# A Preliminary Note on the Glochidia of Japanese Freshwater Mussels.

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Although the species of the Unionid mussels of Japan, including Hokkaido, Korea, and Formosa, is more than forty in number, a few of them have been so intimately studied as their life histories are clear, The collection of the mussels by the present writer contains the representative specimens of ten genera and thirty 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 materials, excepting some specimens from Korea and Hokkaido. Here the length means a 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 vertical distance from the highest point of the hinge to the extreme ventral margin. The glochidium, however, is subject to striking variations and such divergence in size 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 the glochidium: one, which occupies the majority of the family with heavy triangular valves 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 bowel without any spines (so-called *Lampsilis* 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)

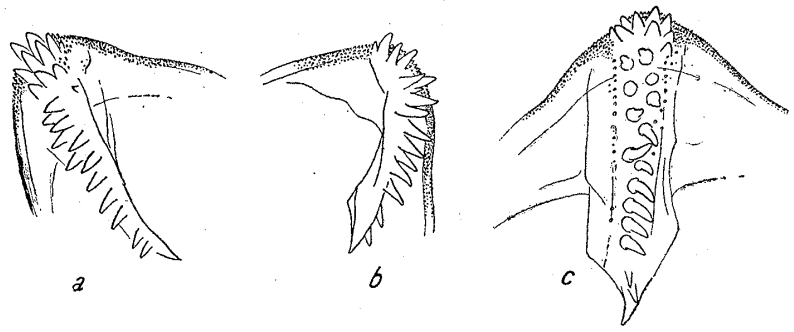


Fig. 1, a, c. Glochidial teeth of *Anodonta arcaeformis*

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

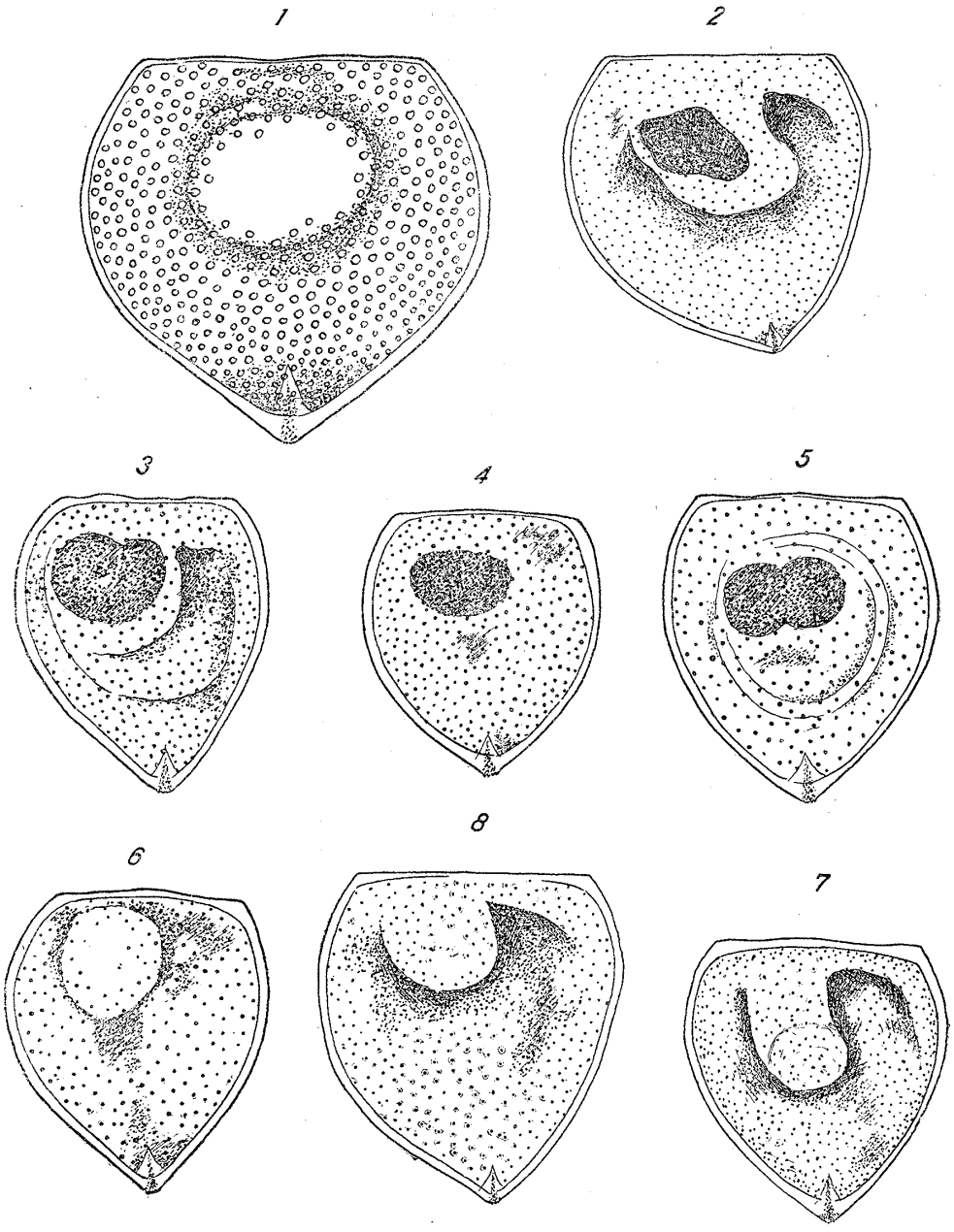


Fig. 1. Glochidium of *Anodonta arcaeformis* (HEUDE).
Fig. 2. Glochidium of *Anodonta beringiana* MIDDENDORFF.
Fig. 3. Glochidium of *Anodonta woodiana calipygos* KOBELT.
Fig. 4. Glochidium of *Anodonta japonica* CLESSIN.
Fig. 5. Glochidium of *Anodonta woodiana lauta* v. MARTENS.
Fig. 6. Glochidium of *Anodonta woodiana lauta tumens* HAAS.
Fig. 7. Glochidium of *Cristaria discidea* (LEA).
Fig. 8. Glochidium of *Cristaria herculea* (MIDDENDORFF).

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

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

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

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

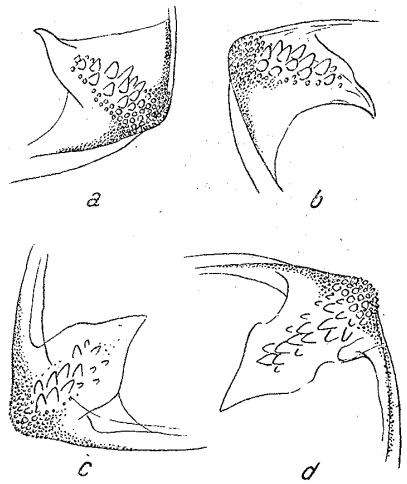


Fig. 2, a, b, c, d. Glochidial teeth of *Adodonta japonica*.

Glochidium: *Anodonta* type; rather large, subtriangular with a spine at the tip of each valve, hinge line nearly straight, depth and length about equal; one specimen 0.296×0.296 mm. and its hinge line 0.222 mm., the other 0.291 ×0.290 mm and its hinge line 0.229 mm. The mass of glochidia is thick oval plate like and its colouration is perhaps brown or buff. Host: unknown. Locality of specimens. Pond Furukamapp, Island Kunashir, collected by Dr. Miyadi on August 31, 1934.

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

Glochidium: *Anodonta* type, slightly large, subtriangular with a spine at the tip of each valve, hinge line irregular, depth greater than length; 0.298×0.247 mm. and its hinge line 0.180 mm. or 0.313×0.265 mm. and hinge line 0.191 mm. The mass of glochidia is thick oval plate-like and white or buff in colour.

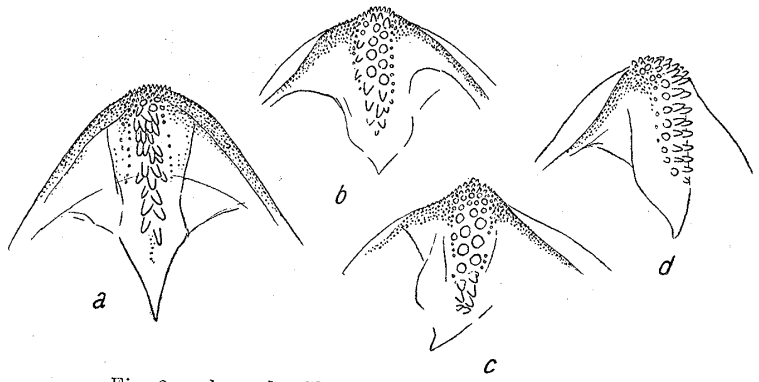


Fig. 3. a, b, c, d. Glochidial teeth of *Anodonta lauta*

Host: unknown. Locality of specimens: Lake Biwa off Hikoné, 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; 0.258×0.232 mm. with hinge line 0.178 mm. or 0.271×0.243 mm. with hinge line 0.167 mm.. The mass of glochidia is thick oval plate-like, and brown in colour. 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 depressed adductor muscle. The hosts of this mussel are the fishes belong to the family Cyprinidae, such as *Acheilognathus* sp. on which it occurs as a fin parasite.

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

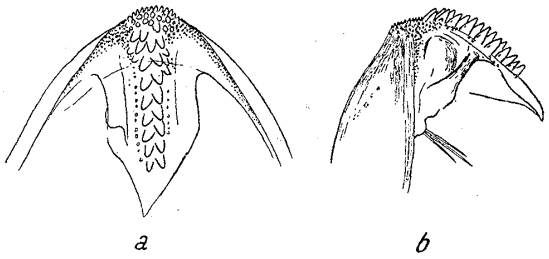


Fig. 4. a, b. Glochidial teeth of *Anodonta woodiana lauta tumens*

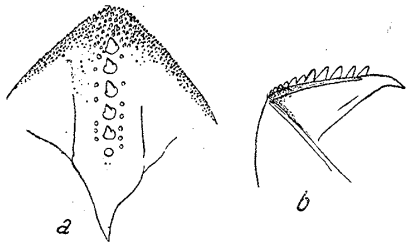


Fig. 5. a, b. Glochidial teeth of *Anodonta woodiana calipygos*

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

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

Glochidium: *Anodonta* type; slightly large, subtriangular with a spine at the tip of each valve, hinge line undulating, occasionally a little curved, depth greater than length; 0.303×0.268 mm. and hinge line 0.202 mm. The glochidia of the allied three species: *calipygos*, *japonica* and *lauta*, as mentioned above, are similar in shape, but 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 *lauta* occurring in Kwansai region nothing can be suggested herewith.

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

Host: unknown. Locality of specimen: a river near Ôgaki, 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. lauta*, only different in the proportion; 0.296 × 0.258 mm. and hinge line 0.180 mm. or 0.277×0.243 mm. and hinge line 0.170 mm.

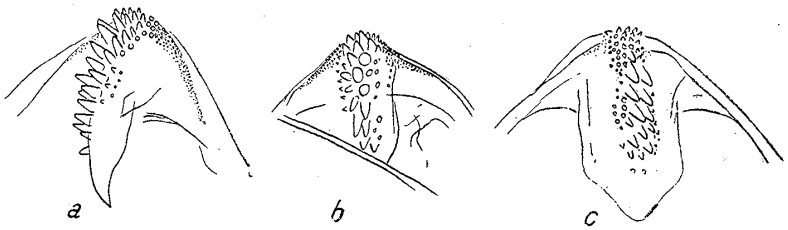


Fig. 6. a, b, c. Glochidial teeth of *Cristaria plicata sygaliosa*

Host: unknown. Locality of specimens: Lake Biwa off Otsu, collected on May 3, 1938, Lake Matsubara (annex to L. Biwa) near Hikoné, 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 tip of each valve, hinge line irregular, depth greater than length; 0.277×0.259 mm. and hinge line 0.203 mm. The mass of glochidia is thick oval plate-like and redbrown in colour.

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; 0.327×0.303 mm. and its hinge line 0.222 mm. The mass of glochidia is thick oval plate like, and perhaps brown or buff in colur.

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; 0.330×0.307 mm. and hinge line 0.221 mm. or 0.312×0.300 mm. and hinge line 0.214 mm. or 0.318×0.284 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 Hikoné, collected on November 21, 1938; Lake Iba (also annex to L. Biwa) near Azuchi, on December 22, 1938; Lake Biwa off Anamura, on October 25, 1938, all by the author.

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

Glochidium: *Lampsilis* 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; 0.273×0.233 mm. and hinge line 0.166 mm. or 0.258×0.218 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, 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: *Lampsilis* 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; 0.222×0.203 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 Hikoné, collected on June 26, 1939 by the author.

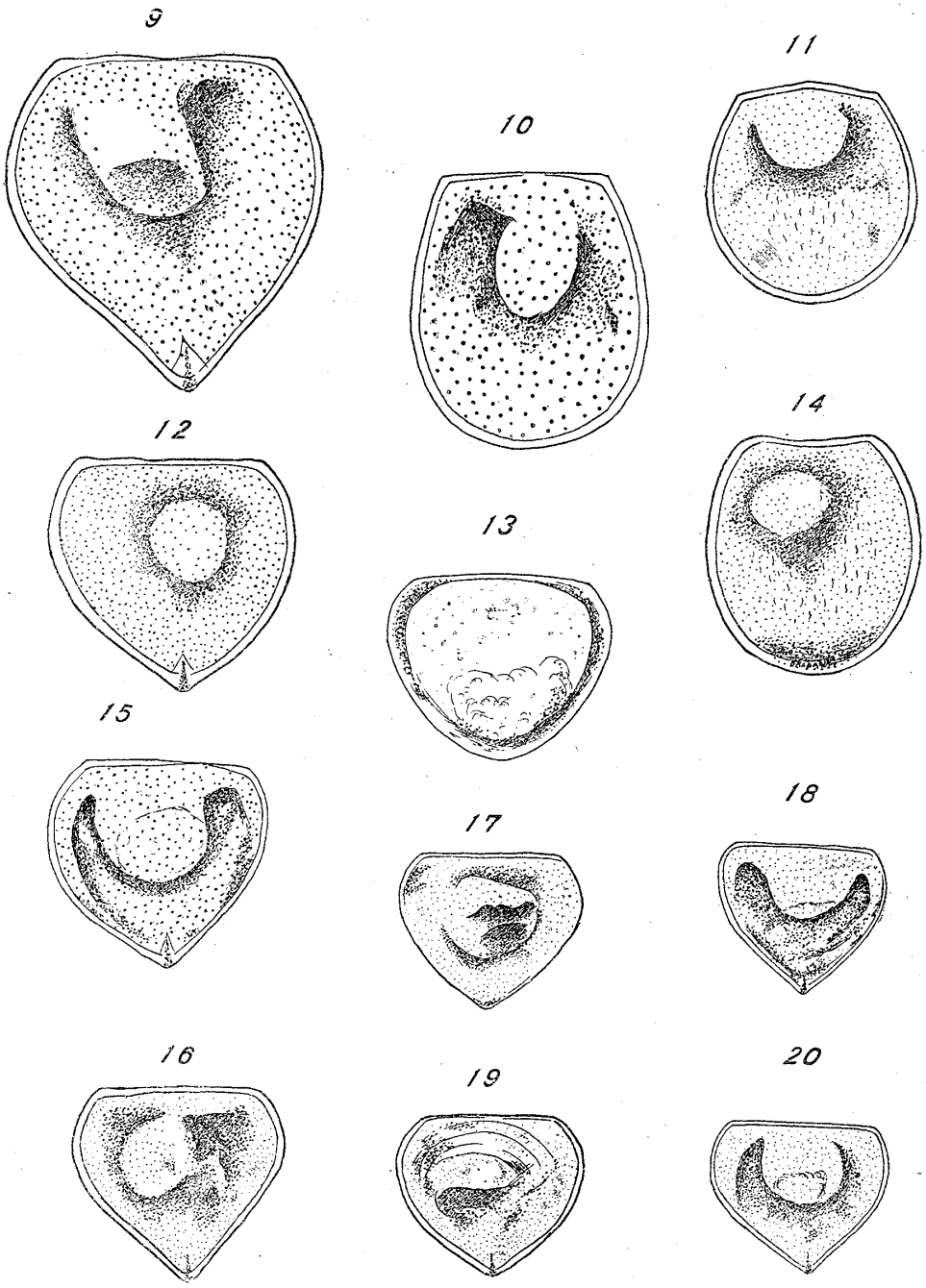


Fig. 9. Glochidium of *Cristaria plicata spatiosa* (CLESSIN).
Fig. 10. Glochidium of *Hyriopsis schlegeli* (v. MARTENS).
Fig. 11. Glochidium of *Inversidens brandtii* (KOBELT).
Fig. 12. Glochidium of *Inversidens hirasei* (HAAS).
Fig. 13. Glochidium of *Inversidens japonensis haconensis* (v. IHERING).
Fig. 14. Glochidium of *Inversidens japanensis* (LEA). (var. *jakohamensis* y. IHERING).
Fig. 15. Glochidium of *Lanceolaria acrorhyncha* (v. MARTENS).
Fig. 16. Glochidium of *Lanceolaria gladiolus* (HEUDE).
Fig. 17. Glochidium of *Unio biwae* KOBELT.
Fig. 18. Glochidium of *Unio douglasiae* GRIFFITH ET PIDGEON.
Fig. 19. Glochidium of *Unio douglasiae nipponensis* v. MARTENS.
Fig. 20. Glochidium of *Unio donglasiae verrucifer* y. MARTENS.

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

Glochidium: *Anodonta* type; medium size, glochidial shell slightly inflated in thickness, subtriangular with a spine at the tip of each valve, hinge line nearly straight, depth and length about equal; 0.229×0.239 mm. and hinge line 0.181 mm. The mass of glochidia is plate-like and milky white or cream in colour.

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

(13) *Inversidens japanensis haconensis* (v. Ihering). Plate 2, Fig. 13.

Glochidium: *Lampsilis* type; rather small, somewhat semicircular, but short in 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; 0.185×0.222 mm. and hinge line 0.166 mm. In general shape this glochidium seems to be intermediate between the *Lampsilis* group and the *Anodonta* group. The mass of glochidia is thin plate-like and milky white in colour.

Host: unknown. Locality of specimens: a river near Karasué, Gifu Pref., collected on June 19, 1939 by the author.

(14) *Inversidens japanensis* (Lea) var. (*Inversidens japanensis jokohamensis* v. Ihering). Plate 2, Fig. 14.

Glochidium: *Lampsilis* type; medium size, semi-elliptical, ventral margin rounded 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; 0.231×0.214 mm. and hinge line 0.140 mm. This glochidium bears a slight resemblance to that of *Hyriopsis schlegeli*, but can be distinguished from this by that the hinge line is shorter and slightly depressed and the general contour rather constricted at either 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 Hikoné, collected on 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; 0.240×0.245 mm. and hinge line 0.185 mm. Inspite of the abundance of shells observed, their glochidia has been rarely discovered.

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

Host: unknown. Locality of specimens: Lake Biwa off Hikoné, collected on 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; 0.203×0.222 mm. and hinge line 0.157 mm. The glochidium of

this species is more larger than the other two species, *gladiolus* and *oxyrhyncha*, and 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, collected 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, depth and length about equal; 0.193×0.208 mm. and hinge line 0.147 mm.. In general outline this can be distinguished by its more pointed tip of valves from the glochidia of *Unio*. The mass of glochidia is cylindrical and deep pink or dense brown in colour.

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

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

Glochidium: as stated in *gladiolus* for reference, namely the proportion in the pre-glochidium of this species was 0.164×0.164 mm. and hinge line 0.154 mm., hence it 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, 1938 by the author.

(19) *Unio biwae* 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; 0.153×0.175 mm. hinge line 0.133 mm. This glochidium is similar in size and shape to that of *douglasiae*, but characterized by its spineless shell. The mass of glochidia is plate-like and milky white or gloomy cream in colour.

Host is unknown. Locality is Lake Biwa off Hikoné, collected on May 29, 1938 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; 0.147×0.166 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, 0.151×0.177 mm. and hinge line 0.138 mm. or 0.156×0.181 mm. and hinge line 0.131 mm.

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

Host: unknown. Locality of specimens: a river near Ôgaki, Gifu Pref., collected 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 et Pidgon. differing only in proportion; namely, 0.148×0.176 mm. hinge line 0.148 mm. The glochidium of *douglasiae* is fairly similar in contour to that of *douglasiae verrucifer*. The mass of glochidia is thin plate-like, and red brown in colour.

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

Remarks: As mentioned above, the presence of the teeth on the external surface of the spine, as well as a rim connected with the lateral wings are characteristic evidences for the identification of all glochidia of *Anodonta* type. The teeth are rather regularly arranged in from three to six rows. Each tooth is extremely small and conical and can be observed in the profile only. According to my own sketches the glochidial teeth of *Anodonta arcaeformis*, *A. japonica*, *A. lauta*, *A. calipygos* and *Cristaria 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 inquiries.

## A KEY FOR IDENTIFICIATION OF UNIONID GLOCHIDIA.

I. *Anodonta* type;
Glochidium subtriangular. usually with one or more spines at the tip of each valve.
A. Glochidium with spines.
1. Depth greater than length.
a. Hinge line nearly straight.
i. Size rather large.
*Cristaria herculea* (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 lauta* v. Martens, (fig. 5), 0.303 by 0.268 mm.
*Anodonta woodiana lauta tumens* Haas, (fig. 6), 0.296 by 0.258 mm.
*Anodonta woodiana calipygos* Kobelt, (fig. 3), 0.298 by 0.247 mm.
? *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 hirasei* (Haas), (fig. 12), 0.229 by 0.239 mm.
*Inversidens reiniana* (Kobelt), 0.240 by 0.245 mm.
iii. Size rather small.
*Lanceolaria acrorhyncha* (v. Martens), (fig. 15), 0.203 by 0.222 mm.

*Lanceolaria gladiolus* (Heude), (fig. 16), 0.193 by 0.208 mm.
*Lanceolaria oxyrhyncha* (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 Pidgeon, (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 arcaeformis* (Heude), (fig. 1), 0.380 by 0.398 mm.

B. Glochidium without spines, only with teeth along the ventral margin of each valve.

4. Length greater than depth.
   a. Hinge line straight, or nearly so.
      Size small.
      *Unio biwae* Kobelt, (fig. 17), 0.153 by 0.175 mm.

II. *Lampsilis* type;

Glochidium semi-elliptical, or semi-circular; ventral margin rounded; no spines 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 schlegeli* (v. Martens), (fig. 10), 0.273 by 0.233 mm.
   b. Hinge line fairly curved.
      Size medium; glochidium almost circular; ventral margin rounded.
      *Inversidens brandtii* (Kobert), (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.
      *Inversidens japanesis haconensis* (v. Ihering), (fig. 13), 0.185 by 0.222 mm.

Glochidium without spines, but with teeth along the ventral margin of each valve.

3. Depth greater than length.
   a. Hinge line slightly depressed.
      Size medium; glochidium semi-elliptical; ventral margin rounded.
      *Inversidens japanensis* (Lea) var., (var. *jokohamensis* v. Ihering). (fig. 14), 0.231 by 0.214 mm.

## BIBLIOGRAPHY

Coker, Shira, Clark and Howard. 1921. Natural history and propagation of Fresh-water mussels.

Haas, F. 1930. Beiträge zur Kenntnis ostaciatischen Najaden.

Howard, A. D. 1922. Experiment in the culture of Fresh-water mussels.

v. Ihering, 1892. Die Süsswasser-Bivalven Japans.

Kuroda, T. 1930. A Hand-List of Shells in Japan.

Lefevre, C. and Curtis, W. C. 1910. Reproduction and Parasitism in the Unionidae. Journ. Exp. Zool. Vol. 9. No. 1. 1908, Experiments in the Artificial Propagation of Fresh-water Mussels. Proceed. Internat.

Simpson, C. T. 1900. Synopsis of the Naiades.

Surber, T. 1912, 1915. Identification of the Glochidia of Fresh-water mussels. Comm. Fish. Doc. No. 771. No. 813.