

Classification of the Japanese Planorbidae

By

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With Plates XII-XVIII and 4 Text-figures

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I. Introduction

Fifteen species, one subspecies, and one variety of Planorbidae have been recorded from Japan: i. e., *Planorbis spirillus*, *Segmentina lucida*, and *Segmentina usta*, by GOULD (1859); *Planorbis Swinhoei*, by H. ADAMS (1866), *Planorbis compressus* var. *japonicus*, *Planorbis albus* MÜLLER, and *Planorbis nitidellus*, by MARTENS (1867 and 1877); *Planorbis (Gyraulus) illibatus*, *Planorbis (Gyraulus) hiemantium*, and *Planorbis (Segmentina) mica*, by WESTERLUND (1883); *Planorbis neglectus* HASSELT, by CLESSIN (1886); *Choanomphalus japonicus*, *Choanomphalus japonicus perstriatulus*, and *Planorbis (Gyraulus) biwaënsis*, by PRESTON (1916); *Camptoceras hirasei*, by WALKER (1916); *Camptoceras ijimai*, by S. HIRASE (1922); *Camptoceras prashadi* (= *Bulinus hirasei*), by CLENCH (1927).

After examining many specimens, collected by Dr. D. MIYADI, Mr. T. KURODA, Dr. M. UENO, and by myself and also by many others from almost all parts of Japan, I found several synonyms in these seventeen names and also other species not previously reported.

In the present paper I will describe fourteen species and three subspecies, in which five species and two subspecies are new, and one species is hitherto unrecorded from Japan; they are as follows:

- I. Subfamily Bulliniinae (Isidorinae)
 - Genus *Camptoceras*
 - A. Subgenus *Culmenella*
 - 1. *Camptoceras (Culmenella) prashadi* CLENCH
 - B. Subgenus *Camptoceras*
 - 2. C. (*Camptoceras*) *hirasei* WALKER
 - Genus *Anisus*
 - A. Subgenus *Segmentina*
 - 3. *Anisus (Segmentina) nitidellus* (v. MARTENS)
 - 4 a. A. (*Seg.*) *usta* (GOULD)
 - b. A. (*Seg.*) *usta swinhoei* (H. ADAMS)

B. Subgenus *Hippeutis*

- 5.
- A. (Hippeutis) peipinensis*
- (PING et YEN)

C. Subgenus *Gyraulus*

6. *A. (Gyraulus) pulcher* n. sp.
 7. *A. (Gyr.) tōkyōensis* n. sp.
 8. *A. (Gyr.) hiemantium* (WESTERLUND)
 9. *A. (Gyr.) iwaotakii* n. sp.
 10. *A. (Gyr.) biwaënsis* (PRESTON)
 11. *A. (Gyr.) amplificatus* n. sp.
 12 a. *A. (Gyr.) albus* (MÜLLER)
 b. *A. (Gyr.) albus noziriensis* n. subsp.
 13. *A. (Gyr.) gredleri* (BIELZ)
 14. *A. (Gyr.) laevis infirmus* n. subsp.

The system of classification adopted in the present paper is principally that of J. THIELE'S (1931) modified by P. EHRMANN (1933) and N. ANNANDALE (1922).

Types and cotypes together with the specimens here described are deposited in the Ôtu Hydrobiological Station of Kyôto Imperial University, and some specimens from topotypes are also presented to the Museum in the Geological Institute of Kyôto Imperial University.

The author wishes to express his appreciation to Prof. T. KAWAMURA, Mr. T. KURODA and Assist. Prof. Iw. TAKI for their valuable suggestions and criticisms throughout the study. Also, he wishes to thank Dr. D. MIYADI, Dr. M. UENO, and Prof. Dr. T. ESAKI for their kindness in providing materials, and in lending me useful literatures.

II. Explanation of several terms adopted in the present paper

Several terms, newly adopted in the present paper, are shown in accompanying Text-Fig. 1.

To show concretely the characters of the shell, I employed six signs in expressing the results of measurement, which are as follows (refer to Text-Fig. 1):

$$\alpha = \frac{\text{Breadth of the shell (B.)}}{\text{Height of the shell (H.)}}$$

$$\beta = \frac{\alpha\beta \text{ in Text-Fig. 1, II, A}}{\beta\gamma \text{ in the same figure}}$$

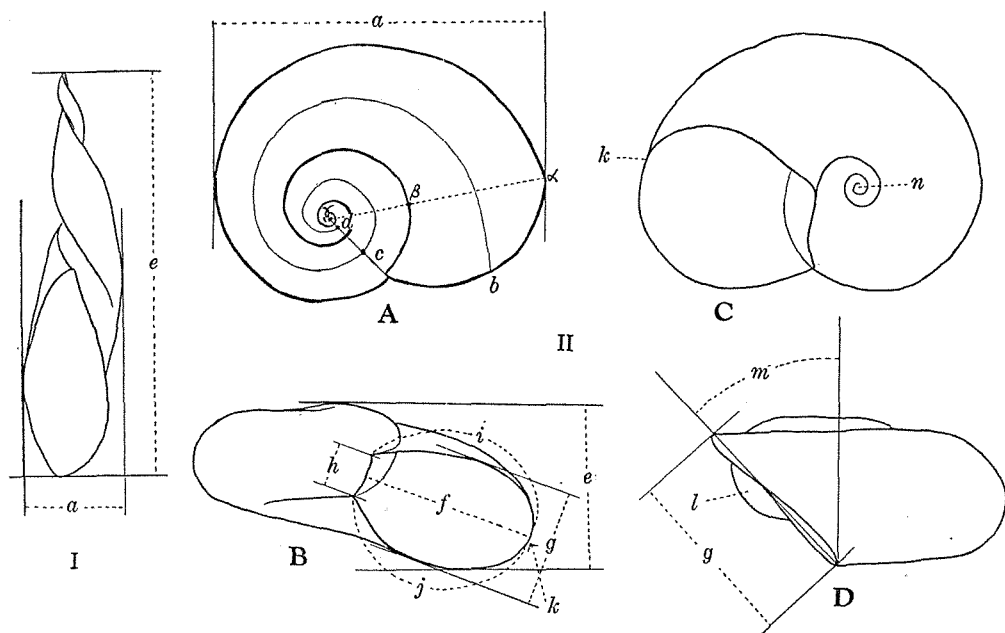
$$\gamma = \frac{\text{Breadth of the aperture (B.A.)}}{\text{Height of the aperture (H.A.)}}$$

$$\delta = \frac{\text{Length of the inner margin of the aperture (h.)}}{\text{Height of the aperture (H.A.)}}$$

$$\varepsilon = \frac{\text{Length of the inner margin of the aperture (h.)}}{\text{Height of the shell (H.)}}$$

$$\zeta = \frac{\text{Length of the inner margin of the aperture (h.)}}{\text{Breadth of the aperture (B.A.)}}$$

The signs α , β , γ , δ are employed in the cases of the subgenus *Gyraulus*



Text-Fig. 1.

I. *Camptoceras*; II. *Anisus*. A: seen from above, B: seen from in front, C: seen from below, D: seen from side. *a*: breadth of the shell (Br.) *b-c*: body whorl, *c-d*: penultimate whorl, γ : apex, *e*: height of the shell (H.), *f*: breadth of the aperture (Br. A.), *g*: height of the aperture (*h*), *i*: dorsal margin of the aperture, *j*: ventral margin of the aperture, *k*: peripheral margin of the aperture, *l*: front side of the last whorl, *m*: inclinatory angle of the aperture, *n*: umbilicus.

and *Hippeutis*, and the signs α , β , ε , ζ for the subgenus *Segmentina*, since the shape of the aperture of *Segmentina* is unfavourable for measurement. For the genus *Camptoceras* two signs α and ε are employed.

III. Key to the classification of the Japanese Planorbidae

A. Key to the subfamilies and genera

- a. Shell flattened, dexterous, more or less discoidal or conoidal, somewhat compactly whorled, the value of α always greater than 1.5, rachidian of radula bicuspid Planorbinae (only 1 genus in Japan *Anisus*) B
 - b. Shell elongate, sinistral, more or less ovate or cornucopia-form, suture remarkably broad, deep, oblique, loosely whorled, the value of α always smaller than 0.6, rachidian of radula tricuspid Bullininae (only 1 genus in Japan *Camptoceras*) C
- + + + + +

The genus *Anisus* contains 3 subgenera and *Camptoceras* contains 2 subgenera, as follows:—

B. Key to the subgenera of *Anisus*

- 1 a. Inside of the body whorl with 3 ridges or lamellae, which are visible through the shell wall (especially from below); shell conoidal, very much compactly whorled, surface exceedingly polished, glossy *Segmentina* (2 species and 1 subspecies in Japan) D
- b. Shell without internal ridges; flattened conoidal or discoidal, not so much compactly whorled, surface polished or coarse, glossy or opaque. 2
- 2 a. Aperture lunate, parietal wall remarkably projected outwards with wedge-shaped keel; shell flattened conoidal; whorls more or less convex above; flattened below; periphery sharply keeled; surface usually polished, glossy; spiral striae absent *Hippeutis* (only 1 species in Japan *Anisus* (*Hippeutis*) *peipinensis* (PING et YEN), (Height 2.1 mm., Breadth 8.4 mm.))
- b. Aperture ovate or truncated elliptic or cordate, parietal wall rounded, only slightly or scarcely projected outwards; flattened conoidal or flattened lenticular; whorls more or less convex above and below; periphery keeled or rounded; surface polished or coarse, glossy or opaque; spiral striae present in some species *Gyraulus* (8 species and 3 subspecies in Japan) E

C. Key to the subgenera and species of *Camptoceras*

- a. Shell ovate but dissolute, with spiral lines of minute chaetae, α about 0.56 *Culmenella* only 1 species in Japan *Camptoceras* (*Culmenella*) *prashadi* CLENCH, (Height 6.1 mm., Breadth 3.4 mm.)
- b. Shell definitely cornucopia-form, long, rather loosely coiled, without chaetae, α about 0.26 *Camptoceras* only 1 species in Japan *Camptoceras* (*Camptoceras*) *hirasei* WALKER, (Height 8.6 mm., Breadth 2.2 mm.)

D. Key to the species and subspecies of *Anisus* (*Segmentina*)

- 1 a. Shell small, never over 6 mm. in diameter; depressed, the value of α of normal adult shell (about 4 mm. in diameter) is greater, usually over 2.6, but in the full grown shell (5-6 mm. in diameter) it becomes smaller, ca. 2.4; Height 2.2 mm., Breadth 5.3 mm. *Anisus* (*Segmentina*) *nitidellus* (MARTENS)
- b. Shell large, usually over 7 mm. in diameter; in the younger shell (about 4 mm. in diameter) the value of α is always under 2.5, being more inflated than the above species of the same diameter 2
- 2 a. The adult shell (7-8 mm. in diameter) is more depressed than the younger shell (about 4 mm. in diameter), the value of α of the adult shell being usually over 2.5 even 2.7; the value of ζ usually 0.9-1; Height 3.3 mm., Breadth 8.7 mm. *Anisus* (*Segmentina*) *usta* (GOULD)
- b. The adult shell (7-8 mm. in diameter) is inflated in the same degree as or even more inflated than the younger shell (about 4 mm. in diameter), the value of α of the adult shell being about 2.3, the value of ζ is greater, 1.2-1.3; Height 3.4 mm., Breadth 7.8 mm. *Anisus* (*Segmentina*) *usta swinhoei* (H. ADAMS)

E. Key to the species and subspecies of *Anisus* (*Gyraulus*)

- 1 a. Shell depressed, the value of α is always over 3.7; whorls gradually increasing (whorls usually over 5), not conspicuously enlarged near the aperture, the value of β is always under 1, spiral striae inconspicuous. 2

- b. Shell not so much depressed, or even having somewhat globular form, the value of α is usually under 3.5; whorls rapidly increasing especially in the body whorl (whorls usually less than 4.5), more or less enlarged near the aperture, the value of β is always over 1 (usually over 1.3), spiral striae conspicuously sculptured or obsolete 4
- 2 a. Shell moderately small, usually under 4.5 mm. in diameter, scarcely carinated, periphery rounded; Height 1.1 mm., Breadth 4.3 mm. *Anisus (Gyraulus) pulcher* n. sp.
- b. Shell large, usually over 7 mm. in diameter, more or less carinated in the periphery or keeled, sometimes with projected seam of periostracum of the shell 3
- 3 a. Body whorl greatly depressed at the periphery, remarkably keeled, with conspicuously developed seam of periostracum at the periphery; Height 1.7 mm., Breadth 7.6 mm. *Anisus (Gyraulus) tōkyōensis* n. sp.
- b. Body whorl not so much depressed, somewhat angulated, but not keeled in the periphery, with rarely developed seam of periostracum; Height 1.8 mm., Breadth 7.1 mm. *Anisus (Gyraulus) hiemantium* (WESTERLUND)
- 4 a. Shell small, diameter less than 3 mm.; somewhat globular, whorls exceedingly rapidly increasing both in height and breadth; the value of α under 1.6, the value of β over 2.4; whorls 2.5; Height 1.3 mm., Breadth 2.8 mm. *Anisus (Gyraulus) iwaotakii* n. sp.
- b. Shell larger, diameter over 5 mm.; more or less depressed, whorls rapidly increasing in some species; the value of α over 2.1, β 1-2.3, whorls 3-5 5
- 5 a. Shell thin, tricarinate, each carina usually fringed with a row of short setae; whorls 3; the value of α 2.1-2.6, β 1.5-2.3; Height 2.2 mm., Breadth 5.1 mm. *Anisus (Gyraulus) biwaënsis* (PRESTON)
- b. Shell having only one carina at the periphery or no carina; whorls 3-5; the value of α 2.3-3.5, β 1-2.3 6
- 6 a. Shell large (diameter 9 mm.), thickened, body whorl rapidly grown in diameter toward the aperture and somewhat loosely coiled especially near the aperture, the value of α 2.3-2.6, δ 0.28-0.35; whorls 2.5-3; not carinated; surface coarsely and inconspicuously transversely striated, spiral striae indistinct; Height 4 mm. Breadth 9 mm. *Anisus (Gyraulus) amplificatus* n. sp.
- b. Shell moderately large, diameter usually not over 7 mm., thickened or thin, body whorl not so rapidly increasing in diameter toward the aperture and not so loosely coiled as in the above species or even somewhat compactly coiled; the value of α 2.5-3.5, δ 0.45-0.7; whorls 3-5; usually more or less carinated; spiral and transverse striae distinct or indistinct 7
- 7 a. Body whorl rapidly increasing in diameter toward the aperture, margin usually depressed, more or less carinated at the periphery, in some specimens spiral striae clearly sculptured, surface colour not fresh horny brown but pale, pale yellowish or whitish; the value of β 1.3-1.5. 8
- b. Body whorl not increasing in diameter so much toward the aperture as in the above-mentioned species, carinated at the periphery scarcely or not at all, spiral striae hardly developed, surface horny brown, usually freshly coloured; the value of β 1-1.3. 9
- 8 a. Shell thin, depressed discoidal, both sides flattened, not distinctly lipped; peripheral keel conspicuous or obsolete; the value of α 3.1-3.8, Height 2 mm., Breadth 6.6 mm. *Anisus (Gyraulus) albus* (MÜLLER)
- b. Shell thickened, whorl moderately convex above and below, somewhat globular in outline, with white thickened lip; peripheral keel not distinct; the value of

- α 2.5-2.8; Height 2.2 mm., Breadth 5.9 mm.
 *Anisus (Gyraulus) albus noziriensis* n. sp.
- 9 a. Shell moderately large, 6-7 mm. in diameter, moderately thin, but not fragile, flattened in outline, body whorl scarcely descending to the aperture, the value of α 2.8-3.7; apex concave; colouration fresh horny brown, periphery rounded or slightly carinated, striations fine; Height 1.8 mm., Breadth 6.3 mm.
 *Anisus (Gyraulus) gradleri* (BIELEZ)
- b. Shell small, 4 mm. in diameter, thin, fragile, somewhat globular in outline, body whorl descending to the aperture, the value of α 2.3-2.7; apex not concave; colour paler, periphery rounded, not carinated, striation finer than in the above species; Height 1.6 mm., Breadth 3.7 mm.
 *Anisus (Gyraulus) laevis infirmus* n. subsp.

IV. Descriptions

I. Subfamily Bullininae (=Isidorinae)

Genus *Camptoceras* BENSON, 1843

A. Subgenus *Culmenella* CLENCH, 1927

1. *Camptoceras (Culmenella) prashadi* CLENCH (Pl. XII, Fig. 1)

1927: *Bulinus (Culmenella) hirasei*, CLENCH, Nautilus Vol. 40, p. 121, fig. 1, (non *C. hirasei*, WALKER, 1919).

1931: *Camptoceras (Culmenella) prashadi*, CLENCH, Nautilus, Vol. 44, p. 80.

1933: *Camptoceras (Culmenella) prashadi*, KURODA, Catalogue of mollusca in Hukui-Ken, p. 192.

Shell sinistral, small, thin, translucent, colouration dull amber. Whorls 4, convex, rapidly increasing in size. Suture well impressed. Aperture very large relative to the size of the shell, flaring, rounded ovate. Columellar lip somewhat reflected, forming a narrow umbilical orifice. Anterior margin of the aperture widely curved, outer margin gently rounded, forming an angle of about 70° at the posterior margin. Sculpture composed of many spiral ridges, quite evenly spaced, on which minute chaetae are scattered, intersected by microscopically fine longitudinal striae.

Height 6.1 mm., breadth 3.4 mm., height of aperture 4.2 mm., breadth of aperture 2.1 mm.; α 0.56, γ 0.5.

Localities—Sizyónawate-Mura (formerly Kôka-Mura), Ôsaka-Hu, *Type* (KIRA); Tôkyô (Y. HIRASE); Sakai-Gun, Hukui Ken (KURODA).

B. Subgenus *Camptoceras* BENSON, 1843

2. *Camptoceras (Camptoceras) hirasei* WALKER (Pl. XII, Fig. 2)

1919: *Camptoceras hirasei*, WALKER, Occ. Pap. Mus. Zool. Univ. Michigan, No. 64, p. 1, Pl. 1, figs. 1-8.

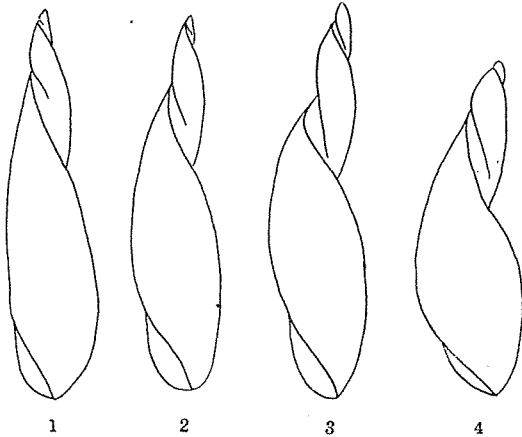
1922: *Camptoceras ijimai* S. HIRASE, Zool. Mag., Vol. 34, p. 391, Pl. 13, figs. 1-7.

1933: *Camptoceras hirasei*, KURODA, Catalogue of mollusca in Hukui-Ken, p. 192.

Shell sinistral, very slender, cornucopia-form, colouration horny. Whorls 3.5, compressed laterally, strongly carinated above and below, separated by a broad, deep, concave channel. Apex bluntly pointed. Aperture elongate oval, narrow, somewhat wider below, forming an angle of about 35° at the posterior margin and about 80° at the anterior margin. Lip continuous. Surface sculptured longitudinally, exceedingly finely, and spiral striae clearly sculptured at first or second whorls but they gradually become more or less obsolete and are scarcely visible on the last whorl.

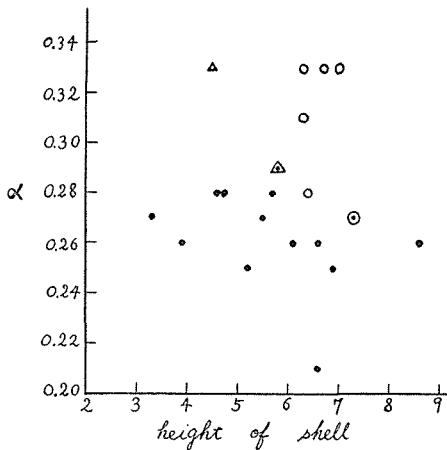
Height 8.6 mm., breadth 2.2 mm., height of aperture 4.1 mm., breadth of aperture 1.7 mm.; α 0.26, γ 0.41.

Localities—Sizyónawate-Mura (formerly Kôka-Mura), Ôsaka-Hu, Type (KIRA); Akabane, Tôkyô (S. HIRASE);



Text-Fig. 2

Variations seen in the outline of the shell of *C. hirasei*. 1-2, from Kôka-Mura; 3, from Ôsawano-Ike; 4, from Seta-Gawa, the last figure shows the typical form of HIRASE's *ijimai*.



Text-Fig. 3

Variations seen in the value of α . ● show the value obtained by examining the snail from Kôka-Mura, ○ shows that of (a) specimens from Ôsawano-Ike, △ shows that of one from Seta-Gawa, ⊙ shows the value calculated from the measurements of the type of *hirasei*, and ▲ shows that of *ijimai*.

Yosida-Gun and Sakai-Gun, Hukui Ken (KURODA); Biwa-Ko, Siga Ken (KURODA); Seta-Gawa, Ôtu (KONDÔ); Ôsawano-Ike, Kyôto (KURODA, KAWAMURA, UENO).

The outline of this species is rather variable. In 1922 S. HIRASE described *C. ijimai*, from Akabane (Tôkyô) as a new species, distinguishing it from *C. hirasei* in three characters, i. e.;

1. the channel of the suture between the last whorl and the penultimate whorl of *ijimai* being narrower than in *hirasei*,
2. the spire of *ijimai* more strongly inclined or curved to the right, when viewed from the dorsal side, than in *hirasei*,
3. the breadth of *ijimai* wider relative to the height than in *hirasei*, viz. the value of α is larger in *ijimai* than in *hirasei*.

But taking his figures and comparing many specimens collected from various habitats, I am compelled to conclude that these three points of demarcation are included in the range of variation of the same species. The transitive form in the outline is clearly seen in Text-Fig. 2, and the same condition in the proportion of the breadth and the height of the shell is represented in Text-Fig. 3.

II. Subfamily Planorbinae

Genus *Anisus* STUDER, 1820

A. Subgenus *Segmentina* FLEMING, 1822

3. *Anisus* (*Segmentina*) *nitidellus* (v. MARTENS) (Pl. XII, Fig. 3)

1867: *Planorbis calathus*, v. MARTENS (non BENSON), Malak. Blätt., Bd. 14, S. 217.

1877: *Planorbis nitidellus*, v. MARTENS, SB. Gesell. nat. Freunde Barlin, Bd. 17, S. 112.

1879: *Planorbis nitidellus*, KOBELT, Fauna Japonica, S. 108, T. 9, fig. 16.

1883: *Planorbis* (*Segmentina*) *mica*, WESTERLUND, Nachr'bl. d. Deut. Malak. Gesell., Jahrg. 15, S. 54.

1883: *Planorbis* (*Segmentina*) *mica*, WESTERLUND, Vega-Exp., Bd. 4, T. 4, fig. 20.

1886: *Planorbis nitidellus*, CLESSIN, Syst. Conch. Cab., Bd. 9, S. 157, T. 23, fig. 2.

1933: *Segmentina nitidella*. KURODA, Catalogue of mollusca in Hukui-Ken. p. 192.

Shell moderately small, subconoidal; colouration variable, reddish yellow or reddish brown or whitish yellow or even pale yellow. Surface polished, exceedingly glossy. Shell thickened or thin and translucent. Whorls 5, somewhat compactly whorled, upper surface convex, apical part somewhat flattened or slightly concave; the majority of spire concealed within the last whorl; suture shallowly impressed, body whorl smoothly rounded, narrowed above and with well rounded angle below. Lower surface flattened, the body whorl occupying most of area, other whorls scarcely visible; umbilicus narrow, deep, cup-form; both inner and outer margins of the body whorl well rounded, obliquely declined. In larger shells the body whorl is more loosely spired than in smaller shells, so that the value of α is smaller in larger shells and the greater part of the surface of the spire can be seen about the apex. Aperture lunate, inclinatory angle about 30°, lip simple; dorsal margin smoothly, moderately curved, descending below and behind; ventral margin exceedingly curved at the interior part, then becoming straight at the base, and at last jointed to the dorsal margin, arching moderately. Inside of the body whorl, at 2 or 3 positions, 3 thin lamellae more or less developed,—one on the inner wall, one on the dorsal wall, and the last one on the ventral wall—, so that the animal passes through somewhat \triangleright -shaped slit (refer to Pl. XIII, Fig. 4g). Spiral striae exceedingly fine and regularly spaced in some specimens and obsolete in others; transverse striae irregular, and in some specimens coarsely and in others finely sculptured.

Height 2.2 mm., breadth 5.3 mm., breadth of aperture 1.3 mm.; α 2.4, β 1.2, ε 0.77, ζ 1.31.

or

Height 1.4 mm., breadth 3.9 mm., breadth of aperture 1 mm.; α 2.8, β 2.12, ε 0.79, ζ 1.1.

Localities—Yokohama, *Type* (v. MARTENS); Akkesi, Hokkaidô (Y. HIRASE); Hakodate, Hokkaidô (HILGENDORF); Mukô-Zima, Tôkyô (HILGENDORF), various parts in Hukui Ken (KURODA); Kobata-Ike, Kyôto (MIYADI); Muya, Tokushima Ken (Y. HIRASE); Takara-Mura, Tokushima Ken (MORI); Hirosima (Iw. TAKI); Harima (Y. HIRASE); Ryûga-Dô, Kôti Ken (MORI); Masi in Simonosaki (=Simonoseki) (WESTERLUND); Yuhuin Hot Spring, Ôita Ken (SAKASITA).

This species is widely distributed all over Japan Proper, and resembles the European *nitidus* MÜLLER,¹⁾ and also the Indian *calathus* BENSON,²⁾ but may be easily distinguished by its loosely whorled spire and because on the upper side the exposed surfaces of the whorls (except the body whorl) have wider space. WESTERLUND's description of *mica* seems to refer to this species. SAKASITA collected this snail in the Yuhuin Hot Spring, where the water temperature was 34-39° and I collected it in the small stream running in the limestone cave, Ryûga-Dô, where light was completely absent.

4 a. *Anisus (Segmentina) usta* (GOULD)

(Pl. XIII, Fig. 4)

1859: *Segmentina lucida*, GOULD, Proc. Bost. Soc. N. H., Vol. 7, p. 41. (non *Planorbis lucidus*, PFEIFFER, 1839, Wiegmann' Arch., Bd. 5, S. 354).

1859: *Segmentina usta*, GOULD, Proc. Bost. Soc. N. H., Vol. 7, p. 41.

Shell moderately large, subconoidal, compactly coiled. Shell moderately solid, thickened or thin. Colouration pale yellowish or pale whitish; surface glossy, polished. Whorls 6, upper surface convex, apical part somewhat flattened or slightly sunken; lower surface flattened. Umbilicus narrow, but deep. Aperture distorted lunate, margin more irregularly curved near the periphery than in *nitidellus*. Inclinator angle of the aperture about 40°. Transverse striae coarse, irregular, not conspicuous; spiral striae scarcely visible, exceedingly fine, but regular. The shell is higher in the younger animal (breadth ca. 4 mm.) than in the adult (refer to Pl. XIII, Fig. 4 c, f), that is, the value of α of the younger shell is 2.4-2.5, whereas that of the adult shell is 2.5-2.7.

Height 3.3 mm., breadth 8.7 mm., breadth of aperture 2.6 mm.; α 2.64, β 1.48, ε 0.76, ζ 0.92.

or

Height 1.8 mm., breadth 4.3 mm.; α 2.4.

Locality—Okinawa, *Type* (SIMPSON, Y. HIRASE); Ryûtan in Syuri, Okinawa (MIYADI and OKUGAWA).

1) *Planorbis nitidus*, MÜLLER, 1774, Verm. terr. fluv. Hist., II, S. 163.

2) *Planorbis calatha*, BENSON, 1850, Ann. Mag. Nat. Hist., (2) V, p. 349.

In addition to this species, GOULD described *Seg. lucida* from Okinawa, which is smaller and more elevated than in *usta*. But the characters of *lucida* are clearly the same as those seen in the smaller specimens of *usta*, as described above. This species is clearly distinguished from *nitidellus* by its larger shell, smaller value of ζ , more numerous whorls, and the characteristic decrease in the value of α with the growth of the shell as mentioned above.

This snail was referred by a certain author to *Seg. Largillierti* DUNKER, which was described from Hongkong and Amoy, but DUNKER's *Largillierti* is more inflated [the value of α smaller, viz., that of *Largillierti* (8.5 mm. in breadth, 3.5 mm. in height) is about 2.4], more reddish in colouration, more compactly whorled, so that the exposed surfaces of the whorls (except the body whorl) are narrower.

4b. *Anisus* (*Segmentina*) *usta swinhoei* (H. ADAMS)
(Pl. XIII, Fig. 5)

1866: *Planorbis Swinhoei*, H. ADAMS, Proc. Zool. Soc., p. 319, Pl. 33, fig. 13.

1886: *Planorbis Swinhoei*, CLESSIN, Syst. Conch. Cab., Bd. 1, Abth. 17, S. 227.

1905: *Planorbis Swinhoei*, PILSBRY et HIRASE, Proc. Acad. Nat. Sci. Philad., Vol. 57, p. 746.

1935: *Planorbis Swinhoei*, HORIKAWA, Venus, Vol. 5, p. 29.

This subspecies may be easily distinguished from *usta* s. s. GOULD by its more yellowish colouration, more elevated, conoidal outline, smaller value of α , and greater value of ζ .

Height 3.4 mm., breadth 7.8 mm., breadth of aperture 2.1 mm.; α 2.3, β 1.3, ε 0.8, ζ 1.3.

Localities—Tainan (Y. HIRASE), Kôsyun (HORIKAWA), Kôsyû (HORIKAWA), Hôsan (HORIKAWA), a small pond near Uzantô (MIYADI) (all in Taiwan). This species is widely distributed in Taiwan.

B. Subgenus *Hippeutis* (*Agassiz*) CHARPENTIER, 1837

5. *Anisus* (*Hippeutis*) *peipinensis* (PING et YEN)
(Pl. XIV, Fig. 6)

1932: *Pyramidula* (*Patula*) *peipinensis*, PING et YEN, Bull. Fan Memor. Inst. Biol., Vol. 3, p. 25, figs. 1-3.

1935: *Gyraulus schmackeri*, HORIKAWA (non CLESSIN), Venus, Vol. 5, p. 29.

Shell moderately thin, very much depressed, lenticular, biconcave. Colouration variable, pale yellowish, pale brownish, or pale whitish. Whorls 4.5. Upper surface flattened, apex and first two whorls sunken and the following whorls gradually raised; earlier three whorls with a gradual increase in breadth of exposed surfaces and the last two whorls with a sudden increase, particularly in the case of the body whorl; body whorl somewhat convex, sloping down and angulated at the periphery. Lower surface of the shell resembling the upper surface, but more flattened and more concave at the umbilical region. Suture well impressed, inside of which the surface of

the whorls is flattened while outside it is convex. Aperture lunate, margin thin, inner margin sharply bent, >-shaped; dorsal margin convex, curved downwards; ventral margin flattened; peripheral margin sharply keeled. Inclinatory angle of the aperture about 55°. Transverse striae fine, beginning to be visible on the third whorl and becoming only slightly coarser near the region of the aperture; spiral striae obsolete.

Height 2.1 mm., breadth 8.4 mm., height of aperture 2.7 mm., breadth of aperture 2.7 mm.; α 4, β 1.47, γ 1, δ 0.63.

Localities—Peiping, China, *Type* (PING et YEN); Sutschou, China (Y. HIRASE?); Heizyō, Tyōsen (DOI); Syōgen, Tyōsen (KURODA); Kiseiri, Kéizyō-nan-Dō, Tyōsen (HATAKEDA); Sinsei, Kokuryōkō-Syō, Manchoukuo (UENO); Kōsyū, Taiwan (HORIKAWA).

This species is somewhat variable as is true of other Planorbiid snails. Two rather distinct types are recognized in this species, one having a biconcave shell with a widely opened, shallow umbilicus, and the apex moderately sunken (Pl. XIV, Fig. 6 a-c), and the other having a subconoidal shell, with a narrow and deep umbilicus, and the apex scarcely sunken (Pl. XIV, Fig. 6 d-h). These two forms are apparently specifically distinct, but examining many specimens from Syōgen in Tyōsen I found they are connected in one series with various intermediate forms. The original description is based on a biconcave form. It is shown, therefore, that this species is widely distributed all over the eastern and northern China, Manchoukuo, Tyōsen and Taiwan.

This snail resembles European *A. (Hip.) complanatus* DRAPARNAUD,¹⁾ but may be distinguished by the larger shell and less involuted whorls (so that earlier whorls occupy larger area of the surface).

C. Subgenus *Gyraulus* (Agassiz) CHARPENTIER, 1837

6. *Anisus* (*Gyraulus*) *pulcher* n. sp.

(Pl. XIV, Fig. 7)

Shell discoidal, rather small, thin, fragile, depressed, some specimens translucent. Colouration pale yellowish or light pale brown, glossy (sometimes the surface of the shell is covered with iron deposits, which give the shell a pale black appearance). Whorls 4.5 (or sometimes 5); slowly and gently increasing, body whorl not conspicuously enlarged to the aperture. Upper surface somewhat concave, apex and earlier two whorls moderately sunken, last two whorls well inflated and convex; suture well impressed; inside and outside of the suture similarly convex at the last two whorls, but at the earlier two whorls, inside of suture somewhat flattened, outside convex. Lower surface similar to the upper surface, but less concave, more flattened, in the umbilical part less sunken; umbilicus wide. Periphery slightly angulated. Aperture cordate, parietal wall polished, margin thin,

1) *Hip. complanatus*, DRAPARNAUD, 1805, Hist. Moll. France, p. 47, Pl. 2, figs. 20-22.

lip entire, whitish; inner margin of the aperture slightly concave, dorsal margin slightly convex, and ventral margin narrowly convex. Inclinary angle of the aperture about 40° . Transverse striae fine, but distinct, somewhat irregular; spiral striae slightly sculptured, more clearly below than above.

Height 1.1 mm., breadth 4.3 mm., height of aperture 1.3 mm., breadth of aperture 1.5 mm.; α 3.9, β 0.75, γ 1.15, δ 0.62.

Localities—Kasyû-Mura¹⁾, Awazi-Sima, *Type* (Y. HIRASE); Kamotani-Mura, Tokushima Ken (MORI); Nakahara-Mati near Matue (TAKAGI); Turumigaoka in Beppu, Ôita Ken (SAKASITA).

The largest specimen measures 1.2 mm. in height and 4.6 mm. in breadth.

The distribution is somewhat restricted. In outline, this species resembles *A. (Gyr.) hiemantium* (WESTERLUND) which is commonly distributed in Japan, but it may be easily distinguished from the latter by its smaller, more fragile shell, less angulated periphery, and more inflated and more regularly spired whorl. SAKASITA collected this snail in a hot spring at Turumigaoka in Beppu, where the water temperature was 36°C .

7. *Anisus (Gyraulus) tôkyôensis* n. sp.

(Pl. XV, Fig. 8)

Shell flattened, discoidal, large, somewhat thickened, colouration pale yellowish, not glossy or dull glossy, general outline deformable, in some specimens whorls are irregularly coiled (especially in the body whorl). Whorls 5; slowly and gently increasing, body whorl not particularly enlarged near the aperture. Upper surface flattened, not concave; apex hardly sunken, clearly visible; each whorl smoothly and widely convex, outer part of the body whorl gently inclining, descending below; suture moderately impressed, whorls convex on both sides. Periphery very conspicuously keeled, having a projecting, thin, periostracal carinal flange on it. Lower surface slightly concave or flattened to the same extent as in the upper surface, inside of suture the surface flattened and outside, convex; central part somewhat sunken, umbilicus very wide, earlier whorls clearly visible. Aperture oblique, opening downward, distorted cordiform; margin thin, not specially lipped; inside of aperture slightly polished, whitish, dull glossy, inner margin slightly concave especially near the dorsal end, dorsal margin smoothly and gently arched, ventral margin more curved than dorsal margin, peripheral margin angulated. Inclinary angle of the aperture about 50° . Transverse striae somewhat coarse, irregular, and even obsolete at earlier two or three whorls; spiral striae obsolete or scarcely developed.

Height 1.7 mm., breadth 7.6 mm., height of aperture 2.4 mm., breadth of aperture 2.8 mm.; α 4.46, β 1, γ 1.17, δ 0.46.

Locality—A small pond in front of the statue of Nankô,²⁾ before the Imperial Palace in Tôkyô (Syôgaki).

1) 賀集村.

2) 楠公銅像前小池 (東京宮城前).

The outline is somewhat similar to *A. (Gyr.) hiemantium* (WESTERLUND), but it may be distinguished by its more flattened body whorl and conspicuous carination; and also from *A. (Gyr.) pulcher* it may be easily separated by its larger, thickened shell, flattened body whorl, conspicuous carination, less developed spiral striae, etc.

8. *Anisus (Gyraulus) hiemantium* (WESTERLUND)
(Pl. XV, Fig. 9)

- 1883: *Planorbis (Gyraulus) hiemantium*, WESTERLUND, Nachr'bl. d. Deut. malak. Gesell., Bd. 15, S. 53.
 1883: *Planorbis (Gyraulus) hiemantium*, WESTERLUND, Vega-Exp., Bd. 4, T. 4, fig. 15.
 1918: *Planorbis compressus* var. *japonicus*, KAWAMURA (non v. MARTENS), Japanese freshwater biology, p. 353-354, fig. 430.
 1933: *Gyraulus compressus japonicus*, KURODA (non v. MARTENS), Catalogue of mollusca in Hukui Ken, p. 192.
 1934: *Gyraulus japonicus*, UÉNO (non v. MARTENS), Freshwater animals at Kamikôti and Azusa-Gawa, p. 22, fig. 9.
 1935: *Gyraulus japonicus*, HORIKAWA (non v. MARTENS), Venus, Vol. 5, p. 29.
 1935: *Gyraulus compressus japonicus*, KURODA (non v. MARTENS), Catalogue of mollusca in Miyazaki Ken, p. 58.

Shell moderately large, discoidal, somewhat deformable, moderately thin, translucent or opaque, glossy, colouration pale yellowish or brown. Whorls 5, gradually increasing, not so much specially enlarged to the aperture, periphery carinated or not. Upper surface slightly concave or flattened, earlier two whorls somewhat sunken, last two whorls inflated, so that suture well impressed. Lower surface is similar to the upper surface. Aperture elongated distorted cordiform, the inside polished, glossy, colouration light whitish yellow. Inclinator angle of the aperture about 40°. Transverse striae fine, but becoming somewhat coarser and more irregular near the aperture; spiral striae obsolete or distinct.

Height 1.8 mm., breadth 7.1 mm., height of aperture 1.8 mm., breadth of aperture 2.5 mm.; α 4.75, β 0.95, γ 1.38, δ 0.61.

Localities—Hirosima, *Type* (Vega-Exp.); Nagano Ken (UÉNO); Kyôto (KURODA, MORI); all parts of Hukui Ken (KURODA, etc.); Takaoka, Miyazaki and Higasiyone, Miyazaki Ken (KURODA, etc.); Okinawa (Y. HIRASE; Syuri, TUDA); Kôzyô, Tyôsen (SIBA); Keizyô, Tyôsen (KAWAMURA); Heizyô, Tyôsen (SIBA).

This species has for a long time been referred to *Gyr. compressus japonicus* v. MARTENS 1867, but in my opinion, this description and classification must have been given to a local form (*acronicus*-type) of *A. (Gyr.) albus* MÜLLER (refer to the Paragraph 12 a and Pl. XVII, Fig. 13 k-o). In 1883 WESTERLUND described *Planorbis (Gyr.) hiemantium* from Hiro Sami (=Hirosima) for the first time giving a proper name to the present species.

The outline of this species is somewhat variable; there are specimens in which the upper surface is more concave than the lower surface or the

former is less concave than the latter, etc. This species is related to the previous species, *A. (Gyr.) tōkyōensis*, but the separating characters have already been mentioned.

9. *Anisus (Gyraulus) iwaotakii* n. sp.
(Pl. XV, Fig. 10)

Shell very small, outline characteristic, whorls very much inflated so that the shell is prominently higher in comparison with the congeners, with widely opened aperture; shell very thin, translucent, colouration light horny brown, dull glossy. Whorls 2.5, very rapidly and greatly increasing in diameter towards the aperture both in height and breadth; apex scarcely visible, involuted by the following whorls. Upper surface somewhat flattened, central part deeply sunken, greater parts of area occupied by the body whorl, surface of each whorl smoothly but conspicuously inflated, so that the suture is well impressed; the first whorl is abruptly sunken; the surface in the latter whorls is evenly convex. Periphery rounded. Lower surface characterized by the unusually large body whorl and widely opened umbilicus. Aperture very large relative to the size of shell, subcircular, subtruncated in the inner marginal part, the inside polished, with pearl-like gloss; margin very thin, not lipped, inner margin roundish, its upper and lower ends strongly curved outwards, dorsal margin smoothly convex, peripheral margin regularly rounded, ventral margin more curved than in dorsal surface, but also regularly and smoothly; inclinatory angle of the aperture rather small, about 30°. Transverse striae very fine, regular, but not very conspicuous; spiral striae rather coarse relative to transverse striae, regular, generally faint, but somewhat distinct on the peripheral surface of the body whorl, especially in front of the aperture.

Height 1.3 mm., breadth 2.8 mm., height of aperture 1.5 mm., breadth of aperture 1.5 mm.; α 1.56, β 2.4, γ 1, δ 0.53.

Locality—Kutugake Hot Spring¹⁾, Nagano Ken, Type (YAGI, TAKAHASI).

The outline of this characteristic snail is reminiscent of the American *Planorbis dilatatus* GOULD,²⁾ but in the American species the shell is more thickened, upper surface is more flattened, apex is scarcely sunken, the upper surface of each whorl being less inflated, transverse striae coarser, outline of the aperture somewhat triangular, and the periphery obtusely angulated so that the general view resembles a "top".

10. *Anisus (Gyraulus) biwaënsis* (PRESTON)
(Pl. XVI, Fig. 11)

1916: *Choanomphalus japonicus*, PRESTON, Ann. Mag. Nat. Hist., Ser. 8, Vol. 17, p. 160, Pl. 9, fig. 2.

1916: *Choanomphalus japonicus perstriatulus*, PRESTON, *ibid.*, p. 161, Pl. 9, fig. 1.

1916: *Planorbis (Gyraulus) biwaënsis*, PRESTON, *ibid.*, p. 161, Pl. 9, fig. 3.

1) 香掛温泉.

2) *Pl. dilatatus*, GOULD, 1841, Rep. Invert. Mass., p. 210, fig. 140.

Shell moderately thin, but not translucent, deformable, normally tricarinate, subovate, with swollen spire, colouration pale yellowish brown or whitish yellow. Whorls 3, rapidly increasing, the body whorl normally tricarinate, the middle carina being situated at the periphery, the upper and lower carinae about equidistant from it; between the carinae appear somewhat distant, microscopic, spiral striae, while the whole shell is transversely, rather finely striated. In an abnormal shell the three main carinae being less developed and the intercarinal spiral striae becoming stronger, the surface becomes less angular. Upper surface flattened, apex scarcely sunken, each whorl convex, outside of the first carina the surface of the body whorl rapidly descending obliquely. Lower surface concave, angulated at the base with the third carina; umbilicus moderately wide, deep. Aperture irregularly pentagonal in outline, angulated at the three carinal points and upper and lower ends of inner margin; inside of the aperture whitish, scarcely polished; inner margin curved, dorsal margin protruded forward angularly at the dorsal carina, receding below, sloping into ventral margin through lateral carinal point, ventral margin obtusely sinuated at the ventral carina; inclinatory angle of the aperture about 45° .

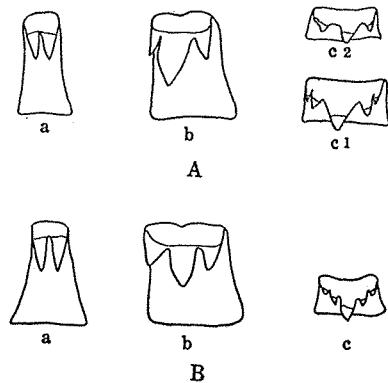
Height 2.2 mm., breadth 5.1 mm., height of aperture 2.1 mm., breadth of aperture 2 mm.; α 2.3, β 1.5, γ 0.95, δ 0.62.

Localities—Biwa-Ko, *Type* (ANNANDALE, KAWAMURA, MIYADI, UENO, MORI, and many others); Yogo-Ko, Siga Ken (MIYADI); Seta-Gawa, Siga Ken (KONDÔ); the drainage (at Nyakuôzi) connected with Biwa-Ko, Siga Ken and Kyôto (KURODA).

The distribution of this species is restricted to a rather narrow area, namely, to Biwa-Ko and the connected water system.

The outline of the shell is rather deformable, some have rows of minute chaetae arranged not only on the three main carinae but also (though rarely) on some intercarinal spiral striae and others have no such chaeta, and further in some cases the shell becomes less angular, in other cases even moderately depressed having rounded periphery and ovate aperture. But in all cases the base of shell is more or less angulated at the middle.

From these variabilities observed in this species, it seems reasonable to treat PRESTON's two species and one subspecies as one species, and further, although PRESTON described the more angular specimen as belonging to the genus *Choanomphalus*, which was re-



Text-Fig. 4

- A: Radula-teeth of *A. (Gyr.) biwaensis* (PRESTON) from Biwa-Ko.
 B: Radula-teeth of *A. (Gyr.) albus* (MÜLLER) from Syana-Numa.
 a: Central-, b: Lateral-, c: Marginal-tooth.

ported from Lake Baikal by GERSTFELDT (1859), yet after examining the radula I found this species clearly belonging to the genus *Anisus*. That is to say, the lateral tooth of the snail of the genus *Anisus* has one chief cusp and two accessory cusps, whereas that of *Choanomphalus* has one chief cusp and only one accessory cusp, and the marginal tooth of the former is pentacuspoid and that of the latter is tricuspid (THIELE, 1931, p. 478-482), and the teeth of this species have clearly the characters of the genus *Anisus* as are illustrated in Text-Fig. 4 (rarely the marginal tooth of this species is tricuspid as is shown in Text-Fig. 4, A, c2, but it is not unreasonable to consider this a rare exceptional case). PRESTON's *Pl.* (*Gyraulus*) *biwaënsis*, is described as having a less angular and more depressed shell with somewhat ovate aperture (refer to Pl. XVI, Fig. 11 f).

11. *Anisus* (*Gyraulus*) *amplificatus* n. sp.
(Pl. XVI, Fig. 12)

Shell large, thickened, aperture large, colouration dark brown, surface covered with iron-deposits, and hence opaque. Whorls 3, exceedingly rapidly increasing toward the aperture, loosely spired especially in the body whorl, so that the suture is deeply impressed. Upper surface flattened or slightly convex, each whorl convex, both inside and outside of suture the surface convex, apex not sunken, most part of upper area being occupied by the body whorl. Periphery rounded. Lower surface concave, almost whole area being occupied by the body whorl, of which surface smoothly convex, umbilicus moderate size, deep, the surface inside of suture flattened, outside convex. Aperture remarkably large, ovate, inner margin very short, scarcely curved, dorsal margin smoothly arched, ventral margin more curved than in the dorsal margin; inclinatory angle of aperture about 50°. Transverse striae coarse, irregular, often obsolete at the earlier two whorls; spiral striae indistinct.

Height 4 mm., breadth 9 mm., height of aperture 4.6 mm., breadth of aperture 5 mm.; α 2.3, β 1.86, γ 1.1, δ 0.28.

Locality—Biwa-Ko¹⁾, *Type* (YAGURA).

This is a large snail, having remarkably large and inflated body whorl, enlarged aperture. But I wonder whether this is only a full grown form of the previous species, *A. (Gyr.) biwaënsis* (PRESTON), because in some specimens the aperture has a pentagonal appearance in outline and the value of α , β and γ are very similar to those of the previous species.

12 a. *Anisus* (*Gyraulus*) *albus* (MÜLLER)
(Pl. XVI, Fig. 13; Pl. XVII, Fig. 13; Text-Fig. 4, B)

1774: *Planorbis albus*, MÜLLER, Verm. terr. fluv. Hist., Bd. 2, S. 164.

1859: *Planorbis spirillus*, GOULD, Proc. Bost. Soc. N. H., Vol. 7, p. 41.

1867: *Planorbis compressus* var. *japonicus*, v. MARTENS, Malak. Blätt., Bd. 14, S. 214.

1) 琵琶湖.

- 1877: *Planorbis compressus* var. *japonicus*, v. MARTENS, SB. Gesell. nat. Freunde Berlin, Bd. 17.
 1877: *Planorbis albus*, v. MARTENS, *ibid.*, Bd. 17.
 1886: *Planorbis neglectus*, CLESSIN, Syst. Conch. Cab. Bd. I, Abth. 17, S. 194. T. 28, fig. 5.
 1905: *Planorbis compressus japonicus*, PILSBRY et HIRASE, Proc. Acad. Nat. Sci. Philad., Vol. 57, p. 746.

Shell of moderate size, of moderate thickness or thin, opaque or translucent, remarkably deformable; body whorl inflated with rounded periphery or depressed with carinated periphery; in the latter case, the general outline of the shell somewhat symmetrical; colouration variable, being horny brown, pale yellowish, pale, or whitish yellow. Whorls 4, somewhat rapidly and regularly increasing in diameter towards the aperture, upper surface of the body whorl more depressed than lower. Upper surface flattened, each whorl convex, earlier two whorls somewhat sunken, surfaces of last two whorls lying almost in the same level, suture well impressed, and inside and outside of it the surfaces are nearly convex. Periphery rounded or remarkably carinated with minute chaetae arranged in a row on the carina. Lower surface shallowly concave, each whorl convex, suture well impressed, inside of which flattened and outside convex, in the carinated form lower surface flattened equally with upper surface. Aperture distorted elliptical or cordate, margin gently rounded or angulated; inclinatory angle of the aperture about 50-45°. Transverse striae fine, irregular; spiral striae regularly and somewhat distantly arranged or quite obsolete.

Height 2 mm., breadth 6.6 mm., height of aperture 2.4 mm., breadth of aperture 2.4 mm.; α 3.3, β 1.5, γ 1, δ 0.54.

Localities—Kimon-Numa, Hurukamappu-Numa, Sibutyari-Numa, Syana-Numa, Tôhutu-Ko, Rubetu-Numa, Naibo-Numa, Seseki-Numa, Higasibiroku-Ko, Bakko-Numa, Nikisiro-Ko (the ponds and lakes above mentioned are all in Minami-Tisima and all specimens were collected by MIYADI); Hakodate, Hokkaidô (HILGENDORF); Tôro-Ko, Hokkaidô (MIYADI); Akkesi-Ko, Hokkaidô (MIYADI); Sikaribetu-Ko, Hokkaidô (UÉNO); Naga-Numa, Miyagi Ken (MIYADI), Sai-Ko, Totigi Ken (MIYADI); Tyûzenzi-Ko, Totigi Ken (MIYADI); Usiku-Numa, Ibaragi Ken (MIYADI); Gôno-Ike, Tiba Ken (MIYADI); Tega-Numa, Tiba Ken (MIYADI); Imba-Numa, Tiba Ken (MIYADI); Ueno Tôkyô (HILGENDORF), Mukô-Zima, Tôkyô (HILGENDORF); Yokohama (v. MARTENS); Kawaguti-Ko, Yamanasi Ken (MIYADI); Nisino-Umi, Yamanasi Ken (MIYADI), Ôsawano-Ike, Kyôto (MIYADI); Kobata-Ike, Kyôto (MIYADI), a hot spring at Yunomine, Wakayama Ken (OKADA); Ryûga-Dô, a limestone cave, Kôti Ken (MORI); Koniya, Amami-Ôsima in Kagosima Ken (GOULD, KURODA); Uzantô Taiwan (MIYADI); Nanmen, Heianhoku-Dô, Tyôsen (SYÔZI).

This is the commonest and most widely distributed species in Japan (perhaps in the world), manifesting remarkable variability in the form of the shell and adaptability to environmental conditions. Namely, GOULD's *spirillus* from Ôsima (Kagosima Ken) seems to be a description of a smaller and thinner form of this species, which is more commonly distributed in

the southern parts of Japan than in the northern parts. This *spirillus*-form is also characterized by its smaller value of α (ca. 3), i. e., height is larger relative to breadth owing to the descending body whorl near the aperture, somewhat suddenly enlarged penultimate whorl by which only small parts of the surface of earlier two whorls are observable from the dorsal side, and indistinct or obsolete spiral striae. But these characters usually appear in rather small individuals of the typical specimen from northern Japan, and indeed, GOULD himself says that "very like *Pl. albus* and *deflectus*; perhaps the same that MIDDENDORF refers to under the former name, as from Kamtschatka" (GOULD, 1859)¹⁾. Also, MARTENS' *Pl. compressus* var. *japonicus*, which has long been, so far as I can judge by my present knowledge, misidentified by the Japanese conchologists, as *A. (Gyr.) hiemantium* (WESTERLUND) seems to be synonymous with *albus* (MÜLLER). I believe that the classification *compressus* var. *japonicus* was based on the depressed, well carinated form of this species, which is related to the European species, *albus acronicus* FÉRUSAC (EHRMANN, 1933), but may be distinguished easily by its smaller value of α (that of *acronicus* is 4.6-5.4) and greater value of β (that of *acronicus* is about 1.25). This *compressus*-form is also characterized by its almost symmetrical shell (refer to Pl. XVII, Fig. 13 k-o). But these characters are all within the range of normal variability of *albus*, and as already pointed out by MARTENS, "Die japanische Form erinnert an *Pl. lemniscatus*", which is considered by EHRMANN (1933) as a form of *albus acronicus*, so it may be adequate to treat this name—*compressus* var. *japonicus*—as synonymous with *albus* (MÜLLER).

Specimens from Yokohama were identified by CLESSIN (1886) with *Pl. neglectus* HASSELT,²⁾ but as this species is synonymous with Indian *Pl. compressus* HUTTON (1834)³⁾ (v. MARTENS, 1869, p. 213; CLESSIN, 1886, p. 107), the outline of which is very similar to *albus* (MÜLLER) (especially to *albus acronicus*), it may be more suitable to give the name *albus* (MÜLLER) to this specimen.

The adaptability of this snail is also considerable, and this is suggested by the wide distribution mentioned above. OKADA collected this snail in the waters of about 34' at the hot springs of Yunomine in Wakayama Ken and I collected it from the stream running in the limestone cave (Ryûga-Dô) where light was completely absent.

12 b. *Anisus (Gyraulus) albus noziriensis* n. subsp.
(Pl. XVII, Fig. 14)

Shell more thickened, stronger, the value of α smaller (height is larger relative to breadth), apex more sunken, umbilicus deeper than in *albus* s. s. Whorls 4, surface of body whorl more inflated on the lower side than on

1) Although, v. MARTENS (1877) says that "*Pl. albus* MÜLLER Schwerlich *Pl. spirillus* GOULD."

2) *Pl. neglectus*, v. HASSELT, 1823, *Algern. Konst. Letter-Bode*, 1823 (42), 244.

3) *Pl. compressus*, HUTTON, 1834, *Jour. Asist. Soc. Bengal*, III, p. 93.

the upper side; colouration variable, horny brown. Periphery more or less keeled, in some specimens (though rare) angulated obtusely at the base. Aperture distorted inflated cordiform, margin thin, lipped, whitish in colour; dorsal margin smoothly curved, ventral margin more curved than in dorsal margin, peripheral margin angulated. Transverse striae coarse; spiral striae obsolete or clearly, regularly and distantly sculptured.

Height 2.2 mm., breadth 5.9 mm., height of aperture 2.7 mm., breadth of aperture 2.4 mm.; α 2.7, β 1.47, γ 0.89, δ 0.55.

Localities—Noziri-Ko¹⁾, Nagano Ken, *Type* (KAWAMURA); Kussyaro-Ko, Tisima (MIYADI); Urumo-Ko, Tisima (MIYADI); Nisino-Umi, Yamanasi Ken (MIYADI).

The surface of the shell is often covered with iron deposits, on account of which the surface colour is subject to variation.

The outline is somewhat similar to *A. (Gyr.) amplificatus*, but may be distinguished by its smaller shell, less sunken umbilicus, and less enlarged body whorl near the aperture.

13. *Anisus (Gyraulus) gredleri* (BIELZ) (Pl. XVIII, Fig. 15)

1859: *Planorbis gredleri* BIELZ, Gredler Tirols Land- und Süsw. Moll., II, S. 9.

1883: *Planorbis (Gyraulus) illibatus*, WESTERLUND, Nachrbl. d. Deut. Malak. Gesell., Bd. 50, S. 53.

1883: *Planorbis (Gyraulus) illibatus*, WESTERLUND, Vega-Exp., Bd. 4, T. 4, fig. 14.

Shell moderately large, discoidal, somewhat thick or thin; colouration usually horny brown or reddish brown and rarely whitish yellow; glossy or dull glossy. Whorls 5, regularly increasing, somewhat enlarged near the aperture, but not so remarkably as in *albus*. Upper surface slightly concave, each whorl convex, suture impressed, inside of which surface flattened and outside, convex. Periphery rounded or slightly keeled, sometimes with minute chaetae. Lower surface concave, general outline similar to the upper surface. Aperture distorted cordate, the inside polished, horny brown, scarcely lipped, margin thin, inner margin scarcely curved, dorsal margin gently and smoothly curved, ventral margin well curved, peripheral margin angulated; inclinatory angle of the aperture about 40°. Transverse striae coarse, irregular, often obsolete; spiral striae usually obsolete, but in some cases distantly and regularly sculptured. Owing to these indistinct striations, the surface of the shell looks neat.

Height 1.8 mm., breadth 6.3 mm., height of aperture 2.5 mm., breadth of aperture 2.1 mm.; α 3.5, β 1.12, γ 0.84, δ 0.6.

Localities—Hurukamappu-Gawa, Tisima (MIYADI); Nikisiro-Numa, Tisima (MIYADI); Sironuka-Ko, Tisima (MIYADI); Tôhutu-Gawa, Tisima (MIYADI); Simusyu-Tô (MIYADI); Akkesi, Hokkaidô (Y. HIRASE); Senba-Numa near Mito, Ibaragi Ken (KAWAMURA); Ônuyo (=Ômiya), Sizuoka Ken (Vega-Exp.).

WESTERLUND'S *illibatus* from Ônuyo (=Ômiya) seems to have been

1) 野尻湖.

described on a younger form of this species (refer to Pl. XVIII, fig. 15 f, g). This species is distributed all over Europe, Siberia and Kamchatka.

This species is closely related to *albus* s. s. (MÜLLER), but the body whorl is not so much enlarged towards the aperture as in *albus* (so that the value of β is smaller), and the surface of the shell is more polished and glossy owing to less developed growth of striae.

14. *Anisus* (*Gyraulus*) *laevis infirmus* n. subsp.
(Pl. XVIII, Fig. 16)

Shell rather small, thin, opaque, fragile; colouration dark pale or light pale yellow; dull glossy. Whorls 4, somewhat irregularly spired, last two whorls remarkably inflated, so that suture deeply impressed; whorls gradually increasing, the body whorl somewhat descending, not particularly increased in breadth towards the aperture but somewhat increased in height. Upper surface flattened, or slightly convex, earlier two whorls slightly sunken, both inside and outside of suture the surfaces convex owing to inflated whorls. Periphery rounded, not carinated. Lower surface concave, body whorl exceedingly inflated so that greater part of the surface area is occupied by it, earlier two whorls deeply sunken, inside of suture the surface flattened and outside convex owing to descending spires. Aperture roundish in outline, the inside whitish, not lipped; margin thin, inner margin slightly curved, dorsal, peripheral, and ventral margins well curved, roundish in outline; inclinatory angle of the aperture about 45°. Transverse striae fine, irregular, often obsolete; spiral striae indistinct but distantly and regularly sculptured.

Height 1.6 mm., breadth 3.7 mm., height of aperture 1.7 mm., breadth of aperture 1.5 mm.; α 2.3, β 1.2, γ 0.88, δ 0.47.

Localities—A river flowing into Itubisinai-Ko¹⁾, Tisima, *Type* (MIYADI); Kantô, Manchoukuo (SIBA).

This subspecies may be distinguished from *A. (Gyr.) laevis* ALDER²⁾ by its descending body whorl and smaller value of α (this value is 3.3-4 in *laevis*). Also it may be distinguished from *albus* (MÜLLER) by its gradually increasing body whorl (in breadth), rounded periphery, scarcely sculptured spiral striae, more rounded aperture, more inflated whorls, smaller value of β , and from *albus noziriensis* by its thin, fragile and smaller shell, gradually increasing body whorl, smaller value of β , lip-less aperture, and from *gredleri* (BIELZ) by its smaller, thinner and more fragile shell, smaller value of α , pale surface, flattened or slightly convex upper surface, and inflated, descending body whorl.

1) 菱内湖流入河。

2) *Pl. laevis*, ALDER, 1838, Trans. Nat. Hist. Soc. Northumb., II, p. 337.

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Explanation of Plates

Plate XII

- Fig. 1 *Camptoceras* (*Culmenella*) *prashadi* (CLENCH). Tôkyô. H. 6.1 mm., B. 3.4 mm. a—dorsal view, b—ventral view.
- Fig. 2 *Camptoceras* (*Camptoceras*) *hirasei* WALKER. Kôka-Mura near Ôsaka. H. 8.6 mm., B. 2.2 mm. a—dorsal view, b—ventral view.
- Fig. 3 *Anisus* (*Segmentina*) *nitidellus* (v. MARTENS). Tokushima. H. 2.2 mm., B. 5.3 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.

Plate XIII

- Fig. 4 *Anisus* (*Segmentina*) *usta* (GOULD). Ryûtan in Syuri. H. 3.3 mm., B. 8.7 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture, f—front view of young snail (B. ca. 4 mm.), g—inside of the body whorl showing three lamellae.
- Fig. 5 *Anisus* (*Segmentina*) *usta swinhoei* (H. ADAMS). Tainan. H. 3.4 mm., B. 7.8 mm. a—dorsal view, b—front view, c—lateral view, d—aperture.

Plate XIV

- Fig. 6 *Anisus* (*Hippcutis*) *peipinensis* (PING et YEN).
- a-c from Syôgen (typical form). H. 2.1 mm., B. 8.4 mm. a—dorsal view, b—ventral view, c—front view.
- d-h from Taityû (more conoidal and involuted form). H. 1.8 mm., B. 7 mm.

- d—dorsal view, e—ventral view, f—front view, g—lateral view, h—aperture.
 Fig. 7 *Anisus (Gyraulus) pulcher*, n. sp. Type. Awazi-Sima. H. 1.1 mm., B. 4.3 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.

Plate XV

- Fig. 8 *Anisus (Gyraulus) tōkyōensis*, n. sp. Type. Tōkyō. H. 1.7 mm., B. 7.6 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.
 Fig. 9 *Anisus (Gyraulus) hiemantium* (WESTERLUND). Kyōto. H. 1.8 mm., B. 7.1 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.
 Fig. 10 *Anisus (Gyraulus) magnistomus* n. sp. Type. Kutugake Hot Spring. H. 1.3 mm., B. 2.8 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.

Plate XVI

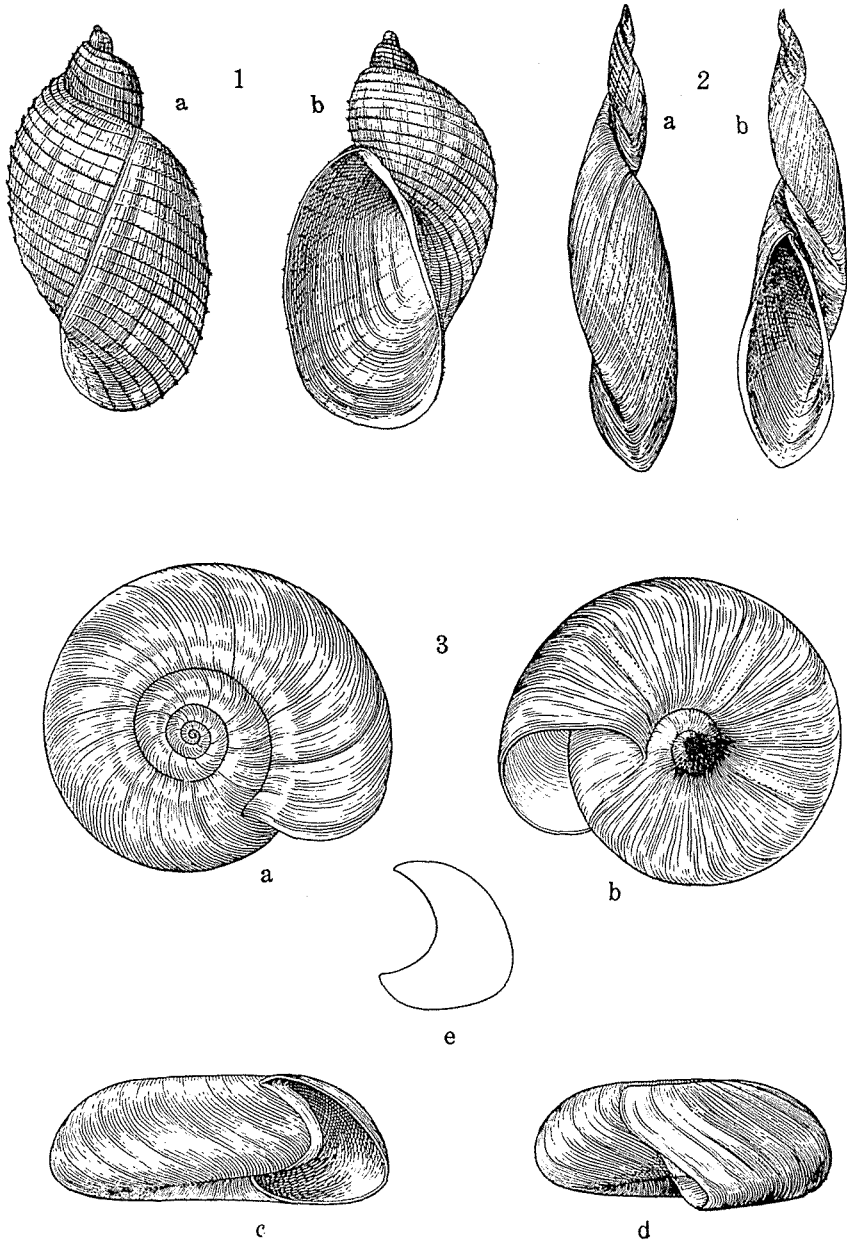
- Fig. 11 *Anisus (Gyraulus) biwaënsis* (PRESTON).
 a-e from Yogo-Ko (typical form) H. 2.2 mm., B. 5.1 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.
 f from Biwa-Ko (intermediate form between PRESTON'S *Choanomphalus japonicus perstriatulus* and *Planorbis biwaënsis*).
 Fig. 12 *Anisus (Gyraulus) amplificatus* n. sp. Type. Biwa-Ko. H. 4 mm., B. 9 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.
 Fig. 13 *Anisus (Gyraulus) albus* (MÜLLER). Kimon-Numa. Typical form. H. 2 mm., B. 6.6 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.

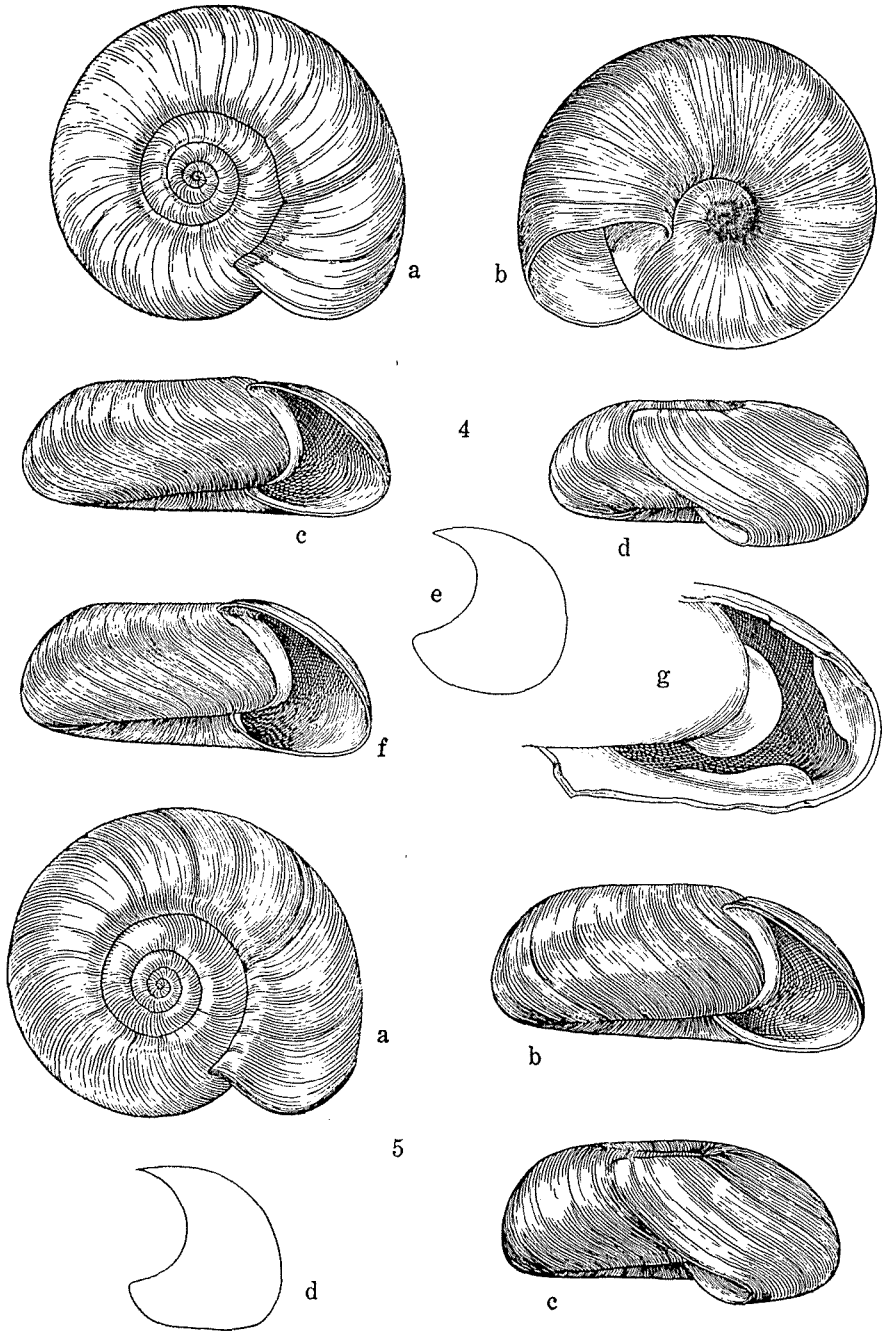
Plate XVII

- Fig. 13 *Anisus (Gyraulus) albus* (MÜLLER).
 f-j from Amami-Ōsima (GOULD'S *spririllus* type). H. 1.3 mm., B. 4.1 mm. f—dorsal view, g—ventral view, h—front view, i—lateral view, j—aperture.
 k-o from Akan-Ko (FÉRUSAC'S *acronicus* type). H. 2 mm., B. 7.1 mm. k—dorsal view, l—ventral view, m—front view, n—lateral view, o—aperture.
 Fig. 14 *Anisus (Gyraulus) albus noziriensis*, n. subsp. Type. Noziri-Ko. H. 2.2 mm., B. 5.9 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.

Plate XVIII

- Fig. 15 *Anisus (Gyraulus) gredleri* (BIELZ).
 a-e from Akkesi (adult snail). H. 1.8 mm., B. 6.3 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.
 f-g from Tiba-Numa near Mito (young snail). This bears striking resemblance to WESTERLUND'S *illibatus*. f—dorsal view, g—ventral view.
 Fig. 16 *Anisus (Gyraulus) laevis infirmus* n. subsp. Type. Itubisinai-Ko. H. 1.6 mm., B. 3.7 mm. a—dorsal view, b—ventral view, c—front view, d—lateral view, e—aperture.





S. MORI del.

