



Title	Paleontological Note on the Two Fossil Species of the Genus Pitar in Hokkaidô
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Citation	Journal of the Faculty of Science, Hokkaido University. Series 4, Geology and mineralogy, 8(4), 381-389
Issue Date	1954-03
Doc URL	http://hdl.handle.net/2115/35877
Type	bulletin (article)
File Information	8(4)_381-390.pdf



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PALEONTOLOGICAL NOTE ON THE TWO FOSSIL
SPECIES OF THE GENUS *PITAR* IN HOKKAIDÔ

By

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(With 1 Plate and 1 Text-Figuer)

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In the present note, the writers try to explain and discuss the paleontological and stratigraphical relations recognized between the two species of the Genus *Pitar*, *P. okadana* (YOKOYAMA) and *P. hokkaidoensis* (NOMURA), that occur in the Neogene Tertiary, developed in and around the Uryû coal-field in the northwestern part of Central Hokkaidô.

This genus is rather rarely represented in the Tertiary deposits of Hokkaidô, and the occurrence is restricted to certain stratigraphical horizons. Although the two above-mentioned species occur in one and the same district, no comparative study has been carried out by anybody. Besides, *P. okadana* was described as a "*Venus*", and it was represented by numerous specimens that show a remarkable range of form variation, so that there is still much to be studied in detail, in behalf both of stratigraphical and paleontological considerations of these fossils.

In dealing with the two species, we wish mainly to try the paleontological observations in the following lines, namely, 1) the delicate conchological relation of the two species, and 2) the relation between the degree of variation of the shell and entombing environment, and the position of two species in the stratigraphic sequence.

[I] The Conchological Relations between the Two Species.

P. okadana, originally described from Okada and Numata formations of the Uryû coal-field in Hokkaido, as "*Venus okadana*" by M. YOKOYAMA (1932),⁽¹⁾ is one of the very common species in this district.

The original description is as follows:

"Shell of moderate size, very thick quite swollen, roundly elliptical, slightly longer than high, very inequilateral, round both in front and behind. Surface with rough concentric lines of growth. Beaks not very prominent".

This species was established upon the specimens illustrated on Plate II, figures 8 and 9 of M. YOKOYAMA'S 1932 paper. But judging from these figures, it is evident that figure 8 does not preserve test, and figure 9 agrees well with the description. Figure 8 obviously differs from figure 9 in outline; because this species has so very thick, characteristic test, that the internal molds show a different appearance from external outline, the two can not be identical.

After examining many specimens of this species obtained from the same locality in the Uryû coal-field, it was ascertained that the types represented by the original specimens, are not at all the ordinary forms of this species. Namely, it has a wide range of variation in the outline as shown in our figures. Accordingly, this species is divided into five main types as follow.

I) QUADRATE FORM (Fig. 2)

Shell of moderate size, ventricose and subquadrate in outline; beak slightly elevated, strongly curved inwards, situated somewhat anteriorly; anterior dorsal margin slightly concave in front of the beak; posterior dorsal margin nearly straight, sloping down slowly, forming a blunt angle with the obliquely truncate posterior extremity; ventral margin nearly straight. Convexity is very remarkable, looking hunch-back-like, this being due to the fact that the convexity culminates on dorsal side, and a blunt ridge runs from beak to posterior ventral corner, the part behind it being strongly depressed.

II) FLAT-QUADRATE FORM (Fig. 1)

The outline of this form is similar to the last Form, but the beak is situated more anteriorly; less convex, rather flattened: without a blunt ridge from beak to posterior ventral corner. Test moderate in thickness as compared to the "Quadrate Form".

III) TRANSVERSE-ELONGATE FORM (Fig. 3)

Shell moderately thick, transversely elongate and ovate in outline; anterior and posterior ends uniformly rounded, smoothly passing into ventral margin. This regularly ovate outline is interrupted by a rather low beak situated far in the front. Convexity is rather inconspicuous.

1) M. YOKOYAMA: Tert. Moll. from Uryû coal-field; Jour. Fac. Sci. Imp. Univ. Tôkyô, Ser. 2, vol. 3, p. 240, pl. 11, fig. 8, 9. 1932.

IV) TRIANGULAR FORM (Fig. 4a, b)

Shell ventricose, roundly subtrigonal in outline, more or less unequilateral, posterior and anterior extremities rather rounded, ventral margin broadly rounded: moderately convex.

This is a very common form of this species, and has the characters presented by the "Quadrated Form" in point of thickness of test, and convexity; but the outline of the shell is not quadrated, neither is there a blunt ridge running from beak to posterior ventral corner.

V) SCALENE FORM (Fig. 5)

This form is allied to the "Triangular Form" in some features, but the position of beak is more anterior, so that posterior dorsal margin slopes obliquely down, and posterior extremity is more narrowly rounded.

Of the five types defined above, the "Triangular Form" is obtained most commonly, and the specimens figured by M. YOKOYAMA seem to be forms transitional between the "Quadrated Form" and the "Scalene Form".

On the other hand, *P. hokkaidoensis* was established by S. NOMURA (1935)¹⁾ as a member of the Takikawa fauna (Pliocene) on the specimens from the Uryû coal-field. In reality, however, *P. hokkaidoensis* does not occur in the Takikawa formation, but in the Tôgëshita formation, named by I. NATSUI, (1938),²⁾ and redefined by W. HASHIMOTO (1950),³⁾ which is overlain by the Mashike formation and underlain by the Poroshin formation.

The original description of the species is as follows; "Shell triangularly ovate, rather inflated; test very thick and solid; anterior and posterior extremities rounded, the former apparently being a little broader than the latter; basal margin partly fractured, but it may be evenly convex or semioval by the indication of growth lines; dorsal margin slopingly convex posteriorly, and more abrupt anteriorly; es-cutcheon very well defined by a distinct ridge behind, longly lanceolate in form; beak not very prominent, turned slightly forward, nearly touching, placed considerably forward of the middle part of the disc; lunule ill-defined or almost obsolete. Surface of the shell marked by

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- 1) S. NOMURA: A note on some Foss. Moll. from Takikawa bed, N-W part, Hokkaidô; Sei. Tôhoku Imp. Univ. vol. 18, p. 35, pl. 4, fig. 1, 2. 1935.
 - 2) I. NATSUI: Geology of Horonuka Dist. Uryû coalf.; Graduation Thesis of Inst. Geol. Min. Imp. Univ. Hokkaidô, no. 51, 1938.
 - 3) W. HASHIMOTO: Geology of the Marginal parts of Kabato-Mount. Ishikari Prov. Hokkaidô; Bull. Geol. Comm. Hokkaidô, no. 13, pp. 11-17, 1950.

numerous, coarse, distinct concentric lines of growth”.

This species, having a more stable outline as compared to *P. okadana*, is generally distinguished from the latter by thinner test, lower beak and lower convexity, and is not hunchback-like. However, on examining many specimens of the two species, it is certain that there are many which it is difficult to distinguished from one another; the two species are closely related to each other in regard to external characters.

Next, as to the internal features of the two species, the pallial sinus is similar in form, “simple, rounded in the end and extending into the shell a distance of one-second the length of shell”.

The hinge of *P. okadana*, shown by fig. 7 and 8, has the characters described in the following lines;

“Right valve with three cardinals and anterior socket; posterior cardinal rather narrow, elongated, separated from numph by distinct groove; median cardinal hemicone in form, parallel to the very short anterior cardinals, anterior socket rather large and deep. Left valve with three cardinals and an anterior lateral; posterior cardinal faint, shorter than numph, fused but demarcated by a superficial groove; median cardinal very strong, heavy, triangler in cross section, and slightly arcuated; the hinge plate between the anterior and median cardinal is ornamented by three feeble lines running parallel to median cardinal”.

In the meanwhile, the hinge of *P. hokkaidoensis* appears very much like that of *P. okadana* though there is a slight difference in the following points.

1) The left median cardinal and anterior cardinal of *P. hokkaidoensis* are nearer to each other than those of *P. okadana*.

2) The left posterior cardinal tooth of *P. okadana* is more or less arcuate, but that of *P. hokkaidoensis* is rather straight.

3) The hinge plate between the left anterior and posterior cardinals are ornamented by three feeble lines in *P. okadana* is not well observed in *P. hokkaidoensis*.

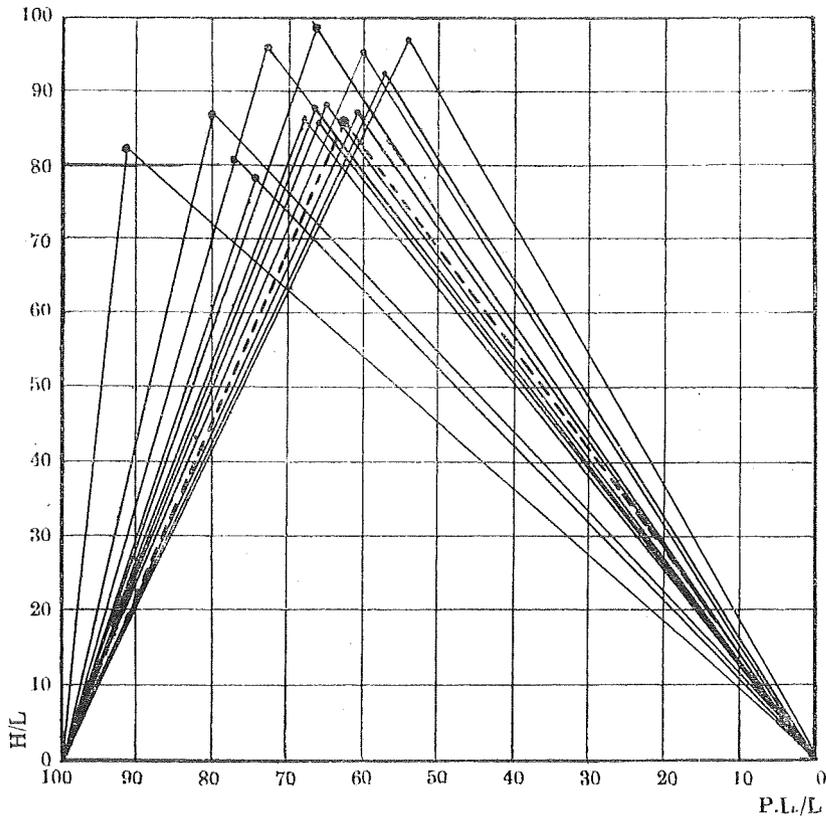
As will be seen from what has been stated above, the writers cannot recognize any significant difference between the two species, with respect both to external and internal characters.

Therefore, excepting the shell convexity and the thickness of test, *P. hokkaidoensis* merges within the limits of *P. okadana*. However, when the convexity and test-thickness are brought into consideration, *P. hokkaidoensis* has to be regarded as a variety or a subspecies.

[II] The Relation between the Degree of Variation of Shell and the Entombing Environments, and the Stratigraphical Relation of the Two Species.

Examining all the material at hand, we have become disposed to recognize a gradual transition of shell forms among the specimens ranging from the type of the "Quadrate Form" to that of the "Transverse-elongate Form" simultaneously with the shifting of the beak position from about 1/2 to 1/10 of the shell length from the anterior margin.

Here, it should be kept in mind whether or not such variation in



Text-Figure. Graph showing ratio of length to height and length to beak position. (L: Length; H: Height; P. L.: Length from beak to posterior end; ----- *P. hokkaidoensis* ————— *P. okadana*).

shell outline and the different modifications of the two species are due to change of environment, or have a certain relation with the range of their vertical distribution in the Neogene sequence, developed around the Uryû coal-field.

From the observation on a large number of the specimens, we have recognized that the variation in *P. okadana* is probably due to change of environment, on the one hand, and also the difference between the two species corresponds to the different stratigraphical position, on the other.

The variation of the shell form of *P. okadana* is not the phenomenon caused by the lapse of the time as would be manifest in their vertical distribution in the three horizons, Sasakizawa, Poroshin and Tôgeshita formations. In reality all of the five forms are found in each of these three horizons, on the one hand. There is the fact, on the other hand, that the "Quadrate Form" is yielded commonly from the Sasakizawa formation and the conglomerate facies of the Poroshin formation, and that in the sandstone and sandy shale facies of the Poroshin formation, all the form variations are obtained, although "Triangular Form" is by far the most abundant in individual number.

This seems to show that the variation reflects the changes of environmental conditions. In other words, it may be considered that the specialized thick-test and the hunchback-like convexity are the result of adaptation to the environmental condition favorable for depositing conglomeratic sediments.

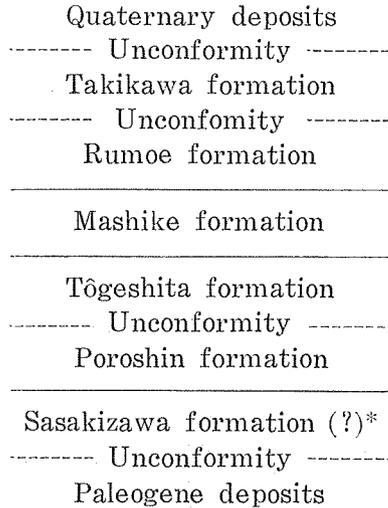
As to the last points, the fact that the fossil specimens are found in the rock with their two valves intact may enforce the possibility. Most likely these pelecypods could not have been allochthonously buried to form a shell conglomerate, so to say.

Moreover, *Spisula ezodensata* (KUBOTA), found in association with *P. okadana* in the conglomerate facies supplies an evidence for this conclusion. It is represented by rather a small number of individuals, but they are similar to *P. okadana* in assuming a "Quadrate Form", with the characteristic, specialized thick-test and the hunchback-like convexity.

Taking the two species, *P. okadana* and *P. hokkaidoensis*, into consideration together, as to their stratigraphical distribution, the writers are strongly inclined to regard the slight difference existing between these species represents the changes resulted during the lapse of time rather than the effect of the change of ecological condition. Then,

the stratigraphical importance of these species may be increased a good deal.

The results of surveys carried on by many geologists summed up, the stratigraphic succession of the marine Neogene formation developed in the Uryû coal-field region is schemed as follows.



P. okadana is a species which has a vertical range from the Sasakizawa to the Tôgeshita formations, and it appears that this species has flourished in the Poroshin formation.

At the type locality and in its environs, the species is great abundantly found in the Poroshin formation. The size of the shells, the number of individual and the variety of forms, seem to point to the fact that the Poroshin time was the acmaic period of development of *P. okadana*. Either prior to or after the Poroshin period, namely, either in the Sasakizawa or the Tôgeshita formations, the species is decidedly rare on the one hand, and the forms other than the "Triangular Form" are scarcely found in the Tôgeshita formation as if to show the trend toward stability.

P. hokkaidoensis occurs in the Tôgeshita formation, but not in the older formation which richly yields *P. okadana*, in spite that the two

* Whether the Sasakizawa and the Poroshin formations are really two stratigraphical units or they are contemporaneous, further paleontological and stratigraphical evidences are necessary to decide.

species are closely related to each other conchologically. In other words, *P. hokkaidoensis* is found only in the younger formation in which *P. okadana* declines in individual number. This suggests that there is a tendency in the shell form to gradually approach to the "Triangular Form".

From the foregoing lines concerning the conchological and stratigraphical evidences, it is suggested that there may be some interesting relations as follows, although the writers can try only a tentative conclusion.

1) *P. okadana* and *hokkaidoensis* are closely related to each other conchologically, and the slight difference recognized between them is most likely connected with the difference in the geological horizons. Strictly speaking, *P. okadana* represents the Poroshin fauna (Middle Miocene) and *P. hokkaidoensis* belongs to the Tôgeshita fauna (Upper Miocene) in Hokkaidô.

2) The fact that *P. okadana* was very variable in form and unstable in Poroshin formation, in which this species seems to have been at the climax of life, may have been due not only to the change of their environmental conditions, but also to the struggle for existence and development: if it really was so, *P. hokkaidoensis* may be regarded as to represent the next evolutionary or developmental stage of *P. okadana*.

However, in order to draw a conclusion we have to collect further data from wider fields and to examine in detail.

So far the discussion on the relation between the two species from Hokkaidô. Now the writers try to extend their discussion on the relation of *P. okadana* to its allied forms found in the Tertiary deposits of the other parts of Japan outside Hokkaidô, and of Korea.

Among the fossils found in the Neogene deposits of Japan and Korea, two Miocene species, *P. yabei*, reported by Y. OTUKA (1934)⁽¹⁾ from the lower Kadonosawa series in Nisatai, Iwate and *P. itoi* reported by J. MAKIYAMA (1926)⁽²⁾ from the Miocene Monkô-dô, Danchin-dô formation in Korea are of interest and importance.

The former somewhat resembles our species externally but its internal characters have not been described, so that we cannot tell

1) Y. OTUKA: Tert. Struct. N-W. Iwate; Bull. Earthq. Res. Inst. vol. 12, pt. 3, pp. 617-618, pl. 48, fig. 49, 50. 1934.

2) J. MAKIYAMA: Tert. Foss. from N. Kankyô-dô, Korea; Memo. Coll. Sci. Kyôto, Imp. Univ. Ser. B, vol. 2, art. 8, p. 159, pl. 13, fig. 7.

the true affinity between them. The latter was reported, subsequently, to occur at Kantin, Korea, by J. MAKIYAMA (1936),⁽¹⁾ at Matumori in the vicinity of Sendai, in the Miocene beds in Hukusima-ken by S. NOMURA and K. HATAI (1936, 1937)⁽²⁾⁽³⁾ and at Moniwa in Sendai by S. NOMURA (1940)⁽⁴⁾.

The writers unfortunately have not had the opportunity of examining them, but judging from the original description and figures by J. MAKIYAMA as well as the illustration of the nature of hinge by S. NOMURA and K. HATAI (1936), the species seems to have some characters similar to those of *P. okadana*, although there are some distinctive features. Namely, this species has an outline similar to the "Transverse-elongate Form" of *P. okadana*, but its left three similar cardinals and a long posterior cardinal (by original description) are different from those of *P. okadana*.

The hinge structure of *P. itoi* figured by S. NOMURA and K. HATAI (1936), if compared with that of *P. okadana*, has stronger anterior cardinals, and the space between the middle and the posterior ones is narrower.

Although it is not clear how *P. itoi* is related to the *P. okadana* conchologically, the writers are quite sure that they belong to one and the same particular group of the Genus *Pitar* which is characterized by *P. okadana* and *P. hokkaidoensis* as discussed above. These species have in common the following characteristic features.

- 1) Test is large with coarse surface ornamentation.
- 2) The hinge plate in front of anterior cardinal is short.
- 3) Left anterior lateral tooth is tubercular in form.

It seems that this extraordinary group of the Genus *Pitar* has some conchological significance. At present stage of our knowledge at least, this group can be probably considered as an important indicator of the Miocene formation in Japan.

This problem will be discussed when the associate fossils will be reported in detail on a future occasion.

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- 1) J. MAKIYAMA: Meisen Miocene North Korea; Ibid. vol. 10, art. 6, p. 214, pl. 5, fig. 5.
 - 2) S. NOMURA and K. HATAI: Foss. from Tanagura beds in the vicinity of the town Tanagura, Hukusima-ken, Northeast Honsyû, Jap.; Saito Ho-on Kai, Mus. Res. Bull. no. 10, p. 128, pl. 15, fig. 5.
 - 3) S. NOMURA and K. HATAI; List of Miocene Moll. and Brach. collected of Sendai, Rikuzen Prov. Jap. Ibid., no. 13, p. 135, pl. 18, fig. 4.
 - 4) S. NOMURA: Fauna of Moniwa shell beds exposed along the Natori-gawa in the vicinity of Sendai, Miyagi Pref.; Sci. Rep. Imp. Univ. Ser. 2, vol. 21, no. 1, p. 27, pl. 3, fig. 22.

Explanation
of
Plate 24

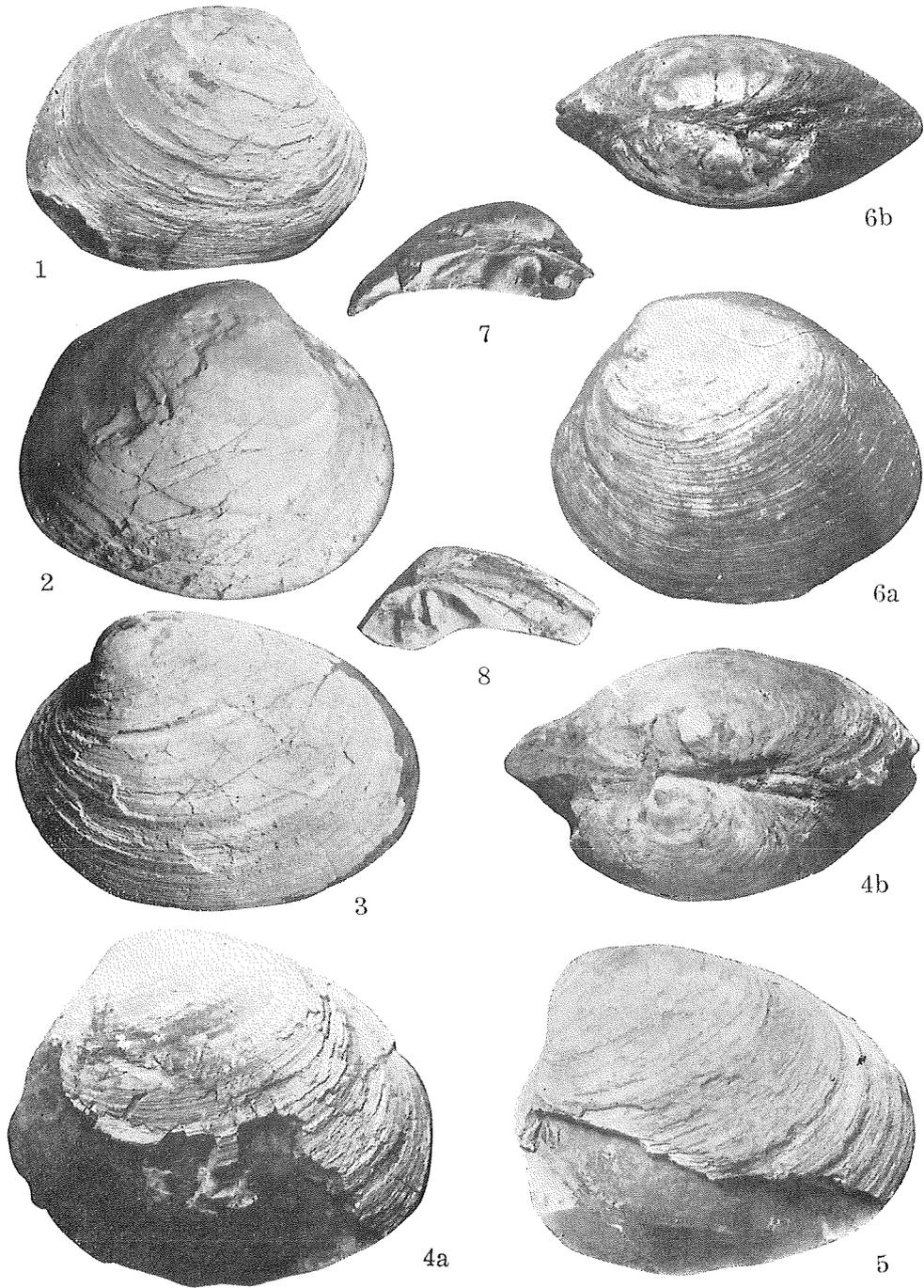
Plate 24

Figs. 1-5. *Pitar okadana* (YOKOYAMA)

- 1) "Flat-quadrate Form": Loc. The Okadanosawa, a branch of the Uryû-gawa. From the shaly sandstone part in the Poroshin formation.
- 2) "Quadrate Form": Loc. The Simokinenbetsu-gawa, Uryû coal-field. From the conglomerate part in the Poroshin formation.
- 3) "Transverse-elongate Form": Loc. The Okadanosawa, a branch of the Uryû-gawa. From the shaly sandstone part in the Poroshin formation.
- 4) "Triangular Form": Loc. ditto.
- 5) "Scalene Form": Loc. ditto.

Figs. 6 a, b. *Pitar hokkaidoensis* (NOMURA): Loc. the junction of the Ponrurummo-pegawa and the Rumoi-gawa.

Figs. 7, 8. *Pitar okadana* (YOKOYAMA): Loc. The Okadanosawa, a branch of the Uryû-gawa; showing the hinge apparatus.



I. HAYASAKA and S. UOZUMI: Two Fossil Species of Genus *Pitar*.