Bull. Natn. Sci. Mus., Ser. C (Geol.), 4 (3), Sept. 22, 1978

Apertural Features in Some Cretaceous Ammonites from Hokkaido

By

Ikuwo OBATA

Department of Geology, National Science Museum, Tokyo 160

Masao FUTAKAMI

Second Senior High School, Hosei University, Kawasaki 210

Yoshitaro KAWASHITA

29–1, Tokiwa-cho, Tomatsu, Mikasa City 068–22

and

Takemi TAKAHASHI

28–109, Hanazono-cho, Yayoi, Mikasa City 068–22

Introduction

Details of apertural features are rarely preserved on fossil shells of the ammonoids. The hitherto reported examples in connection with sexual dimorphism are in some particulary well preserved specimens from the Jurassic of Europe (*e.g.* MAKOWSKI, 1962; CALLOMAN, 1963; LEHMANN, 1966; PALFRAMAN, 1966, 67, 69). MATSUMOTO *et al.* (1972) described in detail the apertural features in some Puzosiinae from Hokkaido when they created *Kitchinites* (*Neopuzosia*) *haboroensis* MATSUMOTO et INOMA. They stated that at least some, if not all, Puzosiinae have an paertural margin which is characterized by a rostrum and lateral lappets.

We have recently noticed several Cretaceous ammonites in which the peristome of the shell is preserved. In this paper we report our observations and discuss shell forming patterns for further study.

Before starting the description we express our sincere gratitude to Prof. U. LEHMANN of Hambourg University, Dr. Y. KANIE of Yokosuka City Museum and Dr. K. TANABE of Kyushu University for fruitfull discussion at Atami on the occasion of symposium held on the 3rd August, 1978. Our cordial thanks extend to Dr. J. HANCOCK of King's College, London, for rephrasing the English.

Descriptions

The ammonites with apertural peristome were collected from Abeshinai, Haboro, Ikushumbets and Manji areas, Hokkaido (Fig. 1). For the stratigraphy of these areas readers may refer to the explanatory text of the geological maps of the scale 1: 50,000, "Nakagawa-machi" (HASHOMOTO *et al.*, 1967), "Sankei" (YAMAGUCHI and MATSUNO,

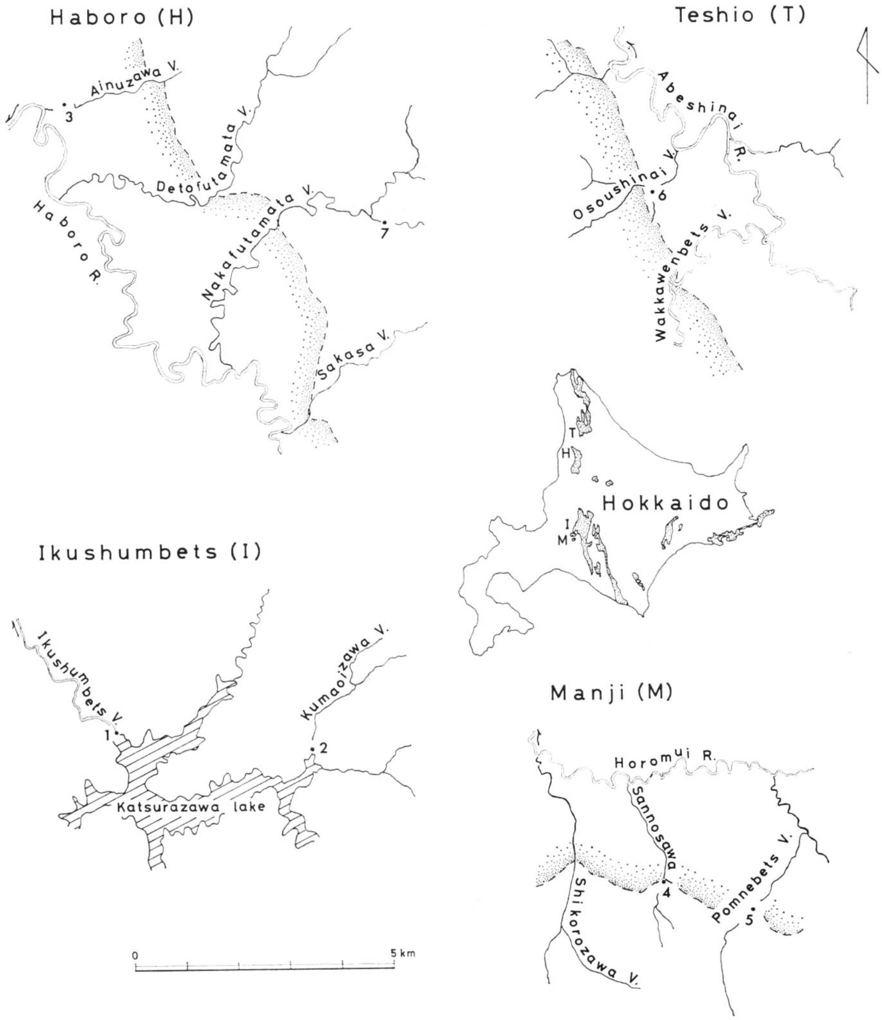

Fig. 1. Localities from which the specimens described were obtained.
1: KC 1001 from the locality near the Katsurazawa dam, Ikushumbets Valley: *Desmoceras* (*P.*) *japonicum compressior*. 2: NSM.PM 9255 from the junction of Kumaoi-zawa and Katsurazawa lake, Ikushumbets Valley; *Damesites semicostatus*. 3: KC 1002, 200 m eastward from the junction of the Ainu-zawa and the Haboro River; *Hauericeras* (*G.*) *angustum*. 4: NSM.PM 7125 and 7126 from loc. SN 2001 of the Sanno-sawa, Manji area; *Yokoyamaoceras minimum*. 5: PM. 9258 from loc. PN 4F04 of the Pomnebets, Manji area; *Yokoyamaoceras* aff. *minimum*. 6: NSM.PM 9256 from a locality of the Osoushinai-zawa, about 1 km upper reach apart from the junction of the Abeshinai River, Teshio area; *Kitchinites* (*N.*) cf. *japonicus*. 7: NSM.PM 9257 from floated nodule at 6 km upper reach of the Nakafutamata-zawa, Haboro; *Kitchinites* (*N.*) aff. *haboroensis*.

1963) and "Tappu" (TSUSHIMA *et al.*, 1958) as well as UEDA *et al.* (1962), MATSUMOTO (1965) and OBATA and FUTAKAMI (1975, 77).

The specimens are five individuals of desmoceratids belonging to two species of the Desmoceratinae, one species of the Hauericeratinae, two species of the Puzosiinae and two species of the Kossmaticeratidae. For the systematic descriptions of these species see papers by MATSUMOTO (1954a, b, 1955), MATSUMOTO and OBATA (1955), and MATSUMOTO, MURAMOTO and INOMA (1972).

The apertural features are described below species by species.

Desmoceras (*Pseudouhligella*) *japonicum compressior* MATSUMOTO

Pl. 2, fig. 3; Fig. 2

Material.—KC 1001, a specimen from a locality under the Katsurazawa dam, a tributary of the Ikushumbets Valley (Coll. Y. KAWASHITA).

Description.—Shell is of moderate size, slightly more than 90 mm in diameter at the adult stage. Spiral length of the body chamber is 220 degrees. Several constrictions are well marked on the last whorl.

In front of the last constriction the apertural margin is seen. There is an elongated rostrum which is strongly projected on the venter, being slightly more than 17 mm in length. Slightly lower than the middle of the flank, less distinct lappet-

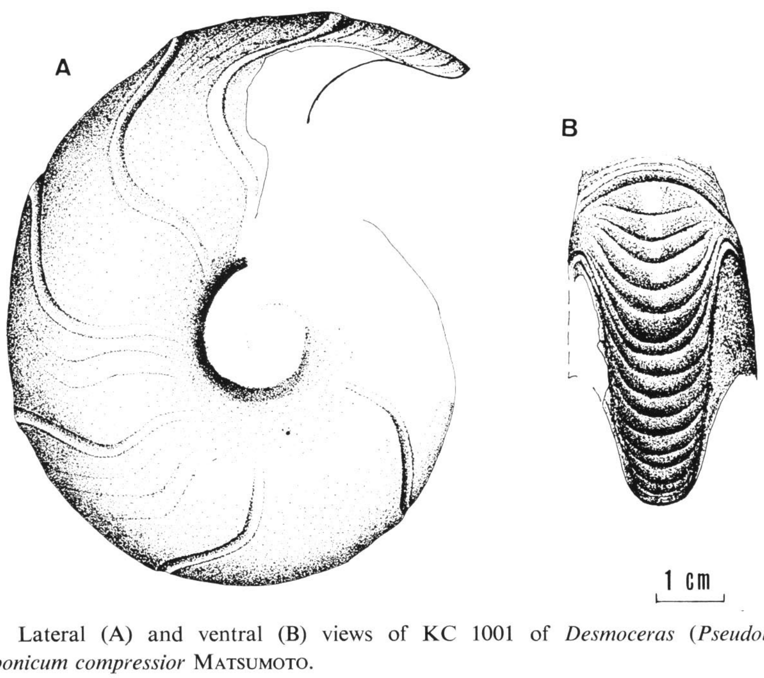

Fig. 2. Lateral (A) and ventral (B) views of KC 1001 of *Desmoceras* (*Pseudouhligella*) *japonicum compressior* MATSUMOTO.

like projections are discernible, although the exact outline of apertural margin is not traced because of insufficient preservation of the shell.

Certainly the curvature of the peristome is the same as that of the constrictions. Numerous lirae cover the rostrum and the adjacent ventral part, but they decrease in strength on the flank.

Damesites semicostatus MATSUMOTO

Pl. 2, fig. 1; Fig. 3

Material.—NSM PM. 9255, a specimen from the junction of Kumaoi-zawa and Katsura-zawa Lake, Ikushumbets Valley (Coll. M. FUTAKAMI).

Description.—Shell is of moderate size, slightly less than 60 mm in diameter at the adult stage. Spiral length of the body chamber is 245 degrees. Near the apertural margin a strong rostrum accompanied by a keel is developed on the venter. The rostrum, slightly more than 18 mm in length, is broadest at the base, rapidly tapers to the anterior, forming an acute triangle in outline.

The apertural margin seems to be roughly parallel to the ribs in outline, although it is probably injured here and there. Distinct sharp costae are developed on the apertural part as strongly as on the preceding part of the whorl. The existence of lappets not be confirmed on this specimen. However, the possibility is suggested by the biconcave curvature of ribs slightly lower than the middle of the flank, just like the apertural margin of *Tragodesmoceroides subcostatus* MATSUMOTO (1954, pl. 4, fig. 2).

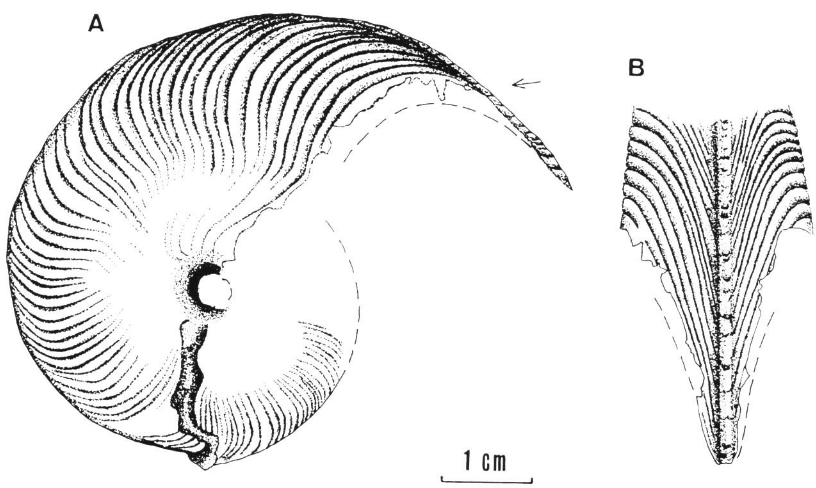

Fig. 3. Lateral (A) and ventral (B) views of NSM.PM 9255 of *Damesites semicostatus* MATSUMOTO.

Hauericeras (*Gardeniceras*) *angustum* YABE

Pl. 3, fig. 1: Fig. 4

Material.—KC. 1002, a loose specimen from about 200 m east of the junction of the Ainu-zawa and the Haboro River (Coll. Y. KAWASHITA).

Description.—Shell is of moderate size, about 114 mm in diameter. Spiral length of the body chamber is 244 degrees.

The shell has an apertural margin which occupies the last one eleventh of the whole body chamber, and is characterized by a rostrum and lateral lappets.

A remarkable ventral rostrum approximately continues the spiral line of coiling, being 24.6 mm in length, and is divided by a shallow lobe at its terminal portion on the mid-venter. Lateral lappets are also remarkable, but are slightly shorter than the rostrum, being 19.3 mm in length. They are set about one third of the way up the flank, and elongated gradually, bending slightly inward at their rip. Thus the apertural margin on the upper part of the flank forms a horse-shoe shape in outline. The lirae are gently sigmoidal on the sides and prominently projected on the venter, but become more and more strongly flexuous on the lappets so as to follow the very outline of the apertural margin.

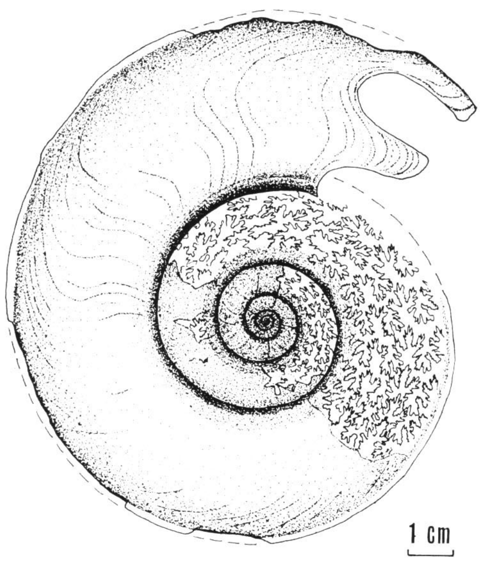

Fig. 4. Lateral view of KC 1002 of *Hauericeras* (*Gardeniceras*) *angustum* YABE.

Kitchinites (*Neopuzosia*) cf. *japonicus* SPATH

Pl. 2, fig. 2: Fig. 5

Material.—NSM.PM 9256, an adult specimen from a locality on the Osoushinai-

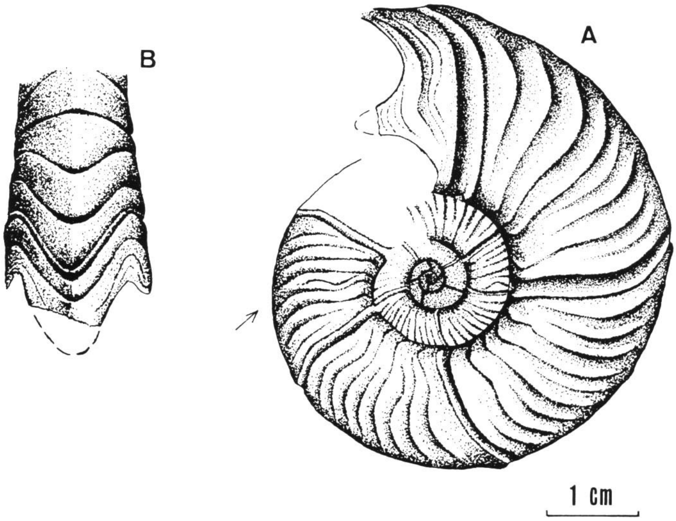

Fig. 5. Lateral (A) and ventral (B) views of NSM.PM 9256 of *Kitchinites* (*Neopuzosia*) cf. *japonicus* SPATH.

zawa River, about 1 km above the junction with the Abeshinai River, Teshio Province (Coll. M. FUTAKAMI).

Description.—The shell is about 55 mm in diameter. Spiral length of the body chamber is 194 degrees. In front of the last constriction on the body-whorl, the linguiform ventral rostrum is moderately projected, being slightly more than 3 mm in length. There are moderate lappets which are situated just outside the inner one third of the flank. They are 6.2 mm long and seem to be convergent in outline. Thus the rostrum and lappet form a crescent lateral sinus.

Between the apertural margin and the last constriction the lirae are developed. These are concave on the inner and outer parts of the whorl with a distinct biconcavity and become more and more strongly flexuous so as to follow exactly the outline of the apertural margin. Behind the last constriction, on the other hand, strong and coarse ribs run subradially on the flanks, with or without slight flexuosity, and show a forward inclination on the ventrolateral part.

A biconcave line of demarcation, possibly the peristome of the immature shell, is discernible between two ribs 270° back from the present aperture.

Kitchinites (*Neopuzosia*) aff. *haboroensis* MATSUMOTO et INOMA

Pl. 1, fig. 4: Fig. 6

Material.—NSM.PM 9257, a specimen from a loose nodule at 6 km up the Naka-futamata-zawa River, Haboro (Coll. M. FUTAKAMI).

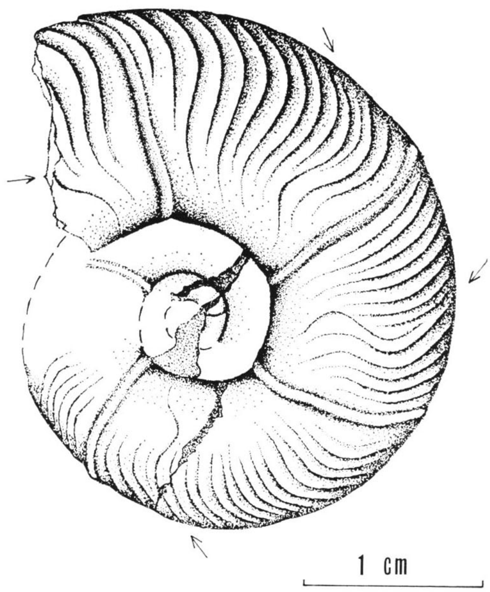

Fig. 6. Lateral view of NSM.PM 9257 of *Kitchinites* (*Neopuzosia*) aff. *haboroensis* MATSUMOTO et INOMA.

Descriptive Remarks.—MATSUMOTO and INOMA (1972) fully described the apertural feature and the sigmoidal line of demarcation showing the apertural margin at an earlier growth-stage in *K.* (*N.*) *haboroensis*. Here we have another interesting specimen. The shell reaches about 50 mm in diameter but the apertural margin is unknown, because the body chamber is destroyed. Spiral length of the body chamber is larger than 214 degrees.

The character of the present specimen is very akin to that of *K.* (*N.*) *haboroensis*, but the whorl is much less compressed and the shell size is larger in the former than in the latter.

One can see at least four lines of demarcation some distance ahead of the constriction on a well preserved inner whorl (30 mm in diameter). They are remarkably sigmoidal, representing somewhat a different type of curvature from the ribbing, and can be interpretated as the peristome of the immature shell, as MATSUMOTO and INOMA (1972) have rightly pointed out. As an example, the presumed rostrum was 2.6 mm in length and the lappet 1.5 mm at 25 mm diameter.

Yokoyamaoceras minimum MATSUMOTO

Pl. 1 figs. 1, 2: Fig. 7

Material.—NSM.PM 7125 and 7126, an adult and an immature specimens from loc. SN 2001 of the Sanno-sawa River, Manji area (Coll. M. FUTAKAMI).

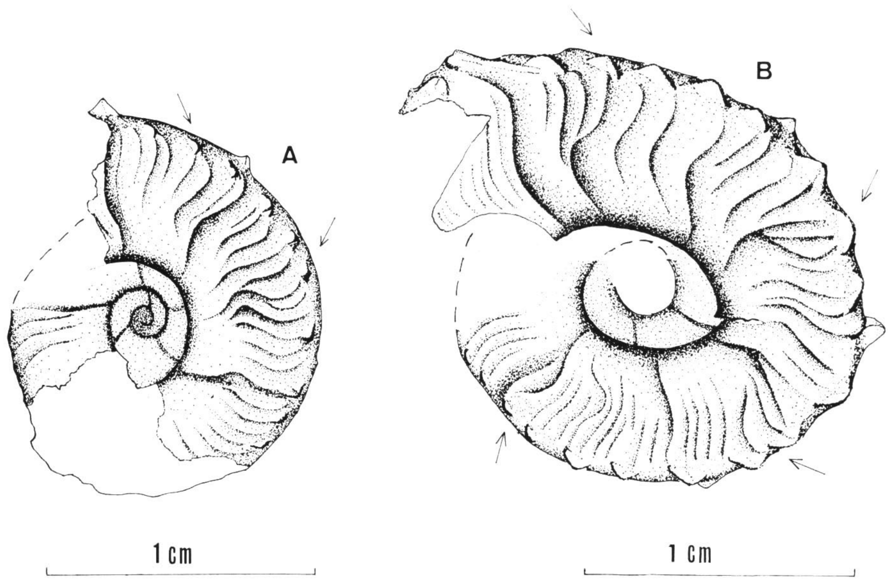

Fig. 7. Lateral views (A, B) of NSM.PM 7126 and 7125 respectively of *Yokoyamaoceras minimum* MATSUMOTO.
A: an immature specimen; B: an adult specimen.

Description.—Shall is small, only 20 mm in diameter. Spiral length of the body chamber is 234 degrees in the younger specimen, and 201 degrees in the adult one. The apertural margin is characterized by a rostrum and lateral lappets. The rostrum is more than 3 mm in length, but the exact outline can not be traced because of insufficient preservation.

Relatively weak lappets, on which lirae are developed, are 3.2 mm in length and situated at about one third of the way up the flank, bending slightly inward at their rip. Near the margin of the lappets there is a relatively strong tubercle.

Four lines of demarcation can be detected, each probably the peristome of the immature shell.

Yokoyamaoceras aff. *minimum* MATSUMOTO

Pl. 1, fig. 3: Fig. 8

Material.—NSM.PM 9258, an adult specimen from loc. PN 4F04 of the Ponnebets River in the Manji area (Coll. T. TAKAHASHI).

Descriptive Remarks.—The present specimen is closely related to the holotype of *Y. minimum* in general appearance, but differs in that it has many tubercles on the mid-venter: each rib on the present specimen bears a siphonal tubercle, while the development of these median tubercles is limited to the raised elevation behind the prorsiradiate constriction in the holotype of *Y. minimum*. Furthermore, distinct lateral

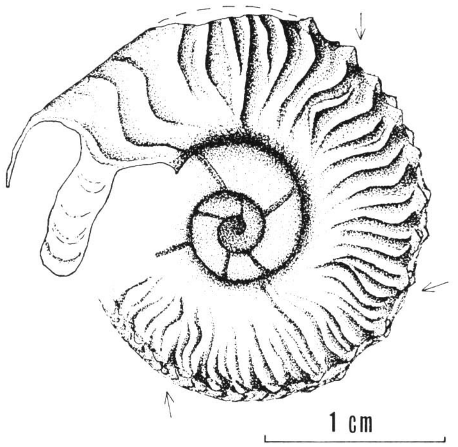

Fig. 8. Lateral view of NSM.PM 9258 of *Yokoyamaoceras* aff. *minimum* MATSUMOTO.

lappets are developed in the present specimen. Probably we are dealing with a new form, but a small specimen, we hesitate to establish a new species or subspecies.

The shell is about 25 mm in diameter. Spiral length of the body chamber is 255 degrees. The apertural margin is characterized by a ventral rostrum and lateral lappets. Near the margin the ribs and the tubercles are weakend and somewhere they disappear. The rostrum, 3.9 mm long, is less pronounced and elongated than the lateral lappets which are 6.1 mm in length. These remarkable lappets are about one third of the way up the mid-flank, bending inward as if contracting the soft body.

Three lines of demarcation, possibly the peristome of the immature shell, are discernible on the last whorl.

Apertural Growth Pattern

As has been described in the preceding section, there are two types of apertural growth in species that formed lappets. In some species markedly sigmoidal lines of demarcation, probably the peristome of the immature shell, can be distinguished some distance after each constriction on a well preserved shell (*e.g. Kitchinites* (*N.*) aff. *haboroensis, Yokoyamaoceras minimum*). In other species there is no trace of such demarcation in the immature stage, and the lateral lappets are only observed at the end of the body chamber (*e.g. Hauericeras* (*G.*) *angustum*).

The cases of *K.* (*N.*) aff. *haboroensis* and *Y. minimum* are particularly interesting, and we investigated the pattern of growth in the first of these. The data for morphologic analysis was prepared by measuring the whorl-height and breadth in relation to the radius from the coiling axis for each ten degrees through the last whorl. (Fig. 9)

As a result repetition of four different phases of growth can be recognized.

(1) The provisional first phase is characterized by the formation of the constric-

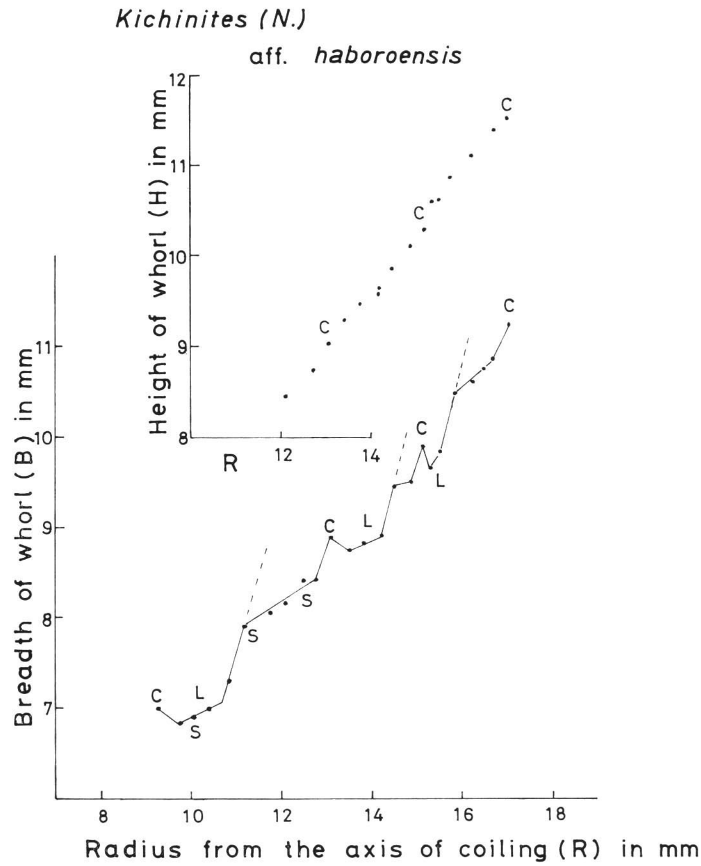

Fig. 9. An example of the relation between the whorl-height and breadth and the radius from the coiling axis.
C: formation of constriction, L: formation of lateral lappets, S: formation of septa.

tion.The whorl increases rapidly in breadth, then decreases suddenly, showing a greater thickness of the shell. It may well be that during this phase the formation of shell was rather slow.

(2) The second phase is characterized by the formation of the distinct apertural margin. After the formation of the constriction the whorl-breadth apparently increases relatively slowly. As MATSUMOTO and INOMA (1972, fig. 6) have illustrated an unmistakable example of an injury on part of an apertural margin at an early growth-stage. It may be that the growth-rate of the whorl is slow, and sometimes even temporarily stopped during this phase.

(3) The third phase is characterized by a rapid increase of the whorl-breadth. Presumably it is the result of a rapid increase of growth in the body itself.

(4) The fourth phase is characterized by a slow increase of the whorl-breadth before the formation of the next constriction.

Thus we anticipate that the growth pattern of the whorl-breadth is closely related to the formation of constrictions and lateral lappets. It should be noted that the growth gradient of the whorl-breadth is nearly the same during the second and fourth phases. The growth gradient of the third phase gradually increases with age.

Notes on Functional Morphology

The Upper Cretaceous ammonites from Japan in which the apertural margin has been described are listed in Table 1.

Table 1. The Upper Cretaceous ammonites in which the apertural margin is described or figured from Japan.

Desmoceratidae		
Desmoceras (*Pseudouhligella*) *japonicum compressior* MATSUMOTO	R.(L.)	OBATA *et al.* (1978), p. 141, text-fig. 2; pl. 2, fig. 3.
Tragodesmoceroides subcostatus MATSUMOTO	R. L.	MATSUMOTO (1954), pl. 4, fig. 2.
Damesites semicostatus MATSUMOTO	R.(L.)	OBATA *et al.* (1978), p. 142, text-fig. 3; pl. 2, fig. 1.
Hauericeras (*Gardeniceras*) *angustum* YABE	R. L.	OBATA *et al.* (1978), p. 143, text-fig. 4; pl. 3, fig. 1.
Mesopuzosia sp. cf. *M. pacifica* MATSUMOTO	R. L.	MATSUMOTO & INOMA (1972), p. 391, text-fig. 9.
Kitchinites (*Neopuzosia*) *japonicus* SPATH	R. L.	MATSUMOTO (1954), p. 92. OBATA *et al.* (1978), p. 143, text-fig. 5; pl. 2, fig. 2.
Kitchinites (*Neopuzosia*) *haboroensis* MATSUMOTO et INOMA	R. L.	MATSUMOTO & INOMA (1972), p. 385–388, text-figs. 5, 6; pl. 47, figs. 5, 6.
K. (*N.*) aff. *haboroensis* MATSUMOTO et INOMA	R. L.	OBATA *et al.* (1978), p. 144, text-fig. 6; pl. 1, fig. 4.
Kossmaticeratidae		
Yokoyamaoceras jimboi MATSUMOTO	R. L.	MATSUMOTO (1955), p. 154, text-fig. 13; pl. 9, fig. 4.
Y. kotoi (JIMBO)	R. L.	MATSUMOTO (1955), p. 152–153, text-fig. 12.
Y. minimum MATSUMOTO	R. L.	OBATA *et al.* (1978), p. 145, text-fig. 7; pl. 1, figs. 1, 2.
Y. aff. *minimum* MATSUMOTO	R. L.	OBATA *et al.* (1978), p. 146, text-fig. 8; pl. 1, fig. 3.
Y. mysticum MATSUMOTO	R. L.	MATSUMOTO (1955), p. 156.
Y. ornatum MATSUMOTO	R. L.	MATSUMOTO (1956), p. 184.
Scaphitidae		
Otoscaphites (*Hyposcaphites*) *matsumotoi* TANABE	L.	TANABE (1977), p. 20, pl. 1, fig. 8.
O. (*H.*) *perrini* (ANDERSON)	L.	YABE (1910), p. 172 [14], pl. 15, fig. 28.

		TANABE (1977), pl. 1, fig. 3.
O. (*O.*) *klamathensis* (ANDERSON)	L.	TANABE (1977), p. 19, pl. 1, fig. 4.
O. (*O.*) *puerculus* (JIMBO)	L.	YABE (1910), p. 170 [12], pl. 15, fig. 25. TANABE (1975), p. 110, pl. 10, figs. 1, 13. TANABE (1977), pl. 62, figs. 2, 5, 7.
Baculitidae		
Sciponoceras baculoides (MANTELL)	R.	MATSUMOTO & OBATA (1963), p. 10, pl. 2, figs. 1, 3.
S. orientale MATSUMOTO et OBATA	R.	MATSUMOTO & OBATA (1963), p. 19, pl. 17, fig. 3.
S. intermedium MATSUMOTO et OBATA	R.	MATSUMOTO & OBATA (1963), p. 26, pl. 8, figs. 1, 2.
Baculites undulatus ROMAN et MAZERAN	R.	MATSUMOTO & OBATA (1963), p. 29, pl. 9, fig. 3, pl. 11, figs. 2, 3.
B. yokoyamai TOKUNAGA et SHIMIZU	R.	MATSUMOTO & OBATA (1963), p. 33, pl. 11, fig. 1, pl. 14, fig. 4.
B. inornatus MEEK	R.	MATSUMOTO & OBATA (1963), p. 80, pl. 6, figs. 1, 6.
B. regina OBATA et MATSUMOTO	R.	OBATA & MATSUMOTO (1963), p. 89, pl. 22, figs. 3, 4, pl. 25, fig. 3.

R.: ventral rostrum, L.: lateral lappet.

From this list the species with lateral lappets are: *Tragodesmoceroides subcostatus, Desmoceras* (*P.*) *japonicum*(?), *Damesites semicostatus* (?), *Hauericeras* (*G.*) *angustum, Mesopuzosia* aff. *pacifica, Kitchinites* (*N.*) *haboroensis, K.* (*N.*) aff. *haboroensis, K.* (*N.*) cf. *japonicus, Yokoyamaoceras jimboi, Y. kotoi, Y. minimum, Y.* aff. *minimum, Y. mysticum, Y. ornatum, Otoscaphites* (*O.*) *puerculus, O.* (*O.*) *klamathensis, O.* (*H.*) *perrini, O.* (*H.*) *matsumotoi.*

Generally speaking, the body chamber, including a pair of long lateral lappets, is sometimes well preserved in desmoceratids, kossmaticeratids, and scaphitids. The lappets are usually situated between mid-flank and the inner third of the in their flank (Fig. 10). The size of the lappets, as represented by the breadth at the mid-point in their length, is much larger selative to the whorl-height in the scaphitids than in the desmoceratids (Fig. 11). Some of the benthic ammonites (*e.g.* adult scaphitoids) may have prominant lappets but no rostrum or the rostrum may be just developed. Lappets may generally restrain a body from movement although in some case they helped to decrease water-resistance. In contrast, the nektonic offshore ammonites (*e.g.* desmoceratids) may have both rostrum and lappets. The nektonic baculitids may have only a rostrum. The ammonites which have strongly projected ribs (*e.g. Quenstedtoceras, Baculites*) often show a ventral rostrum. The development of the rostrum probably implies a decrease in water-resistance so that the animal could be speedy, although a hasty change of swimming direction may have been difficult. Recent nautiloids, which are slow nekton, have neither rostrum nor lateral lappets (Fig. 12). They move slowly in a pendulum-like seesaw pattern, and gradually and easily change the shell direction.

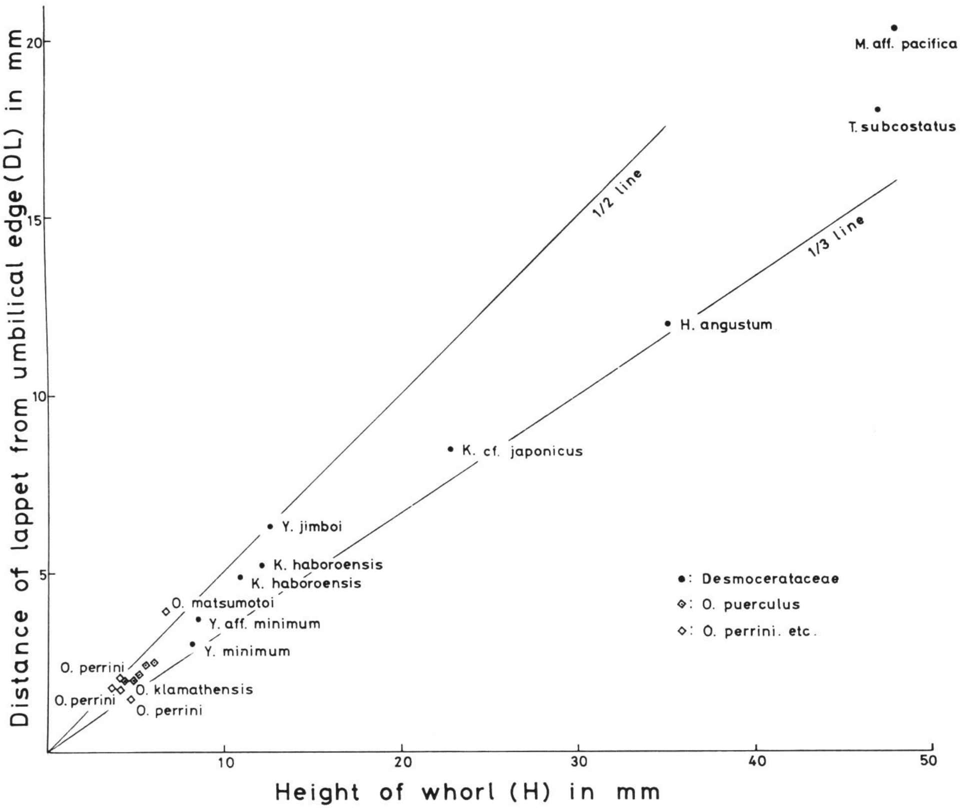

Fig. 10. Situation of the lateral lappets on the flank.
For the measurements of above species readers may refer to the papers mentioned in Table 1.

The position of lateral lappets seems to have been affected by the flexuosity of ribbing and the tuberculation. For example, the lateral lappets in the Cretaceous desmoceratids (*e.g.* MATSUMOTO *et al.*, 1972) are situated on the extension of the convex inner curvature of the sigmoidal ribs, while those in the Jurassic kosmoceratids (*e.g.* BRINKMANN, 1929) are on the extended direction of the row of lateral tubercles.

We agree with MATSUMOTO and INOMA (1972) that the differences in apertural character of the adult shell may be concerned with taxonomy or morphological diversity in evolution, which in turn, is connected with diversity in habitats and mode of life. The constriction just behind the apertural margin may have helped to secure the ammonite body against slipping from the chamber.

The lateral lappets are usually bent slightly inward near their rips, and probably served to hold the body in as well as for protection.

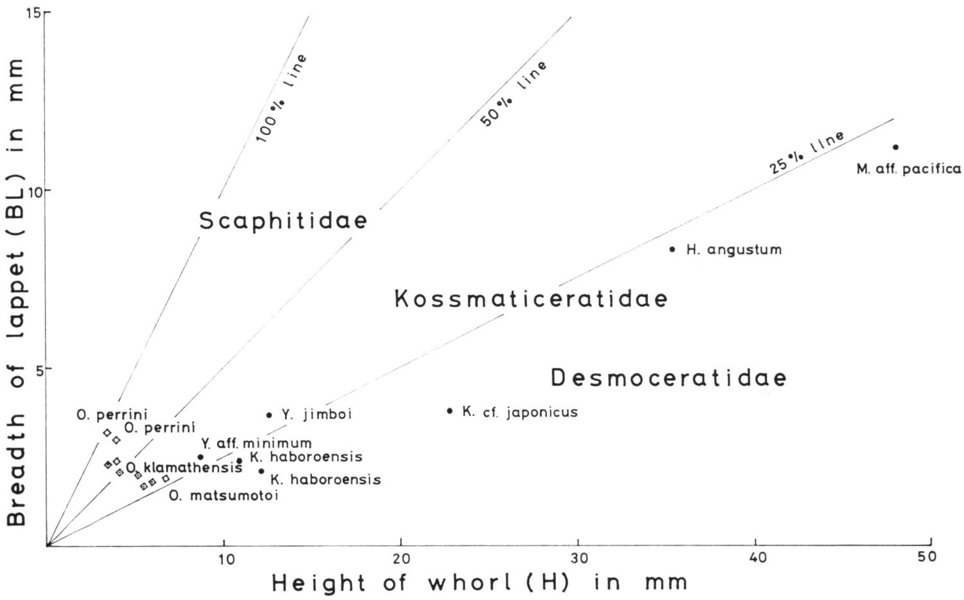

Fig. 11. Comparison of the size of lappets with the whorl-height at family level.
For the measurements of above species readers may refer to the papers mentioned in Table 1.
For the legends of points readers may refer to those of Fig. 10.

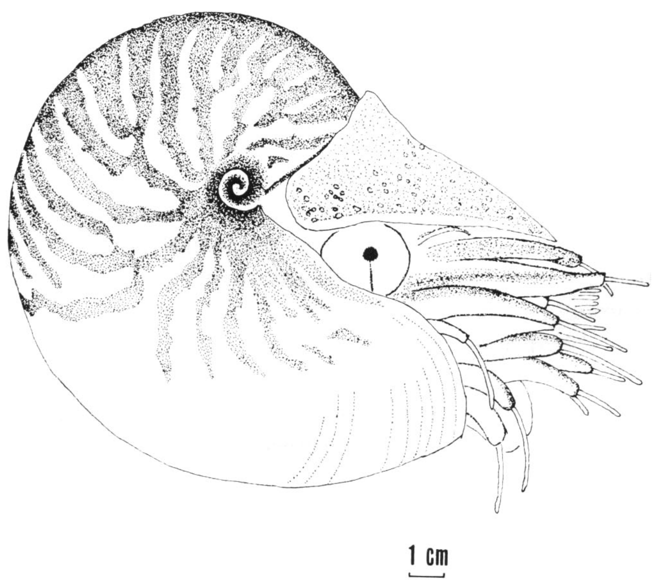

Fig. 12. *Nautilus macromphalus* which is slow nekton and does not show any rostrum or lateral lappets.

Concluding Remarks

We have described apertural features in five species of desmoceratids and two kossmaticeratids. As a result two types of apertural growth can be distinguished in the lappet-forming species. Among them the cases of *Kitchinites* (*Neopuzosia*) aff. *haboroensis* and *Yokoyamaoceras minimum* are noted. In these species the repetition of four different phases of growth were recognized: the growth pattern of the whorl is closely related to the formation of constrictions and lateral lappets. Functional morphology of the apertural characters is provisionally discussed. As CHAMBERLAIN has shown (1976) from flow visualization experiments, inflated, depressed, and widely umbilicate shells have high drag coefficients and compressed, involute oxycones have low drag coefficients. The apertural features should be taken into consideration in order to clarify relationships between shell form, streamlining and swimming ability, and to develop a more thorough understanding of the role of streamlining in the adaptive strategy of ammonites. Among several questions it should be particularly noted that we do not yet have complete records of the Upper Cretaceous ammonites in spite of their abundance in our province.

We should search for better material, especially of the ornate ammonites. It would be very intersting to know the relation between form, locomotion and mode of life in the shallower near-shore dwellers.

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Explanation of Plates

Plate 1

Fig. 1. Lateral (a, c), frontal (b) and ventral (d) views of *Yokoyamaoceras minimum* MATSUMOTO; NSM. PM 7126 from loc. SN 2001 of the Sanno-sawa River, Manji area (Coll. M. FUTAKAMI), ×2.

Fig. 2. Lateral (a, c), frontal (b) and ventral (d) views of *Yokoyamaoceras minimum* MATSUMOTO; NSM. PM 7125 from loc. SN 2001 of the Sanno-sawa River, Manji area (Coll. M. FUTAKAMI), ×2.

Fig. 3. Lateral (a, c), frontal (b) and ventral (d) views of *Yokoyamaoceras* aff. *minimum* MATSUMOTO; NSM. PM 9258 from loc. PN 4F04 of the Pomnebets River, Manji area (Coll. T. TAKAHASHI), ×2.

Fig. 4. Lateral (a, c) and ventral (b) views of *Kitchinites* (*Neopuzosia*) aff. *haboroensis* MATSUMOTO et INOMA; NSM. PM 9257 from a loose nodule in the upper reaches of the River, 6 km from the entrance of Nakafutamata-zawa, Haboro (Coll. M. FUTAKAMI), ×2.

Plate 2

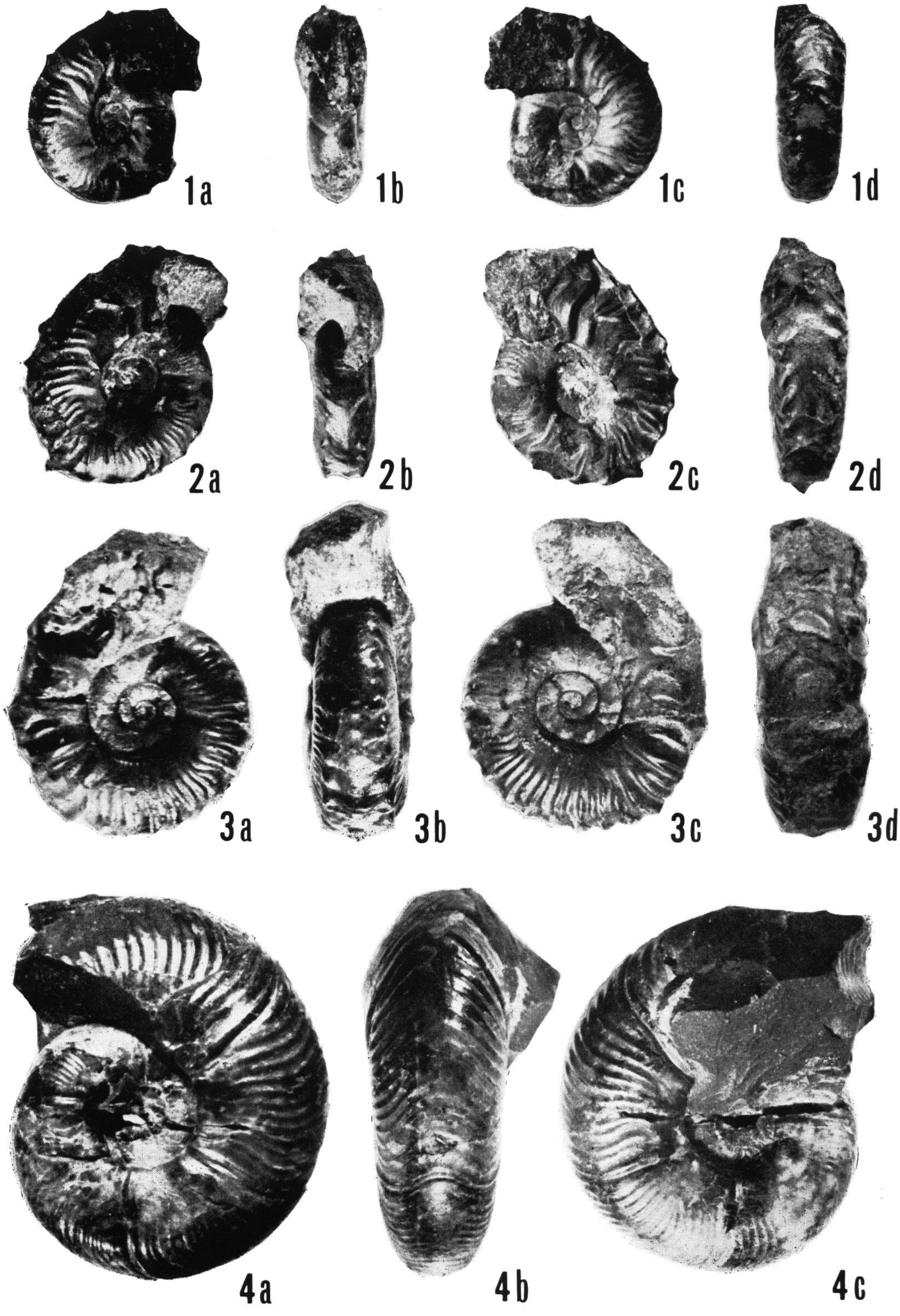
Fig. 1. Lateral (a, c) and ventral (b) views of *Damesites semicostatus* MATSUMOTO; NSM. PM 9255 from the junction of the Kumaoi-zawa River and Katsura-zawa lake, Ikushumbets Valley (Coll. M. FUTAKAMI), ×1.

Fig. 2. Lateral (a, b) and ventral (c) views of *Kitchinites* (*Neopuzosia*) cf. *japonicus* SPATH; NSM.PM 9256 from a locality in the Osoushinai-zawa valley, about 1 km above the junction with the Abeshinai River, Teshio area (Coll. M. FUTAKAMI), ×1.

Fig. 3. Lateral (a, c), frontal (b) and ventral (d, e) views of *Desmoceras* (*Pseudouhligella*) *japonicum compressior* MATSUMOTO; KC 1001 from a locality near the Katsurazawa dam, Ikushumbets Valley (Coll. Y. KAWASHITA), ×2/3.

Plate 3

Fig. 1. Lateral (a, c), frontal (b) and ventral (c) views of *Hauericeras* (*Gardeniceras*) *angustum* YABE; KC 1002, 200 m east of the junction of the Ainu-zawa and the Haboro Rivers (Coll. Y. KAWASHITA), ×4/5.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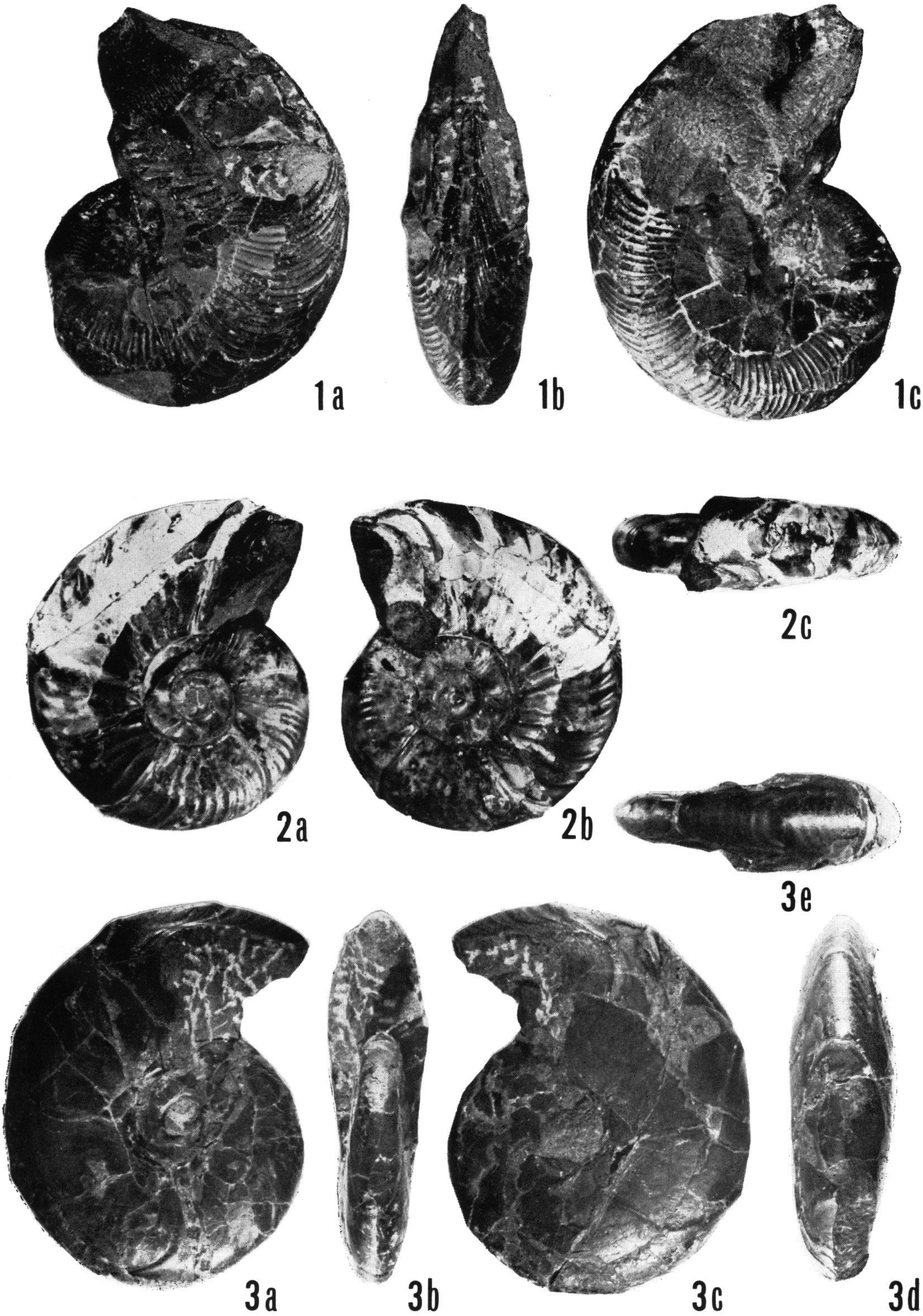
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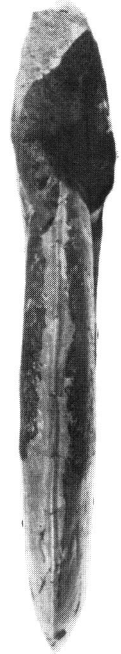

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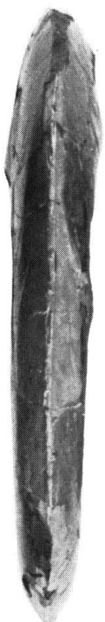

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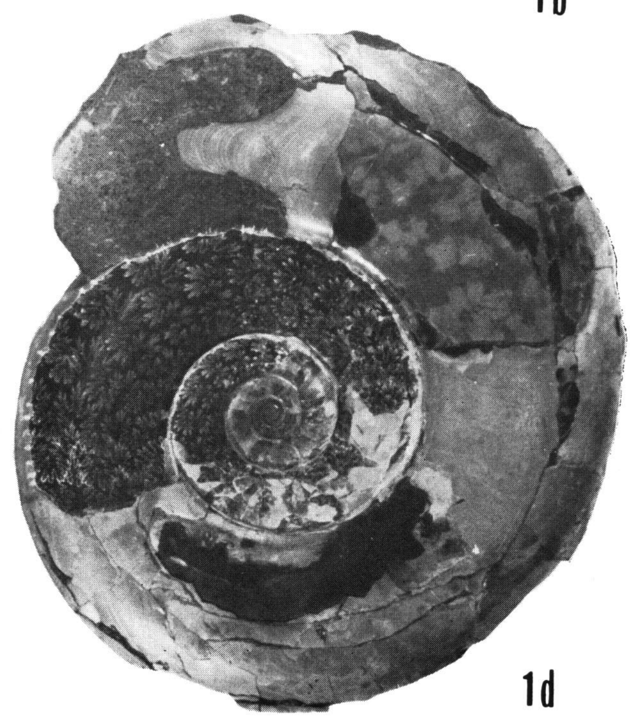

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