races which were observed under by different food cultures. Ibid., Ser. B., (10): 18 - 37. 1958. Do. VII. Comparative studies on breeding and fission frequencies of sexual and asexual races influenced by various concentrations of Ringer solutions and hydrogen-ion concentrations. Ibid., Ser. B, (12): 19 - 44. (In Japanese with English summary)

OKUGAWA, K. I., KAWAKATSU, M. & TARUI, Y., 1955. Studies on the vertical distribution of Japanese fresh-water planarian. II. The Kamikôchi Valley and its adjacent districts. Bull. Kyôto Gakugei Univ., Ser. B, (7): 52 - 66. (In Japanese with English summary)

SIVICKIS, P. B., 1928. The fresh water planarians of the Philippines. Trans. Amer. Micros. Soc., 47 : 356 - 365 (+ Pls. L - LI).

SUGINO, H., 1959. On the transplantation experiments in the different stocks of *Dugesia gonocephala*. Zool. Mag., 68 : 46. (In Japanese) 1960. *Dugesia gonocephala* in Ôsaka Prefecture. Ibid., 69 : 62. (In Japanese) 1962. Mutual transplantation in planarians collected from various localities. Mem. Ôsaka Univ. Liberal Arts and Education, Ser. B, (11): 123 - 127. 1969. Collecting, breeding and experiments of a common Japanese freshwater planarian, *Dugesia japonica*. (with annotations and an appendix written by M. KAWAKATSU : On the physiological races of *D. japonica* as a polytypic species). Collect. & Breed., 31 : 222 - 229, 294 - 303. (In Japanese) 1971. Collecting, breeding and experiments of a common Japanese freshwater planarian, *Dugesia japonica*. In KAWAKATSU, M. & M. IBA (ed.), Comm. Compil. Sci. Papers Publ. Occ. Retir. Prof. Hisao SUGINO at the Age of Sixty - five, Ser. Science Education and Other Subjects, pp. 1 - 16 ; Ibid., Ser. Turbellarians, pp. 1 - 16. (In Japanese)

SUGINO, H., HIROSE, E. & KATÔ, F., 1973. The chromosomes of a Japanese fresh-water planarian, *Dugesia japonica* ICHIKAWA et KAWAKATSU. Nature Study, 19 (4): 41 - 43. (In Japanese)

TAMURA (= YOSHIDA), S. & OKI, I., 1969. Lethal effects of ultraviolet on the planaria, *Dugesia japonica*. Ôsaka-furitsu Kôshû-eisei-kenkyûsho, Kenkyû-Hôkoku, (1): 1 - 3. (In Japanese)

TANAKA, I., 1965. Observation on the breeding of *Dugesia japonica* ICHIKAWA et KAWAKATSU from Okinawa (with an appendix written by M. KAWAKATSU). Collect. & Breed., 27 : 458 - 459. (In

Japanese)

TANAKA, I., UNTEN, M. & UNTEN, K., 1965. Notes on freshwater planaria from Okinawa (with an appendix written by M. KAWAKATSU) Collect. & Breed., 27: 425-428. (In Japanese)

TESHIROGI, W. & ITAGAKI, G., 1965. The chromosomes of *Dugesia* species, a Japanese freshwater planarian known as *Dugesia gonocephala*. Zool. Mag., 74: 38-45. (In Japanese with English summary)

TU, TSENG - JUI, 1934. Notes on some Turbellarians from the Tsing Hua Campus. Sci. Rep. Nat. Tsing Hua Univ., B, (1): 191-206.

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補遺. 川勝正治. 日本列島を含む極東地域に広く分布しているナミウズムシは、形態的・生理的な性質の他、染色体構成についても変異の認められる多型種である。分類学的再検討の結果、本論文で、本種を2亜種に分割した。本種は実験動物として著明なものであり、その分類に關しての困乱をさける目的で、この補遺を付した。

ナミウズムシ *Dugesia japonica* ICHIKAWA et KAWAKATSU, 1964. 極東地域に分布し、下記の2亜種を含む。

Dugesia japonica japonica ICHIKAWA et KAWAKATSU, 1964. 冠名亜種で、香港・台湾(ほぼ全地域)・中国北部・韓国; 日本列島のうち、九州(薩南諸島を含む)・四国・本州・北海道、及び小島嶼に分布。

Dugesia japonica ryukyuensis KAWAKATSU, 1976. 本論文で原記載した新亜種で、台湾(主に中央山地)・中国中部; 琉球諸島・奄美諸島に分布。

上記の2亜種に対して、適当な和名を与えるべきかどうかについても検討した。結論として、下等動物の亜種に和名を与えることは独立種と誤解される恐れもあるので、ナミウズムシという和名を広い意味で用いることにした。この件に關し、御意見をうかがった市川純彦博士と川合禎次博士(楨翅目の分類)に感謝する。

沖・田村・川勝・杉野(1976)及び、川勝・沖・田村・杉野(1976)の記事(動物学雑誌, 85巻, 507-508頁)は本論文の和文摘要の性格を持つ。本種のさまざまな問題に關する解説の記事は改めて別報する。

なお、非専門家の邦文記事中に、日本産のナミウズムシに対して *Dugesia gonocephala* の学名をあてているものを散見するが ヨーロッパナミウズムシ *Dugesia* (= *Planaria*; = *Euplanaria*) *gonocephala* (DUGÈS, 1830) は、ヨーロッパとアフリカにだけ分布する別種であって、極東地域には産しない(市川・川勝, 1964, 動雑, 73巻, 305頁; 川勝, 1965, 遺伝, 19巻, 10号, 31-37頁, 他)。学名の誤用をさけるとともに、非分類学的論文についても実験材料の採集地を明記することが望ましいと考えられる。

December 25, 1976.