

A Preliminary Note on the Glochidia of Japanese Freshwater Mussels.

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Although the species of the Unionid mussels of Japan, including Honkoku, Korea, and Formosa, is more than forty in number, a few of them have been intimately studied as their life histories are clear. The collection of the present writer contains the representative specimens of ten genera and three species, but his knowledge on the glochidia is limited to some twenty species.

The measurement of these glochidia was generally done on the living mussel, excepting some specimens from Korea and Hokkaido. Here the length represents the transverse span across the widest part of the glochidial shell between the anterior and the posterior edges, parallel to the hinge line, while the depth denotes a distance from the highest point of the hinge to the extreme ventral margin of the glochidium, however, is subject to striking variations and such divergence is remarkable even between the individuals of the same species, for instance the glochidium of *Anodonta japonica* was 0.271 by 0.243 mm in the smallest.

In Japan there can be recognized two well-marked morphological types of glochidium: one, which occupies the majority of the family with heavy trivalves which are equipped with a stout spine at the ventral apex (so-called *Anodonta* type), and the other, a smaller group, generally of a contour of a spoon bowl without any spines (so-called *Lamprosis* type). The other peculiar type known from America (*Proptera* type) has never been found in Japan so far as I know.

In the following description of Japanese glochidia no attempt has been made to arrange the species systematically, an alphabetical arrangement being considered rather preferable. (Plate 1, 2)

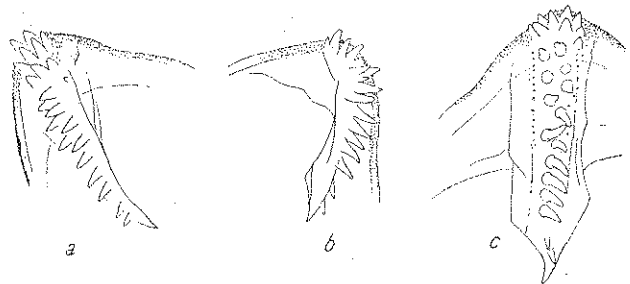


Fig. 1. a, c. Glochidial teeth of *Anodonta acuminata*

Before going further, I wish to offer my sincere thanks to Prof. T. Kawamura for his guidance. My special thanks are also due to Mr. T. Kuroda for the identification of ambiguous species as well as for many valuable suggestions.

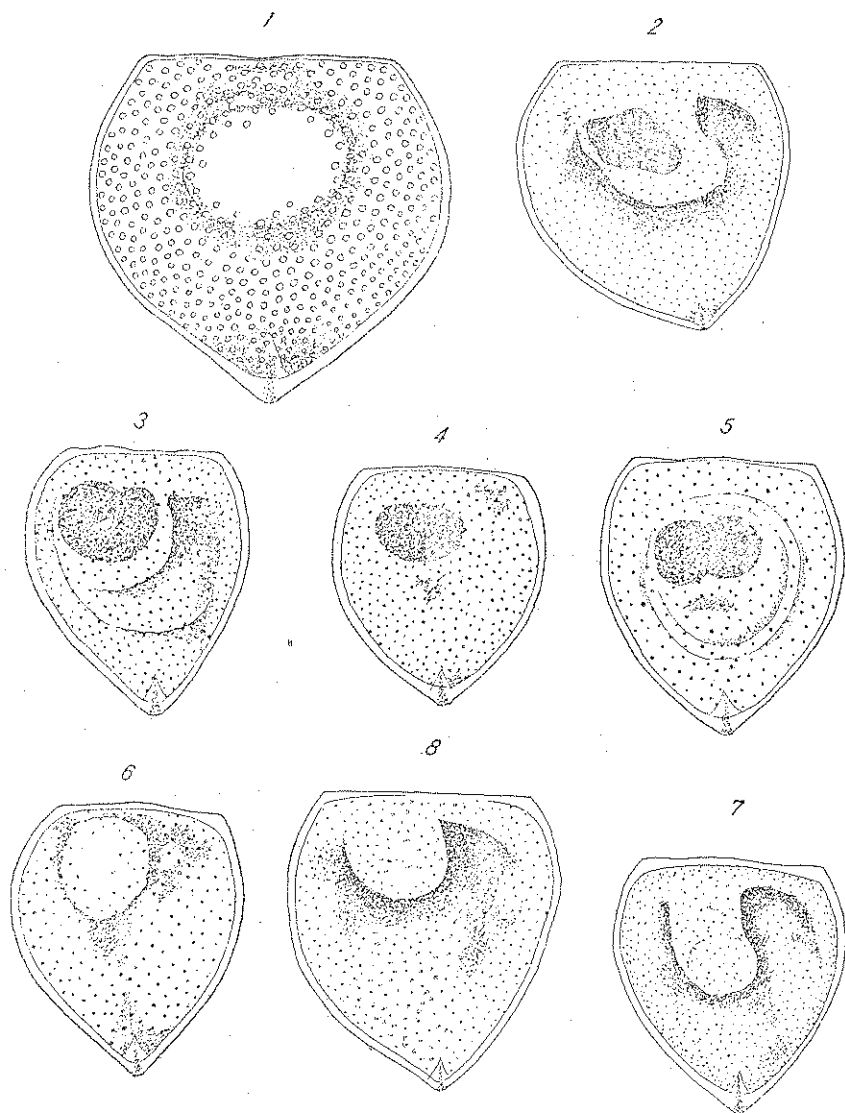


Fig. 1. Glochidium of *Anodonta arcuiformis* (HEUDE).  
 Fig. 2. Glochidium of *Anodonta beringiana* MIDDENDORFF.  
 Fig. 3. Glochidium of *Anodonta woodiana collygus* KORBEL.  
 Fig. 4. Glochidium of *Anodonta japonica* CHESSIN.  
 Fig. 5. Glochidium of *Anodonta woodiana hata* v. MALTENS.  
 Fig. 6. Glochidium of *Anodonta woodiana hata tamenoi* HAAS.  
 Fig. 7. Glochidium of *Cristaria discolor* (LEA).  
 Fig. 8. Glochidium of *Cristaria hercules* (MIDDENDORFF).

(1) *Anodonta arcaiformis* (Heude). Plate 1, Fig. 1.

Glochidium: large *Anodonta* type; subtriangular with a spine at the tip of valve, hinge line irregular, length greater than depth;  $0.380 \times 0.398$  mm. and its hinge line  $0.287$  mm. or  $0.335 \times 0.359$  mm. and hinge line  $0.240$  mm. When grown to larger size this glochidium could hardly be distinguished from other glochidium *Anodonta* type. The masses of glochidia: thick oval plate like, and its colour strong brown.

Host: unknown. Locality of specimens: Lake Biwa off Hikone, collected April 19, 1938 and on December 18, 1938, both by the author.

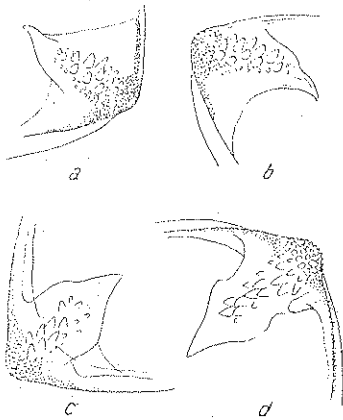
(2) *Anodonta beringiana* Middendorff. Plate 1, Fig. 2.

Fig. 2. a, b, c, d. Glochidial teeth of *Anodonta japonica*.

Glochidium: *Anodonta* type; rather subtriangular with a spine at the tip of valve, hinge line nearly straight, depth length about equal; one specimen  $0.296$  mm. and its hinge line  $0.222$  mm., the other  $0.290$  mm. and its hinge line  $0.229$  mm. mass of glochidia is thick oval plate like; colouration is perhaps brown or buff. Host: unknown. Locality of specimens: Pond Kamayji, Island Kumashiri, collected by Dr. Enata on August 31, 1934.

(3) *Anodonta woodiana* (Claus) Kobelt. Plate 1, Fig. 3.

Glochidium: *Anodonta* type, slightly subtriangular with a spine at the tip of valve, hinge line irregular, depth greater than length;  $0.298$  mm. and its hinge line  $0.180$  mm. or  $0.265$  mm. and its hinge line  $0.191$  mm. mass of glochidia: thick oval plate like and white or buff colour.

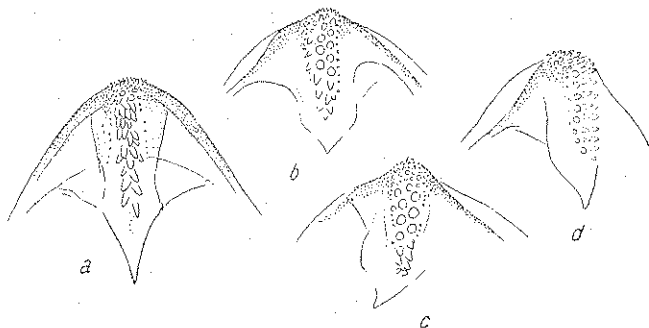


Fig. 3. a, b, c, d. Glochidial teeth of *Anodonta taeniata*.

Host: unknown. Locality of specimens: Lake Biwa off Hikone, collected on June 27, 1938, and on December 5, 1938, both by the author.

(4) *Anodonta japonica* Clessin. Plate 1, Fig. 4.

Glochidium: *Anodonta* type; medium size, subtriangular with a spine at the tip of each valve, hinge line nearly straight or somewhat undulating, depth greater than length;  $0.298$  mm. and its hinge line  $0.180$  mm. or  $0.265$  mm. and its hinge line  $0.191$  mm. mass of glochidia: thick oval plate like and white or buff colour.

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length;  $0.258 \times 0.232$  mm. with hinge line 0.178 mm. or  $0.271 \times 0.243$  mm. with line 0.167 mm. The mass of glochidia is thick oval plate-like, and brown in color. This glochidium closely resembles in general outline that of the other species of *Anodonta*, but may be distinguished by its smaller size and its smaller somewhat pressed adductor muscle. The hosts of this mussel are the fishes belong to the Cyprinidae, such as *Acheilognathus* sp. on which it occurs as a fin parasite.

Locality of Specimens: a river near Nikimura, Gifu Pref., collected on Sept

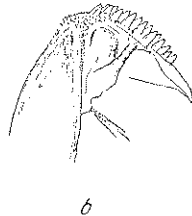
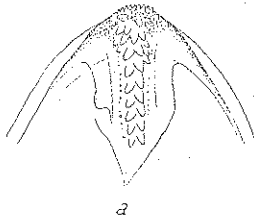


Fig. 4. a, b. Glochidial teeth of *Anodonta woodiana lauda tumens*

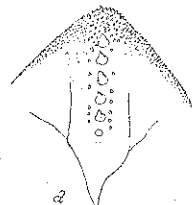


Fig. 5. a, b. Glochidial teeth of *Anodonta woodiana calipygos*

7, 1938 and also a river near Takegahama, Gifu Pref., on September 6, 1938 and 28, 1938, all by the author.

(5) *Anodonta woodiana lauda* v. Martens. Plate 1, Fig. 5.

Glochidium: *Anodonta* type; slightly large, subtriangular with a spine at the apex of each valve, hinge line undulating, occasionally a little curved, depth greater than length;  $0.303 \times 0.268$  mm. and hinge line 0.202 mm. The glochidia of the allied species: *calipygos*, *japonica* and *lauda*, as mentioned above, are similar in shape, they are more or less different in the external feature of spines which are provided with characteristic teeth. This point must be carefully examined for the identification of the glochidia of the *Anodonta* type. Regarding to a variety of *lauda* occurring in the Kansai region nothing can be suggested herewith.

The masses of glochidia: thick oval plate like, and its coloration: buff or bluish or dense brown.

Host: unknown. Locality of specimen: a river near Ōgaki, Gifu Pref., collected on April 23, 1938 by the author.

(6) *Anodonta woodiana lauda tumens* Haas. Plate 1, Fig. 6.

Glochidium: as stated in *A. lauda*, but only different in the proportion;  $0.296 \times 0.258$  mm. and hinge line 0.180 mm. or  $0.277 \times 0.243$  mm. and hinge line 0.170 mm.

Host: unknown.

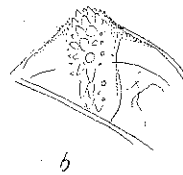


Fig. 6. a, b, c. Glochidial teeth of *Cristaria plicata sinuata*

Locality of specimens: Lake Biwa off Otsu, collected on May 3, 1938, Lake Matsukawa (annex to L. Biwa) near Hikone, on April 13, 1938, all by the author.

(7) *Cristaria discoidea* (Lea). Plate 1, Fig. 7.

Glochidium: *Anodonta* type; slightly large; subtriangular with a spine at the each valve, hinge line irregular, depth greater than length;  $0.277 \times 0.259$  mm. and hinge line 0.203 mm. The mass of glochidia is thick oval plate-like and redbrown in color.

Host: unknown. Locality of specimens: River Daidōkō near Jidō, Korea, collected on May 30, 1939 by the author.

(8) *Cristaria herculea* (Middendorff). Plate 1, Fig. 8.

Glochidium: *Anodonta* type; rather large, subtriangular with a spine at the tip of each valve, hinge line nearly straight, depth greater than length;  $0.327 \times 0.30$  mm. and its hinge line 0.222 mm. The mass of glochidia is thick oval plate like perhaps brown or buff in color.

Host: unknown. Locality of specimens: Lake Naibo, Island of Itrup, collected on by Dr. Miyadi on August 10, 1932.

(9) *Cristaria plicata spatiosa* (Clessin). Plate 2, Fig. 9.

Glochidium: *Anodonta* type; rather large, subtriangular with a spine at the tip of each valve, hinge line long and irregular, depth greater than length;  $0.330 \times 0.284$  mm. and hinge line 0.221 mm. or  $0.312 \times 0.300$  mm. and hinge line 0.214 mm. or 0.284 mm. and hinge line 0.213 mm. In general outline this glochidium resembles that of the other species of *Anodonta*, but has a sharper tip on the ventral margin. The mass of glochidia: thick oval plate like and white or buff in colour.

Host: unknown. Locality of specimens: Lake Matsubara near Hikone, collected on November 21, 1938; Lake Iba (also annex to L. Biwa) near Azuchi, collected on December 22, 1938; Lake Biwa off Anamura, on October 25, 1938, all by the author.

(10) *Hyriopsis schlegelii* (v. Martens). Plate 2, Fig. 10.

Glochidium: *Lampilis* type; slightly large, semi-elliptical with a rounded ventral margin, without any spines at the tip of each valve, hinge line rather long and nearly straight or slightly curved, depth greater than length;  $0.273 \times 0.233$  mm. and hinge line 0.166 mm. or  $0.258 \times 0.218$  mm. and hinge line 0.152 mm. The mass of glochidia is thick oval plate-like and milky white in colour.

Host: unknown. Locality of specimens: a pond at a pearl-culture plant near Anamura, collected on May 4, 1939 and an annex lake to L. Biwa near Anamura, collected on May 5, 1938, both by the author. This mussel is endemic in Lake Biwa and seems to have a very restricted distribution around the Bay of Azuchi.

(11) *Inversidens brandtii* (Kobelt). Plate 2, Fig. 11.

Glochidium: *Lampilis* type; medium size, almost circular with a rounded ventral margin, without any spines at the tip of each valve, hinge line fairly curved, depth greater than length;  $0.222 \times 0.203$  mm. and hinge line 0.113 mm. The mass of glochidia is thin plate-like and gloomy yellow in colour.

Host: unknown. Locality of specimens: Lake Biwa off Hikone, collected on June 26, 1939 by the author.

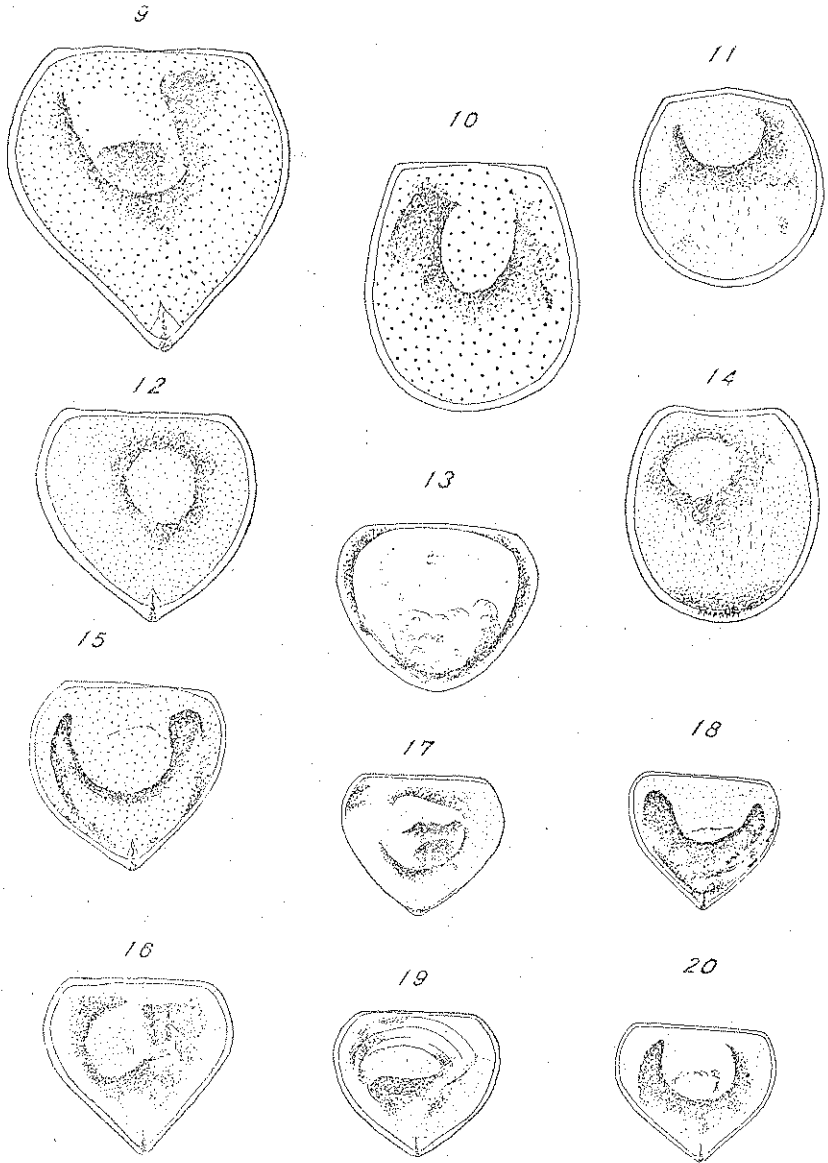


Fig. 9. Glochidium of *Cristaria plicata spatiosa* (CLESSIN).  
 Fig. 10. Glochidium of *Hyriopsis schlegelii* (V. MARTENS).  
 Fig. 11. Glochidium of *Inversidens brandtii* (KOBELT).  
 Fig. 12. Glochidium of *Inversidens kirawae* (HAAS).  
 Fig. 13. Glochidium of *Inversidens japonensis hokkaidensis* (V. IJERING).  
 Fig. 14. Glochidium of *Inversidens japonensis* (LEA). (VAR. *hokkaidensis* V. IJERING).  
 Fig. 15. Glochidium of *Lonecolaria cororhyncha* (V. MARTENS).  
 Fig. 16. Glochidium of *Lonecolaria gladiolus* (HEDD).  
 Fig. 17. Glochidium of *Unio bicuc* KOBELT.  
 Fig. 18. Glochidium of *Unio douglasiae* GIFFITH ET PIDGEON.  
 Fig. 19. Glochidium of *Unio douglasiae nipponensis* V. MARTENS.  
 Fig. 20. Glochidium of *Unio douglasiae verrucifer* V. MARTENS.

(12) *Inversidens kirasei* (Haas). Plate 2, Fig. 12.

Glochidium: *Anodonta* type; medium size, glochidial shell slightly inflated thickness, subtriangular with a spine at the tip of each valve, hinge line straight, depth and length about equal;  $0.229 \times 0.239$  mm. and hinge line 0.1 mm. The mass of glochidia is plate-like and milky white or cream in colour.

Host: unknown. Locality of specimens: Lake Biwa off Hikone, collected December 16, 1938 by the author.

(13) *Inversidens japonensis lacouensis* (v. Ihering). Plate 2, Fig. 13.

Glochidium: *Lampsilis* type; rather small, somewhat semicircular, but its length in proportion to its depth, hence rather reminding an *Anodonta* type, ventral margin obliquely rounded and without any spines at the tip of each valve, hinge line nearly straight, length greater than depth;  $0.185 \times 0.222$  mm. and hinge line 0.1 mm. In general shape this glochidium seems to be intermediate between the *L.* group and the *Anodonta* group. The mass of glochidia is thin plate-like and white in colour.

Host: unknown. Locality of specimens: a river near Karasue, Gifu Prefecture on June 19, 1939 by the author.

(14) *Inversidens japonensis* (Lea) var. (*Inversidens japonensis lamensis* v. Ihering). Plate 2, Fig. 14.

Glochidium: *Lampsilis* type; medium size, semi-elliptical, ventral margin without any spines, but with some zigzag teeth along the ventral margin at the tip of each valve, hinge line slightly depressed rather short, depth greater than length;  $0.231 \times 0.214$  mm. and hinge line 0.140 mm. This glochidium bears a slight resemblance to that of *Hyriopsis schlegelii*, but can be distinguished from this by that the hinge line is shorter and slightly depressed and the general contour rather constricted either above and below the hinge line. The mass of glochidia is plate-like and milky white in colour.

Host: unknown. Locality of specimens: Lake Biwa off Hikone, collected May 21, 1938 by the author.

(15) *Inversidens reiniana* (Kobelt).

Glochidium: *Anodonta* type; medium, slightly inflated in thickness, subtriangular with a spine at the tip of each valve, hinge line nearly straight, depth and length about equal;  $0.240 \times 0.245$  mm. and hinge line 0.185 mm. In spite of the abundance of shells observed, their glochidia has been rarely discovered.

The masses of glochidia: plate like, and its colouration: milky white or cream.

Host: unknown. Locality of specimens: Lake Biwa off Hikone, collected November 21, 1938 by the author.

(16) *Lanceolaria acrorhyncha* (v. Martens). Plate 2, Fig. 15.

Glochidium: *Anodonta* type; rather small, slightly inflated in thickness, subtriangular with a spine at the tip of each valve, hinge line nearly straight, depth and length about equal;  $0.203 \times 0.222$  mm. and hinge line 0.157 mm. The glochidia

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this species is more larger than the other two species, *gladiolus* and *acryphucha*, its length is proportionally greater than its depth. The mass of glochidia is cylindrical, and its colouration: milk white.

Host: unknown. Locality of specimens: River Daidoko near Jido, Korea, lected on May 30, 1939 by the author.

(17) *Lanceolaria gladiolus* (Heude). Plate 2, Fig. 16.

Glochidium: *Anodonta* type; rather small, slightly inflated in thickness, subtriangular with a spine at the tip of each valve, hinge line straight or nearly so, d and length about equal;  $0.193 \times 0.208$  mm. and hinge line 0.147 mm.. In general line this can be distinguished by its more pointed tip of valves from the glochidium *Unio*. The mass of glochidia is cylindrical and deep pink or dense brown in color.

Host: unknown. Locality of specimens: River Nagara near Takegahana, Prof., collected on July 28, 1938 by the author.

(18) *Lanceolaria acryphucha* (v. Martens).

Glochidium: as stated in *gladiolus* for reference, namely the proportion in pre-glochidium of this species was  $0.164 \times 0.164$  mm. and hinge line 0.154 mm., hence is not larger than that of *gladiolus*. The mass of glochidia is cylindrical and yellow sometimes vermilion in colour.

Host: unknown. Locality: Lake Biwa off Hikoné, collected on September 9, 1931 by the author.

(19) *Unio bivae* Kobert. Plate 2, Fig. 17.

Glochidium: *Anodonta* type; small, fairly inflated in thickness, subtriangular without any spines, but with zigzag teeth along the ventral margin at the tip of each valve, hinge line long and straight, length greater than depth;  $0.153 \times 0.175$  mm. hinge line 0.133 mm. This glochidium is similar in size and shape to that of *douglasae* but characterized by its spineless shell. The mass of glochidia is plate-like and milky white or gloomy cream in colour.

Host: unknown. Locality is Lake Biwa off Hikoné, collected on May 29, 1931 by the author.

(20) *Unio douglasiae* Griffith et Pidgeon. Plate 2, Fig. 18.

Glochidium: *Anodonta* type; small, slightly inflated in thickness, subtriangular with a spine at the tip of each valve, hinge line long and nearly straight, length greater than depth;  $0.147 \times 0.166$  mm. and hinge line 0.139 mm. The mass of glochidia: plate-like and light red brown in colour.

Host: unknown. Locality of specimens: River Kwanko near Roryoshin, Korea collected on May 27, 1939 by the author.

(21) *Unio douglasiae nipponensis* v. Martens. Plate 2, Fig. 19.

Glochidium: as stated in regard to the foregoing *douglasiae* Griffith et Pidgeon differing only in proportion; namely,  $0.151 \times 0.177$  mm. and hinge line 0.138 mm. c  $0.156 \times 0.181$  mm. and hinge line 0.131 mm.



Many adult shells of this species were easily obtained at any time. The glochidia is plate-like and buff in colour.

Host: unknown. Locality of specimens: a river near Ôgaki, Gifu Pref., on May 15, 1938 and also May 7, 1938 by the author.

(22) *Unio douglasiae verrucifer* v. Martens. Plate 2, Fig. 20.

Glochidium: as stated in regard to the foregoing *douglasiae* Griffith is differing only in proportion; namely,  $0.148 \times 0.176$  mm. hinge line  $0.148$  mm. Glochidium of *douglasiae* is fairly similar in contour to that of *douglasiae*. The mass of glochidia is thin plate-like, and red brown in colour.

Host is unknown. Locality of specimens: River Daidoko near Jido, collected on May 30, 1939 by the author.

Remarks: As mentioned above, the presence of the teeth on the external spine, as well as a rim connected with the lateral wings are clear evidences for the identification of all glochidia of *Anodonta* type. The teeth regularly arranged in from three to six rows. Each tooth is extremely conical and can be observed in the profile only. According to my own study glochidial teeth of *Anodonta arcuiformis*, *A. japonica*, *A. lutea*, *A. calypygus* or *plicata spatiosa*, etc. are more or less dissimilar to each another. But the classification of such species by the nature of the teeth shall need more detailed inquiry.

#### A KEY FOR IDENTIFICATION OF UNIONID GLOCHIDIA.

##### I. *Anodonta* type;

Glochidium subtriangular, usually with one or more spines at the tip of

##### A. Glochidium with spines.

##### 1. Depth greater than length.

##### a. Hinge line nearly straight.

##### i. Size rather large.

*Cristaria herculca* (Middendorff), (fig. 8),  $0.327$  by  $0.303$  mm.

##### ii. Size medium.

*Anodonta japonica* Clessin, (fig. 4),  $0.258$  by  $0.232$  mm.

##### b. Hinge line irregular, undulate.

##### i. Size rather large.

*Cristaria plicata spatiosa* (Clessin), (fig. 9),  $0.330$  by  $0.307$  mm.

##### ii. Size slightly large,

*Anodonta woodiana lutea* v. Martens, (fig. 5),  $0.303$  by  $0.26$

*Anodonta woodiana lutea tumens* Haas, (fig. 6),  $0.296$  by  $0.2$

*Anodonta woodiana calypygus* Kobelt, (fig. 3),  $0.298$  by  $0.24$

? *Cristaria discoidea* (Lea), (fig. 7),  $0.277$  by  $0.259$  mm.

##### 2. Depth and length about equal.

##### a. Hinge line straight, or nearly so.

##### i. Size rather large.

*Anodonta beringiana* Middendorff, (fig. 2),  $0.296$  by  $0.296$  mm.

##### ii. Size medium.

*Inversidens livaszi* (Haas), (fig. 12),  $0.229$  by  $0.233$  mm.

*Inversidens reiniana* (Kobelt),  $0.240$  by  $0.245$  mm.

##### iii. Size rather small.

*Lanceolaria arrorhyncha* (v. Martens), (fig. 15),  $0.203$  by  $0.203$  mm.

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- Lanceolaria gladiolus* (Heude), (fig. 16), 0.193 by 0.208 mm.  
*Lanceolaria wuyghyacha* (v. Martens), (fig. 20), ? 0.164 by 0.164 mm.
3. Length greater than depth.
    - a. Hinge line straight, or nearly so.  
Size small.  
*Unio douglasiae* Griffith et Bidgeon, (fig. 18), 0.147 by 0.166 mm  
*Unio douglasiae nipponensis* v. Martens, (fig. 19), 0.151 by 0.177 mm  
*Unio douglasiae verrucifer* v. Martens, (fig. 20), 0.148 by 0.176 mm
    - b. Hinge line irregular undulate.  
Size large.  
*Anodonta arcuiformis* (Heude), (fig. 1), 0.380 by 0.398 mm.
  - B. Glochidium without spines, only with teeth along the ventral margin of each.
    4. Length greater than depth.
      - a. Hinge line straight, or nearly so.  
Size small.  
*Unio biwa* Kobelt, (fig. 17), 0.153 by 0.175 mm.
- II. *Lamprosis* type;  
Glochidium semi-elliptical, or semi-circular; ventral margin rounded; no teeth present.  
Glochidium without spines nor teeth.
  1. Depth greater than length.
    - a. Hinge line nearly straight.  
Size slightly large; glochidium semi-elliptical; ventral margin rounded.  
*Hyriopsis schlegelii* (v. Martens), (fig. 10), 0.273 by 0.233 mm.
    - b. Hinge line fairly curved.  
Size medium; glochidium almost circular; ventral margin rounded.  
*Hyrioidens brandtii* (Kobelt), (fig. 11), 0.222 by 0.203 mm.
  2. Length greater than depth.
    - a. Hinge line nearly straight.  
Size rather small; glochidium slightly semi-circular; ventral margin obliquely rounded.  
*Hyrioidens japonensis lacuensis* (v. Ihering), (fig. 13), 0.185 by 0.22 mm.
  - Glochidium without spines, but with teeth along the ventral margin of each.
  3. Depth greater than length.
    - a. Hinge line slightly depressed.  
Size medium; glochidium semi-elliptical; ventral margin rounded.  
*Hyrioidens japonensis* (Lea) var. (var. *jokohamensis* v. Ihering). (fig. 12), 0.231 by 0.214 mm.

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