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ON SOME *DOSINIA* FROM THE PLIOCENE AND PLEISTOCENE FORMATIONS IN HOKKAIDO, JAPAN

by

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(with 11 text-figures, 2 tables and 2 plates)

Abstract

Examination of many collections of Plio-Pleistocene dosinids from Hokkaido reveals that a new distinct species, *Dosinia tomikawensis*, described herein, has been lumped together with *D. tatunokutiensis* or *D. japonica*. *D. tomikawensis* is distinguished from *D. tatunokutiensis* and *D. japonica* by an obscure escutcheon and a rather long ligament. These three species are not known to co-occur, and they may each have different stratigraphic and paleozoogeographic ranges. *D. tomikawensis* occurs in the Pliocene deposits of (1) the Horokaoshirarika Formation, Takikawa, central Hokkaido, (2) the Yuchi Formation, Teshio, northern Hokkaido, (3) the Atsuga Formation, Hidaka Monbetsu, southern part of central Hokkaido, (4) the Togawa Formation, Aomori, and (5) the Maruyama and the Nutov Formations in southern Sakhalin, and in the provincial Pleistocene deposits of (1) the Tomikawa Formation, Hakodate, southwestern Hokkaido, (2) the "upper Yuchi Formation" and the Sarabetsu Formation, Tenpoku, northern Hokkaido, and (3) the Omma Formation, Kanazawa, Ishikawa Prefecture. The occurrence of this species may suggest that this species retreated south- and westward from the adjacent waters of Sakhalin to the present northern-most limits within the warm Tsushima Current with the water temperature deterioration during the lapse of Pliocene to Pleistocene.

Introduction

Dosinia (Phacosoma) tatunokutiensis Nomura, a large, round quadrate shaped dosinid, has been frequently recorded from the provincial Pliocene deposits in Hokkaido and Northeast Honshu, and was found in association with *Fortipecten takahashii* (Yokoyama) (Fujie, 1958; Uozumi, 1962; Masuda, 1966). This dosinid has been recognized as one of the excellent representative fossils of the Takikawa-Honbetsu and Tatunokuti faunas. On the other hand, it is well known that the Omma-Manganji fauna, previously coeval to the *Fortipecten*-bearing fauna, is associated with the other dosinid, *Dosinia (Phacosoma) japonica* (Reeve) (Masuda, 1966). *Dosinia japonica* is commonly found in the Pleistocene deposits of Hokkaido and Northeast Honshu and still lives in the adjacent waters of Japan.

The present writer has studied the Pliocene and Miocene fossils from the enormously thick deposits of Hokkaido, and recently has been given the opportunity to re-examine the dosinid fossils yielded from the Pliocene-Pleistocene deposits of the various localities in Hokkaido and Northeast Honshu. He has realized that some of the Pliocene-Pleistocene dosinid fossils listed under the name of *D. japonica* or *D. tatunokutiensis* are, in fact, a distinct new species, with differing paleozoogeographic and stratigraphic ranges.

In this paper, the author (1) describes the new species, *Dosinia (Phacosoma)*

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tomikawensis, from the Pleistocene Tomikawa Formation and the Pliocene Horokaoshirarika Formation in Hokkaido, (2) reviews the classification of some dosinid species of North Japan, and (3) reviews the stratigraphic and paleozoogeographic distributions of *D. tomikawensis, D. tatunokutiensis* and *D. japonica.*

Description

Family Veneridae
Genus *Dosinia* Scopoli, 1777
Subgenus *Phacosoma* Jukes-Browne, 1912

Type species: *Artemis japonica* Reeve, 1850.

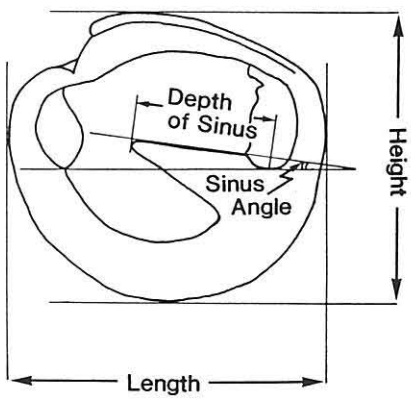
Remarks:- Subgenus *Phacosoma* is characterized by a pouting escutcheon defined by raised ridges (Frizzell, 1936; Cox *et al.*, 1969). The other characters of the shell are slightly different from those of the subgenus *Dosinia*. *Phacosoma* includes 17 living and 13 fossil species and is known only in the West Pacific; the northern limit of distribution of living *Phacosoma* is at a lat. of 43°N around Hokkaido, and the southern limit is at a lat. of 45°S around New Zealand.

Geological range: Oligocene-Recent.

Dosinia (Phacosoma) japonica (Reeve)

(Plate 1, figures 1-3, 5-8.)

1850 *Artemis japonica* Reeve, *Conch. Icon. Artemis* sp. 17, pl. 3, fig. 17.
1862 *Dosinia japonica* (Reeve), Roemer, *Monogr. Molluskengatt. Dosinia*, p. 60, pl. 11, figs. 4, 4a, 4b.
1933 *Dosinia (Phacosoma) japonica* (Reeve), Kuroda, *Cat. of Mollusca, Fukui Pref.*, no. 369, p. 201.
1951 *Dosinia (Phacosoma) japonica* (Reeve), Habe, *Genera of Japanese shell, no. 1, Pelecypoda*, p. 169, text-fig. 384.
1961 *Dosinia japonica* (Reeve), Iwai, *Saito Ho-on Kai Mus., Res. Bull.*, no. 30, pl. 1, figs. 7a-c.
1965 *Dosinia japonica* (Reeve), Iwai, *Bull. Educ. Fac., Hirosaki Univ.*, no. 15, p. 41, pl. 18, figs. 5-6.
1971 *Dosinorbis (Phacosoma) japonicus* (Reeve), Kuroda *et al., The Sea Shells of Sagami Bay*, p. 649, p. 421, pl. 91, fig. 1.
1977 *Phacosoma japonicum* (Reeve), Habe, *Bivalvia and Scaphopoda*, p. 260, pl. 55, fig. 1.
1981 *Dosinia (Phacosoma) japonica* (Reeve), Ogasawara, *Saito Ho-on Kai Mus., Res. Bull.*, no. 49, pl. 1, fig. 12.

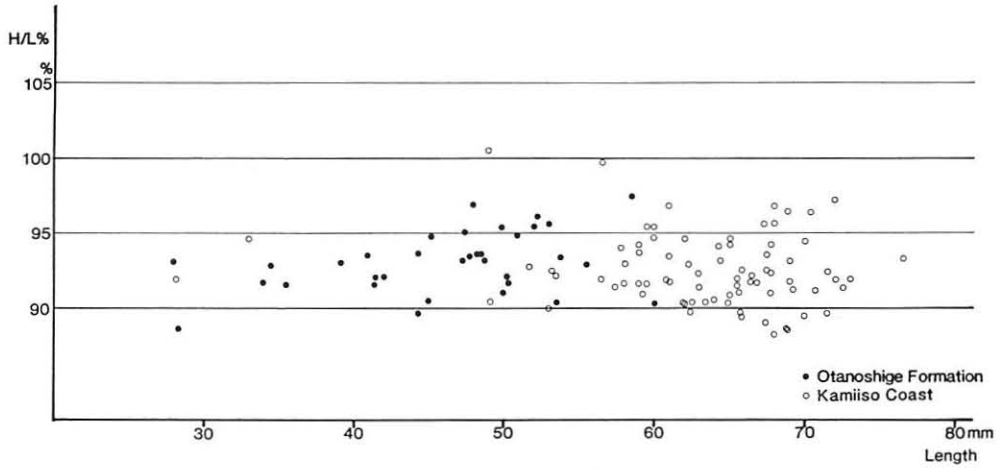


Text-fig. 1 Terminology of *Dosinia(Phacosma)*.

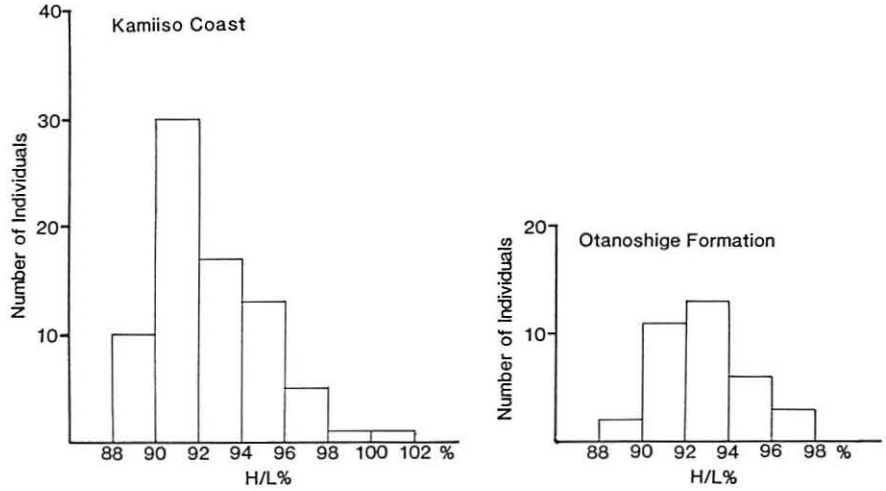
Remarks:- The present writer re-examined many specimens of this species, 70 Pleistocene fossils in Hokkaido and 90 living specimens from various localities in Japan. The results of this study showed the species to be rather variable in morphology, especially in the characters of the following portions: proportions of height/length and depth/height, shape of lunule and pallial sinus. But the escutcheon and the ligament are important species characters and may be available for taxonomic separation at the species level and/or a higher level.

(1) Proportions of height/length and depth/height (Text-figs. 1, 2, 3, 4)

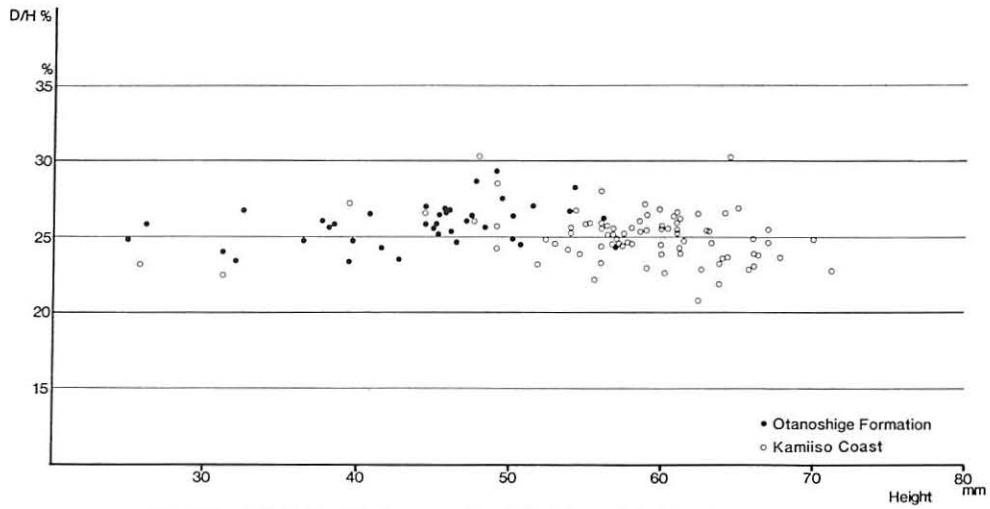
Examining all the material at hand, the present writer recognized a variation of height/length ranging from 88% to 102% and a variation of depth/height ranging from 20% to 31%. In the former, the most common proportion is about 90-94%, and in the latter, it is 24-27%, both being observed from the immature to the adult stage.



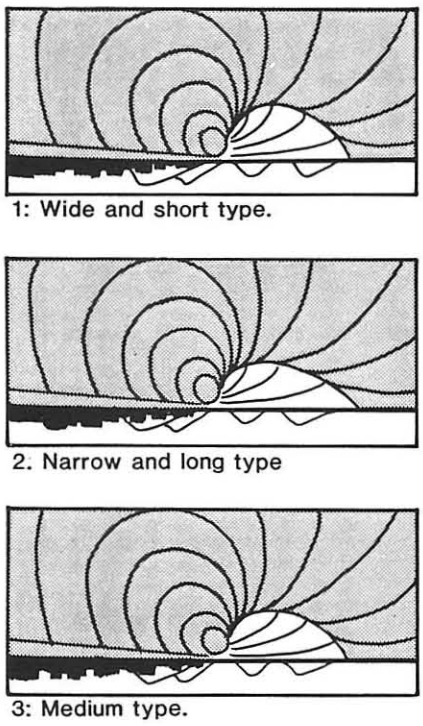
Text-fig. 2 Relationship between height/length and length of *D. japonica*.



Text-fig. 3 Frequency distribution of height/length of *D. japonica*.



Text-fig. 4 Relationship between depth/height and height of *D. japonica*.



Text-fig. 5 Morphology of lunule of *D. japonica*.

Dosinia(Phacosoma) troscheli (Lischke) has quite similar variations in the proportions of H/L and D/H to those of *D. japonica*, and is not readily distinguished from the latter by the above-mentioned characters.

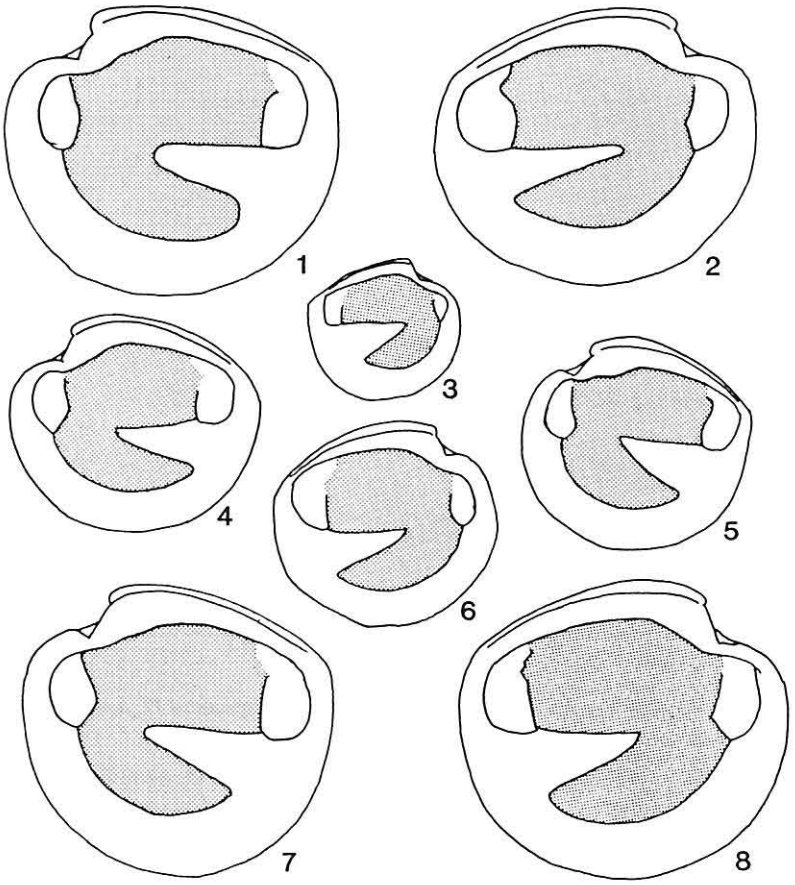
(2) Lunule (Text-fig. 5)

The lunule of *D. japonica* is large, distinct and rather variable in outline; most of the specimens have a moderately wide-long lunule. However, some specimens have narrow-elongated one, and the other specimens from the same locality have a wide-short one.

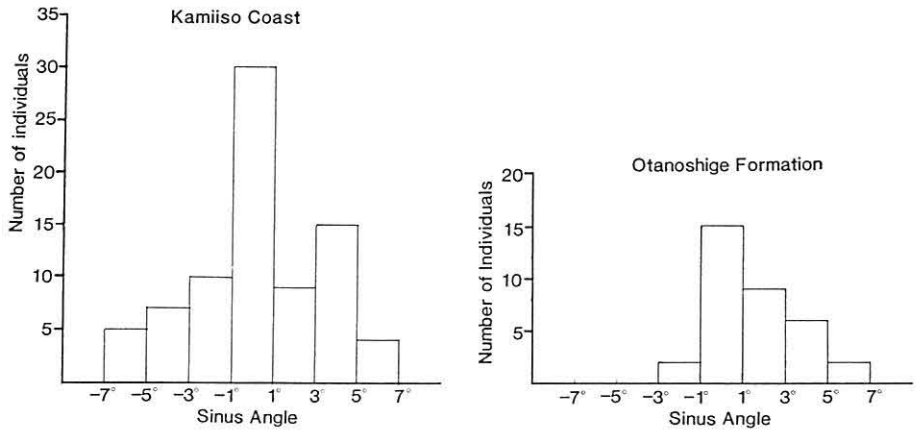
The lunule of *Dosinia(Phacosoma) tatunokutiensis* Nomura, from the Tatunokuti Formation in Sendai, is similar to that of *D. japonica* in shape. Presumably, this feature may not be available for taxonomic separation in *Phacosoma* species.

(3) Pallial sinus (Text-figs. 6, 7, 8)

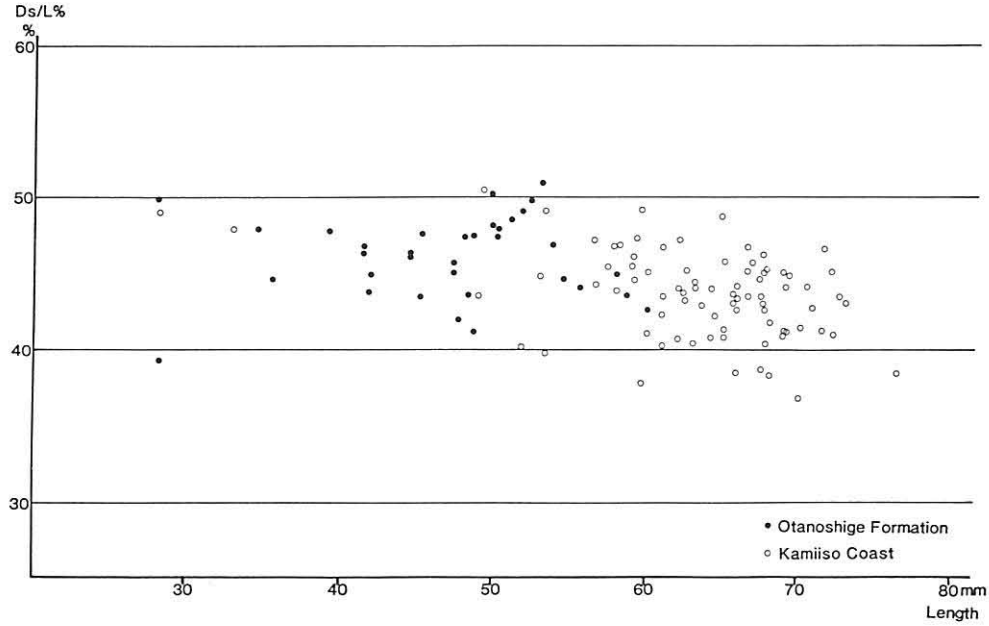
The characters of pallial sinus are considered to be one of the important species characters for taxonomic separation. But the pallial sinus of *D. japonica* is not always stable in shape; it transforms gradually from a rather wide triangular pointed pallial sinus to a narrow one, or from a moderately wide triangular rounded pallial sinus to a narrow one, as illustrated in Text-fig. 6. Consequently, the shape of the pallial sinus



Text-fig. 6 Morphology of pallial sinus of *D. japonica*.
Location: 1, 4-7; Otanoshige Formation, Kushiro, 2-3, 7; Kamiiso Coast, Hakodate, 5; Otoebetsugawa Formation, Ishikari.



Text-fig. 7 Frequency distribution of sinus angle of *D. japonica*.
Upside and under side direction are given respectively by positive and negative values.



Text-fig. 8 Relationship between depth of sinus and length of *D. japonica*.

may be invalid for taxonomic separation in most *Phacosoma* species.

The percentage of depth of sinus/length (= Ds/L%) of this species is also variable, ranging from 52% to 38%. The immature shells of this species (under 50 mm in length) commonly have a rather deeper sinus (45-50% in Ds/L) as compared with the adult shells (see Text-fig. 8). This character may not be very important for taxonomic separation among *Phacosoma* species such as *D. tatunokutiensis* and *D. troscheli*.

The sinus angle of this species (see Text-fig. 1) is also variable, −6° to +6° (Text-

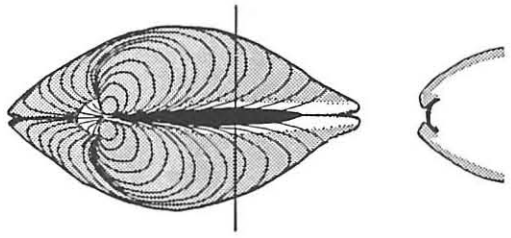
fig. 7). The most common sinus angle is 0°. In *D. tatunokutiensis*, the sinus angle is similar to that of the present species, but this feature may not be very important for taxonomic separation of them.

(4) Escutcheon and ligament (Text-fig. 9)

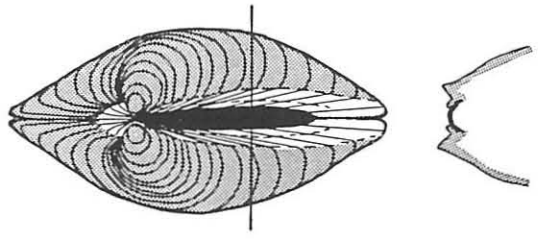
D. japonica is characterized by a distinct, wide and v-shaped escutcheon and a short ligament. The shape of the ligament is closely interrelated with its escutcheon; the wider the escutcheon, the wider the ligament, and the wide ligament facilitates wider opening of the valves. *Dosinia*(s. str) does not have an escutcheon, so its ligament is narrow and long, compared to that of *D. japonica*. The characters of escutcheon and ligament may be available for taxonomic separation not only at the subgenetic level, but also among some species of *Phacosoma*.

Dosinia(Phacosoma) tatunokutiensis Nomura (Nomura, 1938; Masuda, 1966), from the Pliocene Tatunokuti Formation in Sendai and its environs, is closely related to *D. japonica*. In the adult stages, this species is distinguishable from *D. japonica* by its round quadrate outline and its rather high shell, (about 100% in percentage of H/L). But in the immature stages, *D. tatunokutiensis* is very difficult to distinguish from *D. japonica*.

Dosinia(Phacosoma) troscheli (Lischke) closely resembles *D. japonica*. But this species differs from *D. japonica* by the presence of radially brown coloured banding patterns on its shell. In the specimens from the Uchiura Bay in Hokkaido, the range of sinus angle is from 4° to 14°, and the percentage of Ds/L is from 44% to 57%. The former is commonly about 10°, and the latter is commonly 50-52%. Many specimens, about 70% at hand, have a deeper sinus (above 50%in Ds/L) and a larger sinus angle (over 6°) than those of *D. japonica*. But the remainders, about 30%, are not distinguishable from the similar size shell of *D. japonica* by the above-mentioned con-



1: ***Dosinia(Phacosoma) tomikawensis*** **sp. nov.**



2: ***D.(P.) japonica*** **(Reeve)**

Text-fig. 9 Dorsal side views (left) and the sections (right) of escutcheon of (1) *Dosinia tomikawensis* and (2) *D. japonica*.

No.	Length	Height	Depth	Ds	Sinus Angle	V.
KO- 1	35,5mm	32,5mm	8,7mm	15,8mm	−2°30′	R
2	39,2	36,4	9,0	18,7	2°	R
3	53,8	50,2	13,2	25,2	0°	R
4	45.1	40,8	10,8	19,6	−2°30′	R
5	28,2	25,0	6,2	11,1	0°	R
6	47,3	44,5	11,5	21,5	3°30′	R
7	48,5	45,8	12,3	23,0	4°	R
8	60,0	54,2	15,3	25,5	5°	R
9	44,4	41,6	10,1	20,5	0°	R
10	48,3	45,2	11,7	21,0	−1°	R
11	34,5	ca32	7,5	16,5	−3°	R
12	——	——	——	22,2	0°	R
13	53,0	50,7	12,4	27,0	0°	R
14	47,4	ca45	11,5	21,3	0°	R
15	58,0	54,0	14,4	26,0	3°	R
16	47,7	44,5	12,0	20,0	2°40′	L
17	50,2	46,0	12,3	23,8	2°50′	L
18	41,5	38,2	9,8	19,2	0°	L
19	55,5	51,5	13,9	24,5	1°20′	L
20	51,1	48,4	12,4	24,8	3°	L
21	51,9	49,5	13,6	25,5	0°	L
22	48,7	45,8	12,2	20,0	0°	L
23	41,8	39,5	9,2	18,3	0°	L
24	50,2	46,2	11,7	24,0	1°	L
25	45,2	42,8	10,1	21,5	2°20′	L
26	48,0	46,5	11,5	22,7	5°	L
27	——	45,3	11,4	24,3	0°	L
28	——	47,8	13,7	25,0	0°	L
29	52,3	50,2	12,5	26,0	3°	L
30	28,1	26,2	6,8	14,0	0°	L
31	34,0	31,2	7,5	16,3	5°	L
32	49,9	45,4	12,0	24,0	2°	L
33	44,4	39,8	9,9	20,5	2°30′	L

No.	Length	Height	Depth	Ds	Sinus Angle	V.
KO-34	41,4mm	37,7mm	9,8mm	19,3mm	0°	L
35	49,8	47,5	12,5	25,0	0°	L
36	58,6	56,9	13,9	25,5	0°	L
37	41,9	38,5	10,0	18,8	0°	L
38	——	47,2	12,3	25,3	0°	L
39	54,5	49,2	14,4	24,3	0°	L
OT- 1	52,5	48,9	12,6	24,5	0°	L
2	49,8	44,9	12,1	23,8	2°	L
	49,8	44,6	12,1	23,8	2°	R
- 3	61,2	55,8	14,6	25,8	5°	R
4	80,5	74,0	22,0	33,0	81°	L
5	36,2	32,6	7,7	18,0	3°	R
6	45,0	40,6	ca9	21,2	4°	L
7	60,0	56,3	13,0	27,7	0°	R
8	57,3	53,2	13,2	26,0	5°	R
9	51,0	46,2	11,4	24,8	1°	R
MK- 1	52,6	49,5	12,1	23,0	0°	R
2	49,4	46,0	11,4	20,8	0°	R
KN- 1	60,0	56,0	14,4	27,0	3°	R
TM- 1	28,2	25,9	6,0	13,8	2°	L
2	67,5	60,0	14,3	29,0	3°	L
3	59,6	56,8	14,3	22,5	1°	L
	59,6	56,8	14,3	23,8	1°	R
4	73,0	67,0	17,1	32,0	2°	L
5	65,6	60,0	15,4	28,3	0°	L
6	58,9	ca55	14,2	22,2	3°	L
7	65,6	59,8	16,1	28,6	0°	R
8	33,0	31,2	7,0	15,8	——	R
9	70,4	67,8	16,1	31,0	0°	R
10	ca68	65,0	17,5	28,4	−5°	R
11	65,8	60,8	16,0	28,0	3°40′	R
12	ca60	57,2	14,0	27,0	0°	R
13	60,9	56,0	14,5	25,7	6°	R

Table 1 Measurements of *Dosinia(Phacosoma) japonica* (Reeve)

Ds: depth of sinus, V: valve, R: right valve, L: left valve, Location. KO: Kushiro, eastern Hokkaido, (Pleistocene Otanoshige Formation), OT: Ishikari, central Hokkaido, (Pleistocene Otoebetsugawa Formation), MK: Mikawa Bay, Aichi Prefecture, (Recent), KN: Nojima, Kanagawa Prefecture, (Recent), TM: Nanaehama, Kamiiso, southwestern Hokkaido, (Recent).

No.	Length	Height	Depth	Ds	Sinus Angle	V.
TM-14	59,1mm	55,6mm	12,3mm	26,3mm	0°	R
15	60,0	56,8	13,9	24,6	0°	R
16	65,0	59,0	15,0	26,8	0°	R
17	58,0	53,1	13,0	25,4	2°	R
18	68,0	65,8	15,0	26,1	−1°30′	R
19	64,4	60,0	15,3	27,2	2°40′	R
20	67,7	61,5	15,2	30,6	3°	R
21	ca65	61,2	16,0	29,7	−2°30′	R
22	56,6	56,4	14,2	25,0	0°	R
23	59,2	53,8	13,0	28,0	6°	R
24	67,5	62,4	13,0	30,4	−1°30′	R
25	64,2	60,4	15,4	28,2	0°	R
26	69,0	63,3	15,5	28,4	0°	R
27	71,5	66,0	15,2	33,3	3°	R
28	65,8	59,0	15,6	28,5	−1°	R
29	68,0	60,0	14,6	26,0	0°	R
30	67,6	62,4	16,5	28,8	−2°30′	R
31	70,0	66,0	16,4	29,0	−1°30′	R
32	57,4	52,4	13,0	26,0	−4°	R
33	65,5	60,2	13,6	25,3	−6°	R
34	53,0	47,7	12,4	23,7	0°	R
35	53,4	49,2	12,6	21,1	3°	R
36	62,4	56,0	14,3	27,0	0°	R
37	57,8	54,3	14,5	27,0	0°	R
38	63,0	58,0	14,8	25,5	3°	R
39	66,5	61,0	15,8	30,0	1°	R
40	62,0	58,6	14,8	25,2	−4°20′	R
41	64,8	58,5	15,2	31,6	3°	R
42	69,0	64,2	17,0	30,4	−5°20′	R
43	63,0	57,5	14,5	28,0	0°	R
44	49,2	44,5	11,8	24,8	0°	R
45	72,1	70,0	17,3	29,5	0°	R
46	70,8	64,5	19,5	30,2	−5°20′	L
47	67,5	63,8	14,0	31,2	0°	L
48	72,6	67,0	16,5	31,5	3°	L
TM-49	70,0mm	62,6mm	14,7mm	75,7mm	−2°20′	L
50	ca63	——	13,1	27,7	0°	L
51	ca62	56,0	13,0	27,2	4°30′	L
52	59,5	54,5	13,0	29,2	−4°	L
53	66,5	61,2	14,6	28,9	4°40′	L
54	66,8	61,2	14,8	30,5	−2°20′	L
55	76,4	71,2	16,2	29,3	−1°30′	L
56	51,8	48,0	15,0	20,8	−5°	L
57	67,7	63,8	14,8	27,3	−4°30′	L
58	62,3	57,8	14,2	27,2	−4°	L
59	ca65	——	15,7	26,5	4°	L
60	68,9	61,0	15,5	28,4	−1°40′	L
61	56,5	51,9	12,0	26,6	−6°	L
62	68,8	ca61	15,4	31,0	0°	L
63	58,1	54,0	13,6	27,2	0°	L
64	62,5	56,4	14,5	28,2	2°	L
65	67,3	64,3	15,2	30,0	3°	L
66	69,2	63,1	16,0	31,0	0°	L
67	61,0	59,0	13,5	28,5	4°	L
68	62,0	56,0	15,7	29,3	3°	L
69	72,0	66,1	15,8	32,5	−5°30′	L
70	49,0	49,2	14,0	21,3	0°	L
71	71,4	64,0	15,1	29,4	−3°	L
72	68,8	66,3	15,8	28,1	2°	L
73	66,5	61,0	16,2	31,0	4°30′	L
74	61,0	57,0	14,2	26,5	0°	L
75	65,8	58,9	16,0	29,0	−1°	L
76	53,3	49,2	11,9	26,2	0°	L
77	63,5	57,4	14,0	27,2	−1°	L
78	61,0	56,0	13,6	24,5	−5°	L
79	67,4	63,0	16,0	29,3	1°	L
80	64,1	58,0	14,2	26,1	0°	L
81	59,0	55,2	14,3	27,2	0°	L
82	59,0	54,0	13,8	26,8	5°	L
RU- 1	ca90	70,0	ca20	37,5	−3°30′	L

Table 1 (Continued)

chological features. Although the radially coloured banding patterns of the shell is characteristic to *D. troscheli*, this species may be subspecies of *D. japonica*. *Dosinia (Phacosoma) kawagensis* Araki, from the middle Miocene Kaisekizan Formation in Mie Prefecture (Araki, 1960), is closely related to *D. japonica*. But according to Masuda (1963), this species has an extremely inflated shell; the percentage of depth/height is 58-67% in the specimens from the Ajiri Formation, Miyagi Prefecture. The immature shells of this species are more inflated comparing with the adult ones and are easily distinguishable from *D. japonica*.

Geological range: Pleistocene-Recent.

Occurrence: Otoebetsugawa Formation, Ishikari, central Hokkaido; Nakanokawa and Soibetsugawa Formations (=upper Setana Formation), Kuromatsunai, southwestern Hokkaido; Otanoshige Formation, Kushiro, eastern Hokkaido; Hamada Formation, the Shimokita Peninsula, Aomori Prefecture; Totezawa Formation, Hirosaki, Aomori Prefecture; Upper Omma Formation, Kanazawa, Ishikawa Prefecture. All are Pleistocene in age.

Modern zoogeographical distribution: Japan, Korea and North China; the northern limit of distribution is lat. 42°N of the Pacific side and lat. 43°N of the Japan Sea side of Hokkaido, and the southern limit is lat. 31°N of the Pacific side of Kyushu.

Dosinia (Phacosoma) tomikawensis Takagi sp. nov.

(Plate 2, figures 1-5)

1941 *Dosinia tatunokutiensis* Nomura, Hatai and Yoshida, *Bull. Biogeogr. Soc. Japan*, vol. 11, no. 5, pp. 23-25 (non Nomura, 1938).

1961 *Dosinia* cf. *japonica* (Reeve), Chinzei, *Jour. Fac. Sci., Univ. of Tokyo, Ser. 2*, vol. 13, pt. 1, p. 113, pl. 3, fig. 8 (non Reeve, 1850).

1965 *Dosinia (Phacosoma) japonica* (Reeve), Kaseno and Matsuura, *Sci. Rep. Kanazawa Univ.*, vol. 10, no. 1, pl. 15, fig. 1 (non Reeve, 1850).

1965 *Dosinia (Dosinella) angulosa* (Philippi), Kaseno and Matsuura, *Ditto*, vol. 10, no. 1, pl. 15, fig. 1 (non Philippi, 1847).

1966 *Dosinia japonica* Reeve, Sakagami *et al., Jour. Hokkaido Univ. Educ., (Ser. B)*, vol. 17, no. 1, pl. 4, figs. 4a-b (non Reeve, 1850).

1968 *Dosinia anguloides* Nomura, Zhidkova *et al., Acad. Sci., USSR, Siberian Section*, p. 108, pl. 36, fig. 8 (non Nomura, 1935).

1977 *Dosinia (Phacosoma) japonica* (Reeve), Ogasawara, *Sci. Rep. Tohoku Univ., 2nd Ser.*, vol. 47, no. 2, p. 117, pl. 13, figs. 2, 5, 6, pl. 14, fig. 1 (non Reeve).

1982 *Dosinia* cf. *tatunokutiensis* Nomura, Noda et al., *Human Culture and Environ. Stud. of North. Hokkaido*, Univ. of Tsukuba, 3, p. 6, pl. 1, fig. 1A, pl. 2, figs. 10, 11 (non Nomura, 1938).

1984 *Dosinia (Phacosoma) japonica* (Reeve), Matsuura *et al., Ishikawa Pref. Educ.*, vol. 23, pl. IV-8, fig. 1 (non Reeve, 1850).

Description:- Shell medium, thick in test, moderately inflated, orbicular to quadrate in outline, nearly as long as high. Anterior and posterior margin almost equally rounded, passing gradually into evenly arcuate ventral margin; antero-dorsal margin short, substraight or slightly concave in front of beak; postero-dorsal margin broadly rounded, gradually passing into ventral margin. Beak pointed, curved forward, situated anteriorly; lunule cordate in shape, deeply depressed, rather large and long; escutheon extremely narrow, and obscure. Pallial sinus rather narrow, deep, pointed at end and reaches to about 45% of shell length.

No.	Length	Height	Depth	Ds	Sinus Angle	V.
TK-1*	60,2mm	60,0mm	16,4mm	23,0mm	0°	R
2	60,0	60,0	16,0	——	——	R
3	63,0	62,8	16,0	29,0	3°	R
0M-1	55,3	49,5	14,8	25,0	0°	R
2	57,1	56,0	16,0	ca25	3°	L
HO-1	53,5	49,0	24,2/2	26,6	−4°	R
	53,5	49,0	24,2/2	——	——	L
2	47,0	45,5	——	——	——	L
	47,0	45,5	——	——	——	L
3	52,0	51,2	——	26,0	0°	L
	52,0	51,2	——	——	——	R

Table 2 Measurements of *Dosinia(Phacosoma) tomikawensis* Takagi
TK: Hosokomatazawa, Kamiiso, Kamiiso-gun, southwestern Hokkaido, (Pleistocene Tomikawa Formation), 1*: (Holotype) U.H. Reg. No. 30560, 2: U.H. Reg. No. 30561, 3: U.H. Reg. No. 30562.
OM: Kanagawa, Ishikawa Prefecture, (Pleistocene Omma Formation), 1: U.H. Reg. No. 30563, 2: U.H. Reg. No. 30564.
HO: Shisungawa, Shintotsukawa, Kabato-gun, central Hokkaido, (Pliocene Horokaoshirarika Formation), 1: U.H. Reg. No. 30565, 2: U.H. Reg. No. 30566, 3: U.H. Reg. No. 30567.

Holotype: U.H. Reg. No. 30560, Hosokomatazawa, Kamiiso, Kamiiso-gun, southwestern Hokkaido, Japan (41°40′N, 140°40′E). Pleistocene Tomikawa Formation.
Remarks:- *Dosinia tomikawensis* is characterized by a round quadrate shell in outline, obscure escutheon and rather long ligament. The present species is rather variable in morphological outline; it gradually transforms from round quadrate, to nearly orbicular and to rather elongate. The percentage of H/L is commonly about 98-100%, which is similar to that of *D. japonica*. The lunule and pallial sinus are also like those of *D. japonica*. But the present species clearly differs from the other species belonging to subgenus *Phacosoma* by its obscure escutcheon and rather long ligament (Text-fig. 9).

D. tomikawensis has been previously lumped together with *D. tatunokutiensis* or *D. japonica*. Hatai and Yoshida (1941) listed *D. tatunokutiensis* from the Sarabetsu Formation, Wakkanai, northern Hokkaido. Noda *et al.* (1982) also reported *D.* cf. *tatunokutiensis* from Hatai and Yoshida's locality. However, the dosinid specimens from their locality clearly differ from *D. tatunokutiensis* by their obscure escutcheon. These results suggest that specimens from the Sarabetsu Formation can be identified with *D. tomikawensis*.

Sakagami *et al.* (1966) identified a dosinid from the Pleistocene Tomikawa Formation with *D. japonica* and illustrated it in their paper. The present writer collected many specimens from the same locality of Sakagami *et al.* and carefully examined them. The examination revealed that these specimens could be identified with the present new species, *D. tomikawensis*. The present species differs from *D. japonica* by its obscure escutcheon and rather long ligament, as stated above.

D. japonica has also been reported from the Omma Formation by several authors (Kaseno and Matsuura, 1965; Ogasawara, 1977; Matsuura *et al.*, 1984). Recently, Mr. Ken Yasui of Niigata Univ. sent me some specimens of *D. japonica* from the lower parts of the Omma Formation. These specimens are judged to differ from *D. japonica* and identical with *D. tomikawensis*. Kaseno and Matsuura (1965) simultaneously reported *Dosinia angulosa* (Philippi) from the same locality, but judging from their figure, their specimen is quite different from *D. angulosa* and may be synonym of *D. tomikawensis*.

Chinzei (1961) described *D.* cf. *japonica* from the Pliocene Togawa Formation, Aomori Prefecture. His figures, however, do not make it clear that his specimens can be identified with *D. japonica*. The morphological characters of his specimens such as weakly inflated shells with round posterior margin are rather similar to those of *D. tomikawensis*.

Zhidkova *et al.* (1968) reported *Dosinia anguloides* Nomura from the Pliocene Maruyama and Nutov Formations in southern Sakhalin. Judging from their description and figure, it cannot be confirmed that their specimens belong to *D. anguloides*. *D. anguloides* Nomura, (Nomura, 1935), from the middle Miocene Ajiri Formation in Mie Prefecture, is characterized by a small shell, fine surface sculpture and an obscure escutcheon. This species may belong to the subgenus *Dosinella*, as already pointed out by Masuda (1963). The specimens of Zhidkova *et al.* are judged to be *D. tomikawensis* because the morphological characters of the escutcheon and shell ornamentation are quite similar to those of the present species.

On the other hand, *Dosinia (Phacosoma) laminata* (Reeve), living in subtropic to tropic waters in the Pacific, closely resembles and may be closely allied to *D. tomikawensis*, especially in the morphological characters of escutcheon and ligament. But this species is distinguishable from *D. tomikawensis* by a shallower pallial sinus and a larger sinus angle.

Dosinia (Phacosoma) akaisiana Nomura (Nomura, 1935), from the middle Miocene Tanosawa Formation, may be allied to the present species by its obscure escutceon, but this species differs from *D. tomikawensis* by its small and extremely inflated shell.

D. tomikawensis, D. laminata and *D. akaisiana* are characterized by an obscure escutcheon, which is exceptional within the subgenus *Phacosoma*, indicating that they are an extraordinary group of *Phacosoma*.

Geological range: Pliocene-Pleistocene.

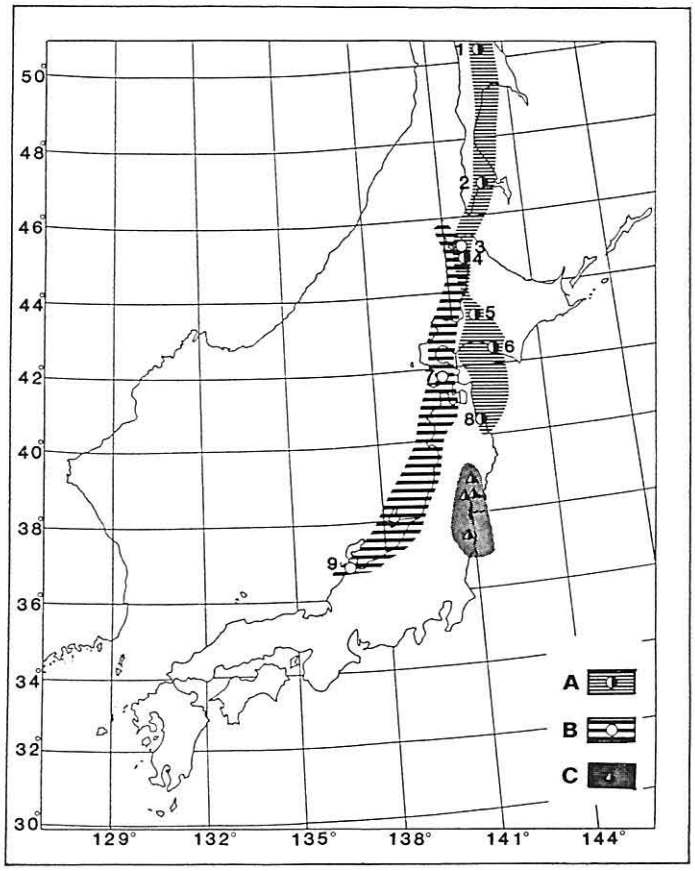
Occurrence: (Pliocene) Yuchi Formation, Toikanbetsu, Horonobe, Teshio-gun, northern Hokkaido; Horokaoshirarika Formation, Shisungawa, Shintotsukawa, Kabato-gun, central Hokkaido; Atsuga Formation, Hidaka Monbetsu, Saru-gun, southern part of central Hokkaido; Togawa Formation, Sannohe, Aomori Prefecture; Maruyama and Nutov Formations, southern Sakhalin.

(Pleistocene) Sarabetsu Formation, Bakkai, Wakkanai, northern Hokkaido; "Upper Yuch Formation", Toyotomi, Teshio, northern Hokkaido; Tomikawa Formation, Hakodate, south-western Hokkaido; Omma Formation, Kanazawa, Ishikawa

Prefecture.

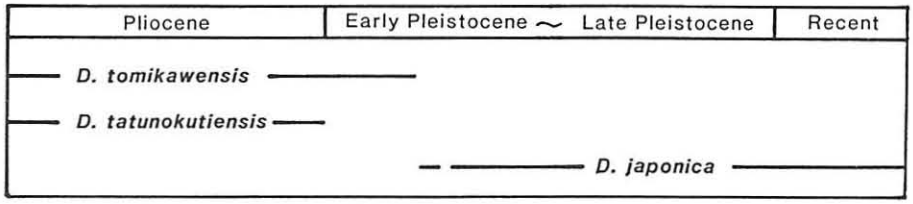
Geologic and Paleozoogeographic distributions: *D. tomikawensis*, characterized by an obscure escutcheon and long ligament, is found from the provincial Pliocene formations: Yuchi Formation, northern Hokkaido, Horokaoshirarika (= Takikawa) Formation, central Hokkaido, Togawa Formation, Aomori Prefecture, Maruyama and Nutov Formations, southern Sakhalin. That is to say, this species occurs in association with the Takikawa-Honbetsu fauna, including the hunch-like scallop, *Fortipecten takahashii* (Yokoyama). This species also ranges up to the provincial Pleistocene formations, and is associated with the "Setana fauna". Therefore, the geologic range of this species is equivalent to the periods from the Takikawa-Honbetsu fauna (6.0-2.0 Ma) to the Setana fauna (2.0-0.7 Ma), which were already reported by Uozumi *et al.* (*in* press). From the viewpoints of the paleozoogeographic distribution, this species extended as far north as southern Sakhalin from Hokkaido, and the southern limit was confined to Aomori Prefecture in the Pliocene. It is probable that this species originated in the waters of early Pliocene Hokkaido and flourished in the adjacent waters of Hokkaido and Sakhalin. It should be noted that such northward invasion of *Dosinia* may be exceptional during the Neogene. Subsequently, this species disappeared in Sakhalin and on the Pacific side of Japan, and migrated to the south- and westward. In the early Pleistocene, this species resided only along the Japan Sea side, as shown in Text-fig. 10. This southward retreat from southern Sakhalin may be attributable to the lowering of water temperatures during the lapse of geologic time. The other Pliocene dosinid, *D. tatunokutiensis*, is known to be associated with the Tatunokuti fauna (Nomura, 1938; Masuda, 1966), which is suggestive of a warmer water temperature than that of the contemporary Takikawa-Honbetsu fauna. *D. tatunokutiensis* resembles to *D. japonica*, and it may be a localized species with a narrow special zoogeographic distribution, as shown in Text-fig. 10.

Near the close of the Setana fauna period (2.0-0.7 Ma) (Uozumi *et al., in* press), still-living *D. japonica* occurred in various localities in North Japan: the upper part of the Setana Formation (= Nakanokawa and Soibetsugawa Formations (Sawada, 1962)), Otoebetsugawa Formation and Otanoshige Formation in Hokkaido; Hamada Formation and Totezawa Formation in Aomori Prefecture; the upper part of the Omma Formation in Ishikawa Prefecture. Ogasawara (1981) re-examined in detail the Omma-Manganji fauna in the type locality of the Omma Formation, and emphasized that the so-called "Omma-Manganji" fauna, previously grouped under one name, is comprised of two different faunal assemblages: the Omma fauna proper and the Younger Omma fauna. The latter one is dominated by the still-living species. Judging from Ogasawara's description and the stratigraphic columnar sections (Ogasawara, 1977, 1981), the lowest known stratigraphic occurrence of *D. japonica* is the upper part of the Omma Formation and not beyond the lower part, yielding Omma fauna proper. In Hokkaido, the occurrence of *D. japonica* is known from the upper part of the Setana Formation but not from its lower part (Suzuki, personal communication, 1985). The upper part of the Setana Formation may be partially coeval wth the period of the Younger Omma fauna, or wholly younger. The faunal compositions of the other *D.*



Text-fig. 10 Paleozoogeographic distribution of *Dosinia tomikawensis* and *D. tatunokutiensis*.
A: Distribution of *Dosinia tomikawensis* (Pliocene), B: *Ditto* (Pleistocene), C: Distribution of *D. tatunokutiensis*. Location: (SAKHALIN) 1: Nutov Formation, Tymovskoje, 2: Maruyama Formation, Dolinsk; (HOKKAIDO) 3: Sarabetsu and "Upper Yuchi" Formations, Wakkanai, 4: Yuchi Formation, Teshio, 5: Horokaoshirarika Formation, Takikawa, 6: Atsuga Formation, Hidaka, 7: Tomikawa Formation, Hakodate; (HONSHU) 8: Togawa Formation, Aomori, 9: Omma Formation, Kanazawa.

japonica-bearing formations, such as Otoebetsugawa Formation and Otanoshige Formation, seem to be dominated by still-living species, which are similar to those of the upper part of the Setana Formation and/or Younger Omma fauna. From the present information, *D. japonica* appears to be an extensive geographic range in Pleistocene deposits of Japan, and in each of the localities from which it is known, it occurs with molluscan assembleges of still-living species, which is suggestive of a provincial Pleistocene age. However, the biostratigraphic positions of those assemblages should be discussed when the stratigraphic and paleontologic sequences are carefully re-examined in their respective geologic sections on future occasions (Text-fig. 11).



Text-fig. 11 Geological ranges of *Dosinia tomikawensis, D. tatunokutiensis* and *D. japonica*.

In any case, *D. tomikawensis* and *D. japonica* are not known to co-occur in the Pliocene-Pleistocene deposits in Hokkaido and in the type locality and environs of the Pleistocene Omma Formation. These two species probably do not co-occur in most localities. This evidence may suggest that both species have different paleozoogeographic and stratigraphic distributions.

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Explanation of Plate 1

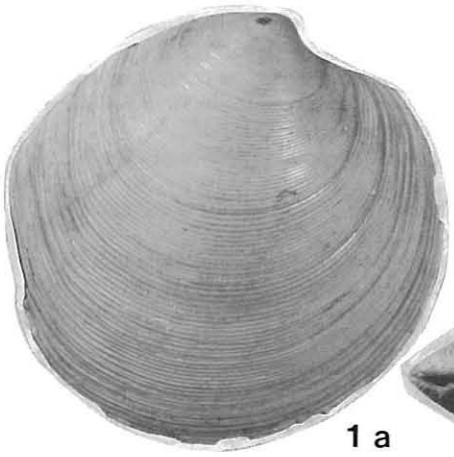
(All figures in natural size, unless otherwise stated)

Figs. 1a-b, 2, 9, 10 *Dosinia(Phacosoma) japonica* (Reeve). Recent, Kamiiso Coast, Hakodate, southwestern Hokkaido. 1a. Right valve, exterior, 1b. Dorsal view, 2. Left valve, interior, 9. Left valve, interior (x2/3), 10. Left valve, interior.

Figs. 3, 5-7 *Dosinia(Phacosoma) japonica* (Reeve). Otanoshige Formation, Kushiro, eastern Hokkaido. 3. Right valve, interior, 5. Left valve, interior, 6. Right valve, interior, 7. Right valve, interior.

Fig. 4 *Dosinia(Phacosoma) troscheli* (Lischke). Shishinai Formation, Ishikarihutomi, Ishikari-gun, central Hokkaido. Right valve, interior. (x2)

Fig. 8 *Dosinia(Phacosoma) japonica* (Reeve). Otoebetsugawa Formation, Ishikawa, central Hokkaido. Dorsal view of the left valve.



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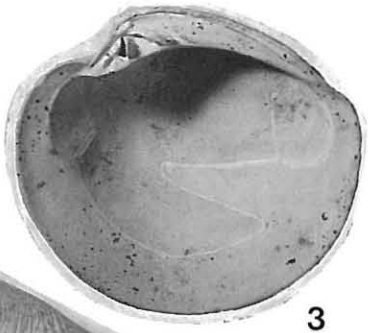

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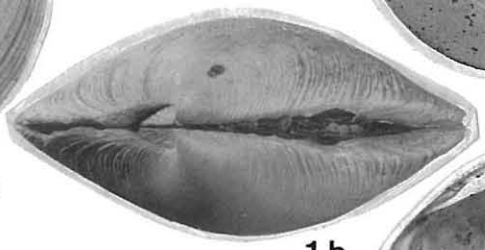

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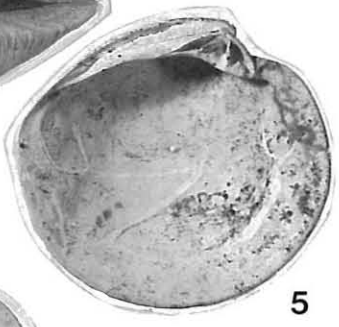

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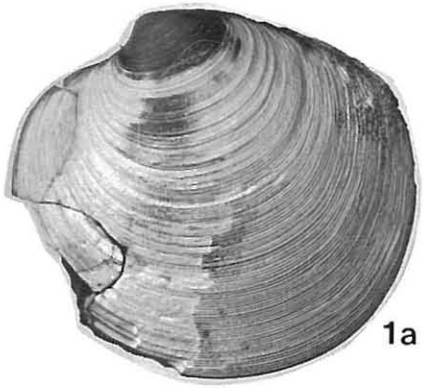
Explanation of Plate 2

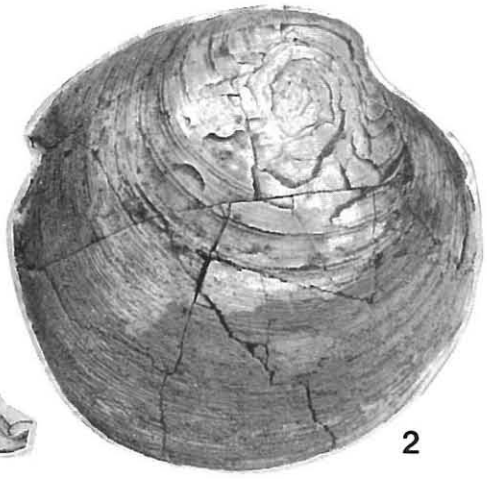
(All figures in natural size)

Figs. 1a-b *Dosinia(Phacosoma) tomikawensis* Takagi, n. sp. U.H. Reg. No. 30565, Horokaoshirarika Formation, Shintotsukawa, kabato-gun, central Hokkaido.
1a. Right valve, exterior, 1b. Left valve.

Figs. 2-5 *Dosinia(Phacosoma) tomikawensis* Takagi n. sp. Tomikawa, Kamiiso-gun, southwestern Hokkaido. 2. U.H. Reg. No. 30561, Right valve, exterior, 3. U.H. Reg. No. 30568, Hinge plate of left valve, 4a-c. (Holotype), U.H. Reg. No. 30560, 4a. Right valve, exterior, 4b. Right valve, interior, 4c. Dorsal view of right valve, 5. U.H. Reg. No. 30562, Right valve, exterior.

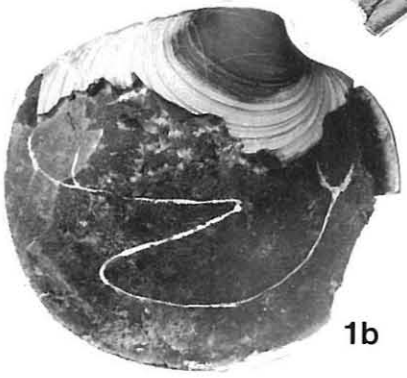


1a

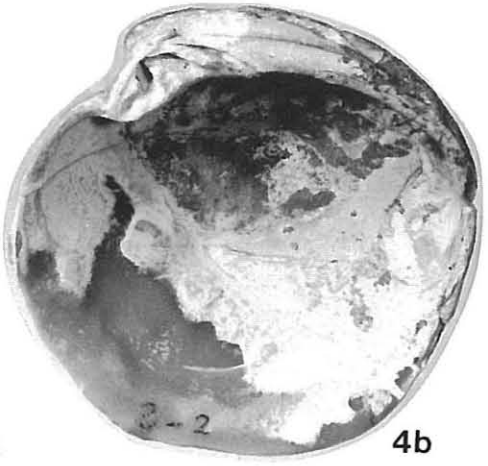


2

3



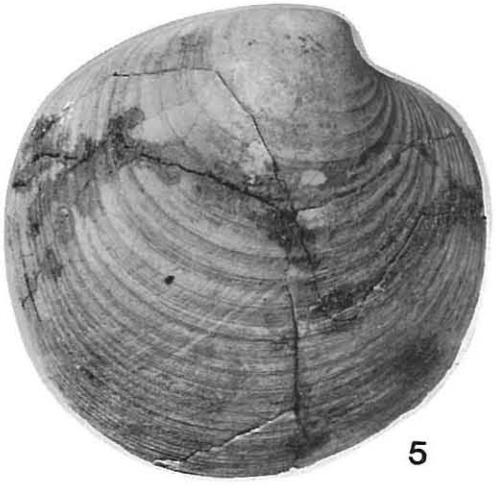
1b



4b

4c

4a



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